Wellbeing: A Complete Reference Guide
Volume II

Wellbeing and the Environment

Edited by
Rachel Cooper, Elizabeth Burton, and Cary L. Cooper

WILEY Blackwell

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About the Editors

Rachel Cooper is Professor of Design Management and Policy at Lancaster University, U.K., where she is Chair of the Lancaster Institute for the Contemporary Arts and co-Director of ImaginationLancaster, an open and exploratory design-led research lab. Her research interests cover design management, design policy, new product development, design in the built environment, design against crime, and socially responsible design. She is currently coinvestigator of Liveable Cities, an ambitious 5-year program of research to develop a method of designing and engineering low-carbon, resource-secure, wellbeing-maximized U.K. cities.

Elizabeth Burton is Professor of Sustainable Building Design and Wellbeing and founder director of the WISE (Wellbeing in Sustainable Environments) research unit at the University of Warwick, U.K. Having qualified as an architect and urban designer, Elizabeth took up a research career with the aim of developing an evidence base for architectural practice. Her research investigates the social aspects of sustainability and how the built environment influences people's wellbeing. She has particular expertise in aging research, including dementia-friendly design. Elizabeth is now seeking to promote design for wellbeing in the built environment through the development of new cross-disciplinary courses.

Cary L. Cooper, CBE, is Distinguished Professor of Organizational Psychology and Health at Lancaster University Management School, U.K. He is the author/editor of over 150 books, has written over 400 scholarly articles for academic journals, and is a frequent contributor to national newspapers, TV, and radio. He is the Chair of the Academy of Social Sciences (comprised of 46 learned societies in the social sciences, with nearly 90,000 social scientists), President of RELATE, President of the Institute of Welfare, and immediate past President of the British Association of Counselling and Psychotherapy. He was the Founding President of the British Academy of Management, Founding Editor of the

Journal of Organizational Behavior, and is currently Editor-in-Chief of the international scholarly journal *Stress & Health*. He has received honorary doctorates from a number of universities (e.g., University of Sheffield, Aston University, and Heriot-Watt University). He has been awarded honorary fellowships by the Royal College of Physicians, Royal College of Physicians of Ireland, British Psychological Society, European Academy of Occupational Health Psychology, and Institute of Occupational Safety and Health. In 2010 Professor Cooper was awarded the Lord Dearing Lifetime Achievement Award at the *The Times Higher Education* Awards for his distinguished contribution to higher education. He was lead scientist on the U.K. Government's Foresight program on Mental Capital and Wellbeing, which had a major impact in the United Kingdom and Europe. Professor Cooper was Chair of the Global Agenda Council on Chronic Diseases in the World Economic Forum in 2009–2010. In 2012, *HR* magazine voted him the Fourth Most Influential HR Thinker. In 2001, he was awarded a CBE by the Queen for his contribution to occupational health.

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Introduction to *Wellbeing: A Complete Reference Guide*

Cary L. Cooper
Lancaster University, U.K.

This series of six volumes explores one of the most important social issues of our times, that of how to enhance the mental wellbeing of people, whether in the developed, developing, or underdeveloped world, and across the life course from birth to old age. We know that 1 in 4–6 people in most countries in the world suffer from a common mental disorder of anxiety, depression, or stress. We also know that mental ill health costs countries billions of dollars per annum. In the United Kingdom, for example, mental health-care costs have amounted to over £77 billion per annum, the bill for sickness absence and presenteeism (people turning up to work ill or not delivering due to job stress) in the workplace is another £26 billion, and the costs of dementia will rise from £20 billion to an estimated £50 billion in 25 years' time (Cooper, Field, Goswami, Jenkins, & Sahakian, 2009). In Germany, the leading cause of early retirement from work in 1989 was musculoskeletal disease but by 2004 it was stress and mental ill health, now representing 40% of all early retirements (German Federal Health Monitoring, 2007). In many European countries (e.g., Finland, Holland, Norway, and Switzerland) the cost of lost productive value due to lack of mental wellbeing is a significant proportion of gross domestic product (McDaid, Knapp, Medeiros, & MHEEN Group, 2008). Indeed, the costs of depression alone in the European Union were shown to be €41 billion, with €77 billion in terms of lost productivity to all the economies (Sobocki, Jonsson, Angst, & Rehnberg, 2006).

The issue of wellbeing has been around for sometime but has been brought to the fore more recently because of the global recession and economic downturn, which have made the situation worse (Antoniou & Cooper, 2013). But it was as early as 1968 that politicians began to talk about the inadequacy of gross national product as a measure of a society's

success. In a powerful speech by Bobby Kennedy at the University of Kansas, when he was on the campaign trail for the Democratic Party nomination for U.S. President, he reflected:

> But even if we act to erase material poverty, there is another greater task, it is to confront the poverty of satisfaction—purpose and dignity—that afflicts us all. Too much and for too long, we seemed to have surrendered personal excellence and community values in the mere accumulation of material things. Our gross national product, now, is over $800 billion a year, but that gross national product—if we judge the United States of America by that—that gross national product counts air pollution and cigarette advertising, and ambulances to clear our highways of carnage. It counts special locks for our doors and the jails for the people who break them. It counts the destruction of the redwood and the loss of our natural wonder in the chaotic sprawl. It counts napalm and counts nuclear warheads and armoured cars for the police to fight the riots in our cities. . . . Yet the GNP does not allow for the health of our children, the quality of their education or the joy of their play. It does not include the beauty of our poetry or the strength of our marriages, the intelligence of our public debate or the integrity of our public officials. It measures neither our wit nor our courage, neither our wisdom nor our learning, neither our compassion nor our devotion to our country, it measures everything in short, except that which makes life worthwhile.
>
> University of Kansas, March 18, 1968,
> http://www.americanswhotellthetruth.org/portraits/robert-f-kennedy

Since that time there have been numerous studies to show that the wealth of a country is not related to its happiness (Cooper & Robertson, 2013); indeed, as you earn far beyond your means you may become less happy or content. More recently, we have had politicians like former President Sarkozy of France, Prime Minister Cameron of the United Kingdom, and the King of Bhutan extoll the virtue of gross national wellbeing; that is, that the goal of a nation's politicians should be to enhance wellbeing among its citizens, with gross national product being only one indicator of a country's success. Indeed, Prime Minister Cameron has instituted an annual assessment of this through the U.K. Office of National Statistics which measures wellbeing among a large sample of the U.K. population, publishing the results, highlighting concerns, and ultimately considering policies to deal with them. The World Economic Forum of leading global companies, nongovernmental organizations, international bodies, and global charities now has one of its Global Agenda Councils on "mental health and wellbeing." Happiness and wellbeing indices abound (e.g., The Happy Planet), and many countries are being compared and assessed on a range of

quality-of-life metrics. Indeed, in April 2012, 79 countries in the General Assembly of the United Nations signed the Bhutan Agreement, supporting the view that an overarching goal of a country should be to enhance the wellbeing and happiness of its people.

The biggest study of its kind undertaken by any government was the 2 year U.K. Government's Foresight project on mental capital and wellbeing, the aim of which was "to produce a challenging and long-term vision for optimising mental capital and wellbeing in the United Kingdom in the 21st century—both for the benefit of society and for the individual" (Cooper et al., 2009). Mental capital was defined as the metaphorical "bank account of the mind," which gets enhanced or depleted throughout the life course (see figure). Mental wellbeing was defined as "a dynamic state that refers to individuals' ability to develop their potential, work productively and creatively, build strong and positive relationships with others and contribute to their community" (Beddington et al., 2008).

Over 85 international science reviews were commissioned to assess the factors that influence an individual's mental capital and wellbeing throughout life, from early childhood to school years to working life to old age. There were numerous findings in this report, which were costed and developed as potential government policy and/or interventions. An example of some of the findings were: (a) if society does not catch learning difficulties in children early enough, there will be increased personal and economic costs downstream, leading to depleted mental wellbeing in terms of increased antisocial behavior as well as significant health costs; (b) if society does not identify the common mental disorders (CMDs) of anxiety, depression, and stress early enough, and provide appropriate treatment and support, society won't be able to tackle the 1 in 4–6 people suffering from depression and other CMDs; (c) with the workplace being more insecure, people working longer hours, and being more overloaded, occupational stress in many countries is now the leading cause of sickness absence and presenteeism, which has implications for the viability of businesses and their productivity; and, finally, (d) with the doubling of over-65-year-olds and the tripling of over-80-year-olds over the next 30 years, society needs to deal with the consequences of dementia now with preventative strategies, better early diagnosis, and more successful and evidence-based treatment regimes. The Foresight project developed many recommendations to enhance mental capital and wellbeing not only in the United Kingdom but also for other countries (Cooper et al., 2009), and its legacy has provided a roadmap for how other countries should think about this in the future, in terms of both policies and interventions for wellbeing.

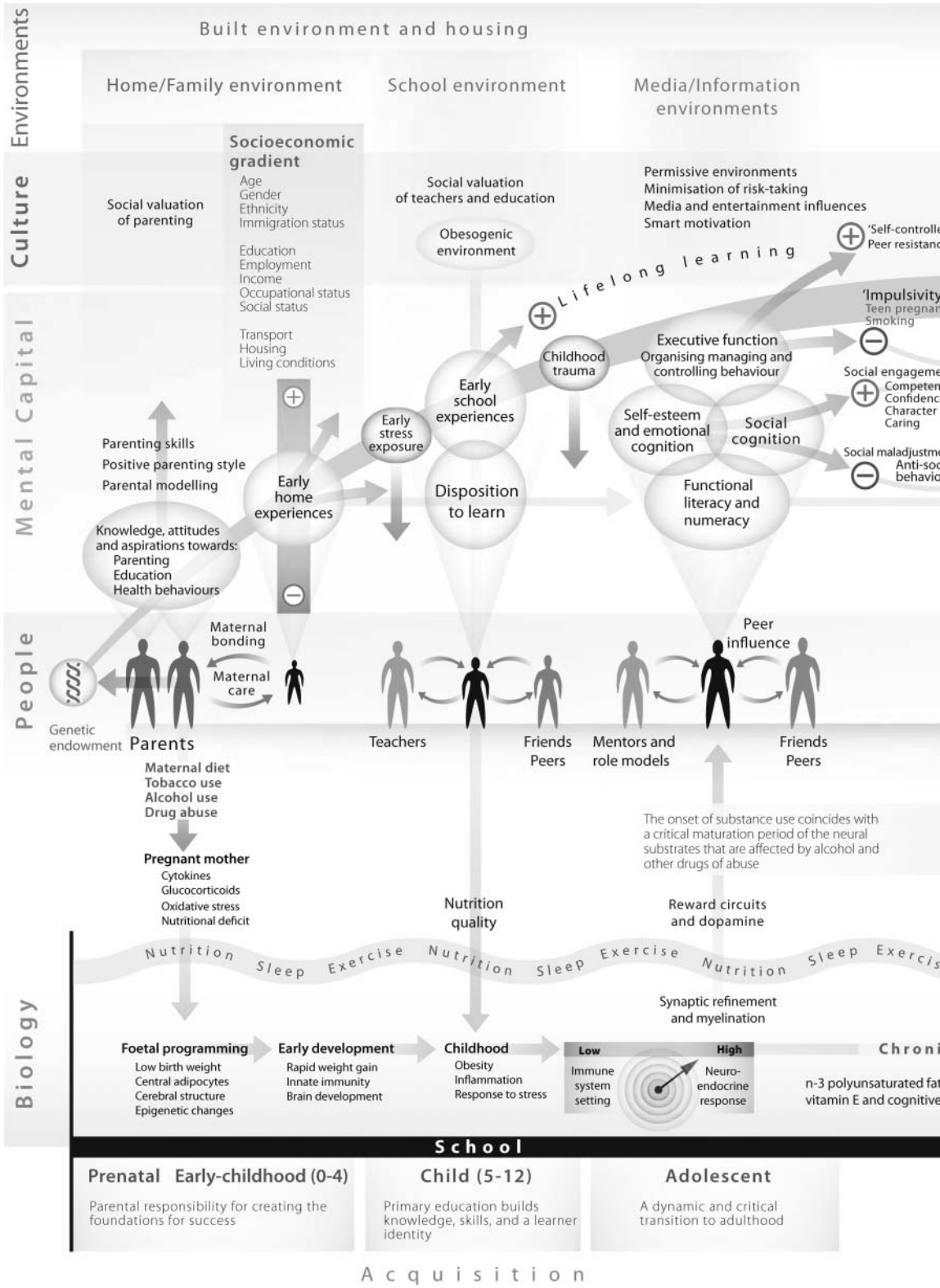
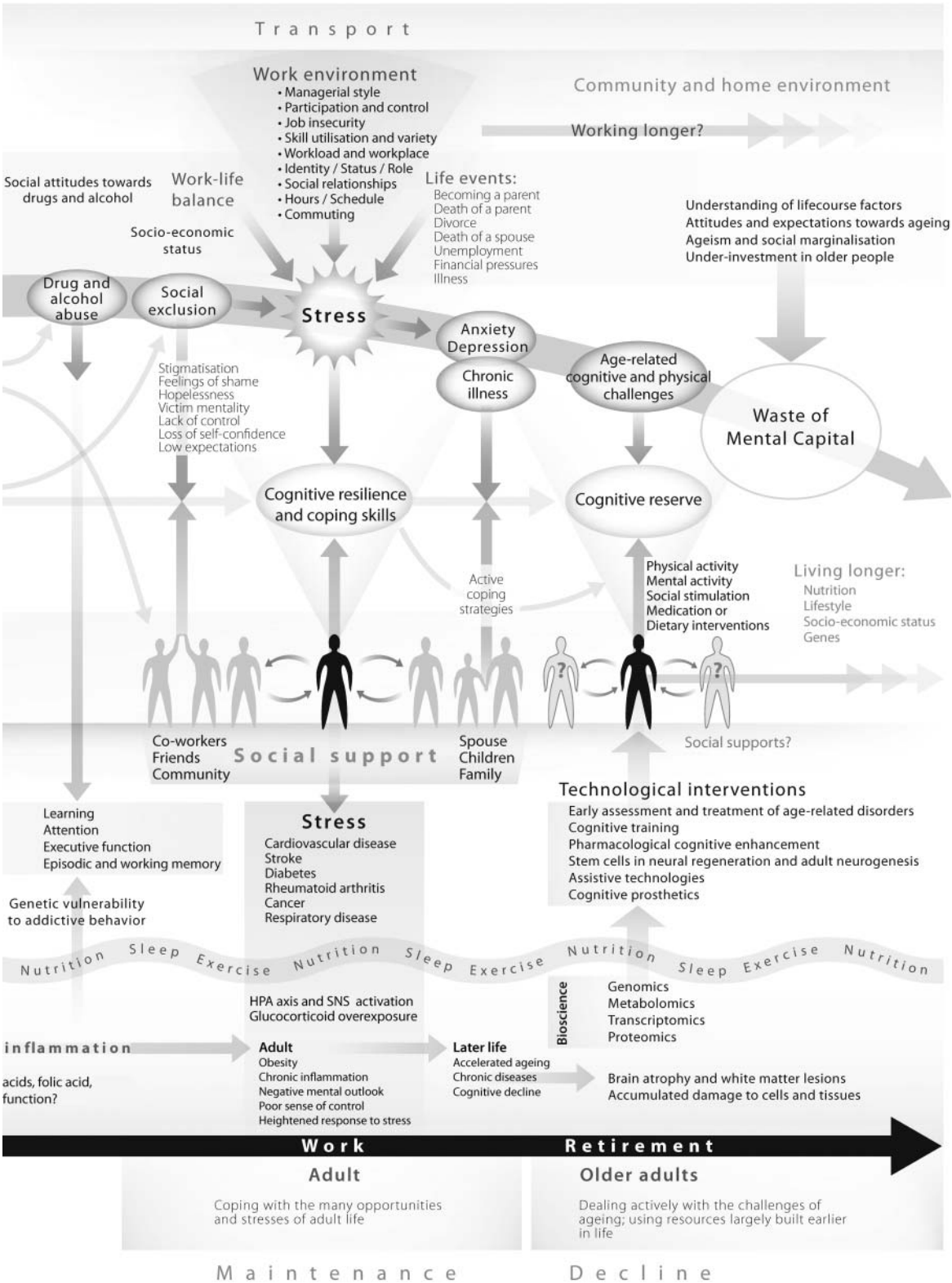


Figure. Synthetic View of the Mental Capital Trajectory.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Rheumatoid arthritis
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Genetic vulnerability to addictive behavior
Nutrition Sleep Exercise Nutrition Sleep Exercise Nutrition Sleep Exercise Nutrition
HPA axis and SNS activation
Glucocorticoid overexposure
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Genomics
Metabolomics
Transcriptomics
Proteomics
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function?
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Heightened response to stress
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Cognitive decline
Brain atrophy and white matter lesions
Accumulated damage to cells and tissues
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Retirement
Adult
Coping with the many opportunities and stresses of adult life
Older adults
Dealing actively with the challenges of ageing; using resources largely built earlier in life
Maintenance
Decline

The Volumes in the Series

Each volume in the series has a senior editor who is a leading international scholar in a particular field, following the life-course model described by the Foresight program. We start with Wellbeing in children and families and progress to Wellbeing and the environment, Work and wellbeing, Wellbeing in later life, The economics of wellbeing, and, finally, Interventions and policies to enhance wellbeing. The contributors to each of these volumes are distinguished international academics who work in the domain covered, reviewing the evidence that can help to develop policies and interventions to enhance wellbeing in that particular context.

In the first volume on children and families we explore four different themes, with a number of chapters under each of these: the development of the early social and cognitive skills that are important in child wellbeing, parenting and children's development, school and child care-settings that impact child and family wellbeing, and stress and family and child wellbeing.

The second volume is on wellbeing and the environment. This comprises sections, with chapters in each, on wellbeing and the neighborhood, wellbeing and buildings, wellbeing and green spaces, crime and the urban environment (and the implications for wellbeing), and wellbeing and the environmental implications for design.

The third volume highlights the issues of work and wellbeing. A range of topics is covered here: the impact of job demands, the role of workplace control, the organizational characteristics of "happy organizations," leadership behaviors that influence employee wellbeing, the sustainable workforce, the "working wounded" (including stigma and return to work), organizational coping strategies and wellbeing, and many more.

The fourth volume highlights wellbeing in later life. Topics covered include the changing demographic context of aging, biological determinants and malleability of aging, psychological aspects of wellbeing in later life, nutrition and lifelong wellbeing, physical exercise and aging, combating isolation through technology in older people, the threat to wellbeing from cognitive decline, and maintaining wellbeing through the end of life, among others.

The fifth volume explores the economics of wellbeing, with chapters on income and wellbeing, alternative measures of national wellbeing, the impact of the great recession on economic wellbeing, whether recessions are good for one's health, investing in the wellbeing of children, investing in

wellbeing in the workplace, promoting health and wellbeing of older people and protecting population mental health, wellbeing during an economic crisis, and many others.

Finally, the sixth volume highlights interventions and policies that can enhance wellbeing throughout the life course. There are three sections, with chapters on the state of wellbeing science, individual/group interventions on childhood and adolescence, promoting mental health and wellbeing in schools, mindfulness training for children and adolescents, interventions in working years and post retirement, mental health promotion in the workplace, intergenerational interventions to enhance wellbeing among retired people, interventions to create positive organizations and communities with wellbeing as a business priority, the power of philanthropy and volunteering, and creating community connections. Finally, policies are discussed, such as mental health and wellbeing at the top of the global agenda, how subjective wellbeing can influence policy, media and the public's mental health, and promoting wellbeing through new technology.

These volumes contain the leading-edge research, practice, and policies to help government, businesses, local authorities, and global institutions consider how we can action some of what Bobby Kennedy suggested were an important set of outcomes for a successful society. Our institutions need to change, and we as individuals need to do so as well, if we are to achieve personal wellbeing, or as Abraham Lincoln wrote during the American Civil War, "it is not the years in your life which are important, but the life in your years." Winston Churchill reflected on this as well, when he wrote in an essay on how he dealt with the excessive pressures of life and found solace: "many remedies are suggested for the avoidance of worry and mental overstrain by persons who, over prolonged periods, have to bear exceptional responsibilities and discharge duties upon a very large scale. Some advise exercise, and others, repose. Some counsel travel, and others, retreat. . . no doubt all of these may play their part according to individual temperament. But the element which is constant and common in all of them is Change. . . a man can wear out a particular part of his mind by continually using it and tiring it, just in the same way as he can wear out the elbows of his coats. . . but the tired parts of the mind can be rested and strengthened, not merely by rest, but by using other parts. . . it is only when new cells are called into activity, when new stars become the lords of the ascendant, that relief, repose, refreshment are afforded."

I hope that these volumes will provide you with the science, practice, and tools to enhance the mental wellbeing of people in your own work.

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1

Wellbeing and the Environment

An Overview

Rachel Cooper
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The environment is everything that isn't me.

Albert Einstein

The first step toward success is taken when you refuse to be a captive of the environment in which you first find yourself.

Mark Caine

The two central dimensions of wellbeing and the environment are people and places. To understand this relationship, it is important to understand (a) how humans engage sensorally with their environment, (b) the type and quality of environment, and (c) its impact on people throughout their life course.

Quite simply, people are affected by their environment through their senses. This results in both psychological and physical effects, whereas people are also the agents that create, modify, and maintain much of the material world in which we live and work; a simple description of a very complex system of cause and effect. The more we know about this process and the intervening variables the more we may be able to design better places, moderate effects, and influence behavior.

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The main factors in the environment that contribute to wellbeing relate to our sensory stimulation; that is, what we see, smell, touch, taste, and feel. Both the physical and the ambient environment have an effect on our senses.

Noise is cited by many scholars as a negative ambient property in physical environments. For example, noise from apartment neighbors is seen as a major cause of annoyance and reduction in individuals' quality of life (Evans & Cohen, 1987; Goldstein, 1990). Although there are positive aspects of noise in the physical environment, often the sound of birds, running water, and certain types of music are used as soothing effects and for the reduction of stress (Ulrich, 2000), and of course music is used as a buffer to general noise (Winter, Paskin, & Baker, 1994).

In contrast, what we see and the notions of aesthetics and beauty have been identified as contributing most often to restorative benefits and a higher sense of wellbeing. So, for instance, exposure and access to views of nature from a variety of physical environments can improve individuals' health and wellbeing by providing restoration from stress and mental fatigue (Kaplan, 2001; Van den Berg, Koole, & Van Der Wulp, 2003). Conversely, an inability to spend time in natural areas may be associated with poor psychological wellbeing (Wells & Evans, 2003). Art as a feature of the physical environment has been identified as a positive contributory factor to wellbeing according to Philipp (2002). The arts can help mitigate mental health conditions such as depression, anxiety, and low self-esteem, as well as improve social integration and isolation.

Other visual aspects of the physical environment have been investigated. Namazi (1993) and Zeisel et al. (2003) examined several environmental design features simultaneously (e.g., lighting, acoustics, color) and found positive and negative impacts on aggression, agitation, social withdrawal, depression, psychotic problems, incontinence, distractibility, self-sufficiency, and continuity.

Like noise, other ambient properties of physical environments exert a negative impact on wellbeing through our tactile, olfactory, and taste senses. For example, those living in damp dwellings experienced more emotional distress (Martin, Platt, & Hunt, 1987) and poorer mental health in general (Hopton & Hunt, 1996, as cited in Krieger and Higgins, 2002) than those not living in damp conditions. Excessive indoor temperatures have been linked with irritability and social intolerance (Collins, 1993, as cited by Krieger and Higgins, 2002). Also, high levels of air pollution predict levels of psychological distress, particularly among people experiencing a recent adverse life event (Evans, Jacobs, Dooley, & Catalano, 1987).

Two additional ambient properties that appear mostly to have an impact (often negative) on our wellbeing are crowding and density. Crowding is believed to have substantial negative effects on social relations (Baum and Paulus, 1987) and psychological health (Edwards, Fuller, Sermsri, & Vorakitphokatorn, 1990; Evans, Palsane, Lepore, & Martin, 1989; Gove and Hughes, 1983; Lepore, Evans, & Palsane, 1991).

However it is clearly not that easy to unpack each influence on individual senses. The way in which we perceive the environment, and its impact upon our senses and psyche is multifactorial, and in many ways it is important to consider the effects through the lens of our life course (Table 1.1.). Environmental stimulants combine to have multisensory effects, both positive and negative, on us across our life course. By looking at it from this perspective we see the nuanced effect of the way in which we design, develop, and engage with the physical environment has on our wellbeing.

Birth and Childhood

As Gilbert and Galea illustrate in Chapter 2 of this volume the environment has a negative effect on unborn children; for example, the increased risk of infection with a greater population density in the mother can have an effect on fetal brain development. In addition, exposure of pollutants such as lead to pregnant women can affect the child's cognition throughout life. Maternal stress too has been seen to affect the offspring and neighborhood factors contribute to stress in everyone.

Noise has been seen to have negative effects on children. Evans, Hygge, and Bullinger (1995) found that a general pattern of adverse psychological stress reactions occurs among young children exposed to chronic noise in their neighborhoods. Childhood noise has also been identified as having a negative effect on children's reading skills (Cohen, Glass, & Singer, 1973).

Dampness, mould, and cold indoor conditions are significantly associated with anxiety and depression (Hyndman, 1990). For children, high-density living will be more tolerated if: they live in smaller, detached dwellings; they have designated play space or a room of their own (Wachs and Gruen, 1982); the dwelling is designed to minimize controllable social interactions (Baum and Valins, 1977, 1979); and floor-plan layouts provide good room separation (Evans, Lepore, & Schroeder, 1996).

Table 1.1. An Illustration of some of the Relationships between the Environment and Wellbeing over the Life Course.

	Childhood	Adulthood	Older age
Senses			
High noise levels	Psychological stress, poor reading skills, general learning	Impact on mental performance, anxiety and stress, learning and blood-pressure, long-term memory, social conflicts work; stress anxiety, exhaustion, violence, job strain	Abnormal sleeping patterns, agitation
Light: too low/high	Impact on learning and cognitive performance	Impact on levels of satisfaction and wellbeing	Impact on sleeping patterns
No views: especially nature		Job dissatisfaction, job stress feelings of isolation, depression, claustrophobia tension	Impact on agitation
Unsafe: infrastructure	Accidents		Impact on accessibility/accidents
Poor air quality		Headaches, tiredness, itchy skin, muscle pain, psychological stress	
Damp/hot/cold	Anxiety and depression		

Dense/overcrowded/lack of privacy	Poor social interaction, strained relationship with parents	Psychological distress, increase in tension	
No green space/leisure and play areas	Poor socioemotional development, poor learning and social environments	Impact on social connectedness	Impact on social connectedness
Unsafe: crime	Impact on social interaction	Impact on social interaction psychological distress	Impact on social interaction isolation
No public space	Impact on social interaction	Impact on social interaction, isolation/mental wellbeing	Impact on social interaction, isolation/mental wellbeing
Poor maintenance	Antisocial behavior	Stress	Stress
Mobility: poor transport			Isolation
Mobility: not walkable	Obesity	Isolation: obesity, cardiovascular disease, diabetes	Isolation: obesity, cardiovascular disease, diabetes

Children are also at risk with regard to safety and fear of crime. Huttenmoser (1995) suggested that 4-year-olds who could not play independently outdoors, primarily because of traffic-related safety, had more strained relations with their parents, fewer playmates, and poorer socioemotional development than children who could play outdoors. However, the presence of nearby nature or restorative characteristics in the home protect children from the impacts of life stress, especially those most at risk from high levels of stress (Wells & Evans, 2003). As Martin and Wood (Chapter 7) and Maxwell and Evans (Chapter 11) illustrate there is a great deal to consider when designing neighborhoods for children and adolescents to ensure access to nature, and to better learning and social environments.

In a child's life *schools* (Jones and Harrison, Chapter 12) are obviously the physical environment in which they spend a significant amount of time, and as such they too have been studied in relation to wellbeing. Duker and Rasing (1989) discovered that classroom redesign had a positive impact on decreasing self-stimulation and inactivity and increased on-task behavior (although, they noted that no changes were observed on inappropriate behavior). Marx, Fuhrer, and Hartig (2000) found that children in a semicircle layout in their school classroom asked more questions than in the traditional row-and-column arrangement. Of course, comfort is important and Knight and Noyes (1999) observed improved on-task behavior with the use of new chair design.

Classrooms are usually decorated with pictures, images, and other displays of student work; teachers have always known this to be a valuable activity. Jago and Tanner (1999) indeed found that the visual environment affects an individual's ability to perceive visual stimuli, therefore affecting mental attitude, performance, and learning. The use of color and light is important here; the impact of light and lighting on learning varies according to the color and quality of light, from natural to artificial and from warm to cool. For instance, Knez (2001) found that individuals had better cognitive task performance in warm lighting, rather than in cool and artificial-daylight white lighting.

Noise impacts highly on learning. Addison, Dancer, Montague, and Davis (1999) explained how ambient noise levels in a classroom can interfere with teaching and learning. For example, noise that was higher than the recommended levels in primary schools in London had a negative impact on students' abilities to learn in the classroom (Shield & Dockrell, 2003, 2004).

Adulthood

As adults the pattern of influence and effect is repeated. Noise has again been studied a great deal: Belojevic, Jakovljevic, and Slepcevic (2003) found that noise has a negative impact on mental performance, anxiety, and stress. Similarly, Stansfeld and Matheson (2003) observed that noise impacts negatively on learning and blood pressure. Chronic exposure to noise can lead to long-term negative impacts, such as long-term memory (Knez and Hygge, 2002). Additionally, Lercher, Evans, and Meis (2003) found that noise impacted on intentional and incidental memory as well as recognition memory.

Our *homes* and our *workplaces* have a significant effect on our wellbeing. For instance, dwellings in direct contact with natural elements as well as views of nature have an enhanced restorative effect on individuals (Evans & McCoy, 1998; Hartig & Evans, 1993; Kaplan & Kaplan, 1989). A perceived lack of privacy in the home due to crowding is also significantly associated with psychological distress (Fuller, Edwards, Sernsri & Vorakitphokatorn, 1993). Not surprisingly perhaps, women aged 25–45 in London were found to suffer more psychological distress in crowded dwellings than any other demographic group (Gabe & Williams, 1987). And Evans, Lepore, Shejwal, and Palsane (1998) found that tension increases between adults and children with residential crowding, which can lead to a greater sense of helplessness among children (Evans et al., 1998). The design of dwellings comes into play here; Evans et al. (1996) found those in more crowded homes suffer less psychological distress when the dwelling unit has more "depth" (i.e., there are more interconnected spaces).

The *workplace* has been the site of considerable research in terms of its impact on our wellbeing, often in terms of the social, behavioral, and managerial activities, but so too has the physical environment. Noise in the workplace that can have a significant negative impact on wellbeing: In general, a noisy work environment is associated with stress, anxiety (Ahasan, Mohiuddin, Vayrynen, Ironkannas, & Quddus, 1999; Akerstert and Landstrom, 1998; Cohen, 1969; Kahn, 1981; Kryter, 1972; Menaghan and Merves, 1984; Norbeck, 1985), emotional exhaustion or burnout (Topf and Dillon, 1988), unhappiness (Loscocco and Spitze, 1990) and, in some cases, workplace violence (Verdugo and Vere, 2003). Higher noise levels in the workplace also can lead to nervousness, distress, and social conflicts at home and at work (Cohen, 1969; Granati et al., 1959, as cited in Halpern, 1995; Miller, 1974). One source of noise can come from people talking at work.

Overhearing conversations in the workplace is perceived to be a major disturbance in getting one's work done and may lead to irritation (Sundstrom, Town, Rice, Osborn, & Brill, 1994). However, our tolerance to noise can be moderated by our other variables such as our job tasks or job strain. Leather, Beale, and Sullivan (2003) found that the higher the strain under which workers find themselves and the louder the noise in their workplace, the more their coping resources will be taxed and the more stressed they will become.

Air quality is another property of the workplace that can impact on our wellbeing. Poor air quality can result in "sick building syndrome," as individuals continually breathe recycled air or do not get sufficient fresh air. This can lead to physical symptoms such as headaches, tiredness, itchy skin, and muscle pains, but symptoms also can include increased psychological stress (Jukes, 2000, as cited in McCoy, 2002).

The design of a building, its internal décor and external views and landscape are significant factors in our wellbeing. Unlike noise and air quality, which are generally perceived to have negative impacts on wellbeing, views from workplace windows and the presence of windows and plants can have a positive impact. For instance, when there is no access to windows in the work environment individuals have reported dissatisfaction with their jobs, feelings of isolation, depression, restriction, claustrophobia, and tension (Finnegan and Solomon, 1981; Ruys, 1970; Sundstrom, 1986). Yet it matters what view is seen from windows; if the individual sees only the built environment this does not have the psychological benefits desired. It has been found that individuals who view only the built environment from their windows experience higher levels of job stress and lower levels of job satisfaction than those who view natural elements or who have no view from a window at all (Kaplan, Talbot, & Kaplan, 1988). Therefore seeing natural elements from windows is important (Moore, 1981; Ulrich, 1984; West, 1986). Also, the presence of indoor plants has been identified as increasing the perceived comfort and attractiveness of a workplace, as well as feelings of wellbeing, although worker productivity may not improve (Kaplan, 1993; Larsen, Adams, Deal, Kweon, & Tyler, 1998; Shoemaker, Randall, Relf, & Geller, 1992).

The natural and the artificial are also relevant in terms of light in a workplace and again related to the design and windows. For instance, it has been maintained that the size of sunlit areas in windows (Boubekri et al. 1991, as cited in Leather, Pyrgas, Beale, & Lawrence, 1998) is important when thinking about windows in the workplace. This study revealed that

the area of sunlight penetration in windows is directly and positively related to job satisfaction and general wellbeing. In terms of artificial lighting, Knez and Enmarker (1998) found that artificial light in the workplace can alter mood. It affects males and females differently; males prefer lighting that is more blue in color whereas females prefer more reddish lighting. Interestingly, though, both genders believed their lighting choices were the most warm and the least cool in terms of color temperature.

Older Age

Obviously in older age we are subject to the same dimensions and resulting effects on our wellbeing from the physical environment as we are in adulthood. However, our physical and mental condition with increased age and possible frailty can leave us more vulnerable to the impact of these factors. Therefore, careful consideration needs to be given to the design and maintenance of the environments we inhabit in old age. For instance, in Chapter 13 Dutton addresses the design of housing for older people. There has been controversy over the relationship between the exposure to noise, light, and sleeping patterns for patients and residents in *nursing homes.* Research conducted by Alessi, Martin, Webber, and Kim (2005) in nursing homes to improve abnormal sleep/wake patterns of residents showed that intervention efforts to decrease nighttime noise and light and increase daily sunlight exposure for some residents only had a modest decrease on nighttime awakenings (10.6 min at baseline versus 9.8 min at follow-up; for those residents who did not receive the intervention, there was an increase in nighttime awakenings: 9.8 min at baseline versus 13.8 min at follow-up). In contrast Van Someren, Kessler, Mirmiran, and Swaab (1997) found that, during periods of increased illumination, the stability of the rest-activity rhythm increased. Moreover, others have found bright light improves patients' sleep/wake cycles (Kim, Song, & Yoo, 2003; LaGarce, 2002).

Across the Life Course

Hospitals are environments we are likely to spend time in at any point in our lives, although often more frequently and for longer periods in older age. As such, they are a site of study from many perspectives; architects

and designers look at them from the points of view of the patient and the workforce, and many studies have focused on the patient's ability to recover or the impact on overall psychological health, for instance in relation to access to nature and views of nature (Ulrich, 2000).

Hospitals are of particular importance as the population ages. Dementia and mental illness is a specific area of interest. Frequently, research on mentally ill patients examines sleep/wake behaviors and agitation levels. For instance, Burgio, Scilley, Hardin, Hsu, and Yancey (1996) found that the use of white noise had a positive impact (23%) on the reduction of verbal agitation. Namazi and Johnson (1992) found that specially designed environments satisfying safety and health concerns enabled residents to have free access to the outdoors during daylight hours. The number of agitated behaviors in five categories of patients decreased under the unlocked-door condition. Wards, toilets, corridors, and elevators are considered the areas where patients have higher levels of agitated behavior (Cohen-Mansfield, Werner, & Marx, 1990; Passini, Pigot, Rainville, & Tetreault, 2000). Namazi and Johnson (1992) also found that the level of agitation and consequent utilization of the toilet can be increased when toilets are visually accessible. Mayer and Darby (1991) found that the use of a mirror on the ward front door reduced the number of individuals exiting.

These findings in terms of light, noise, location of toilets, and use of mirrors illustrate, as do all the studies mentioned here and in this volume, the macro and micro aspects of the buildings we design and use during our life course. There are of course many other overarching life-course buildings such as shops and leisure facilities that have an influence on our wellbeing. However, more generally with the growth of *the city* (more people now live in urban regions that rural ones) we must consider the impact of the urban environment on our wellbeing. This is especially so with the neighborhood: our locale has an impact on the lives we lead, the relationships we build, and our general sense of health and wellbeing across the totality of our life course.

At the *neighborhood* level, for instance, safety is associated with positive mental health (Ziersch, Baum, MacDougall, & Putland, 2005). That is, feeling safe while in the home and when walking around the neighborhood and feeling socially connected with the community may have an individual protective effect (Cho, Park, & Echavarria-Cruz, 2005; Rose, 2000; Ross and Jang, 2000; Sampson, Raudenbush, & Earls, 1997). Conversely, when individuals, particularly women and the elderly, perceive their community to be unsafe they are most likely to have high levels of psychological distress

(Phongsavan, Chey, Bauman, Brooks, & Silove, 2006; Ziersch et al., 2005). Furthermore, residents living in urban public housing with nearby vegetation (e.g., trees) were found to be significantly more effective in managing their major life issues (Kuo, 2001), felt a greater sense of connectedness to the community, and experienced fewer incidents of violence than residents living in more barren environments (Sullivan & Kuo, 1996, as cited in Wells, 2000). Health Canada (1997, as cited in Butterworth, 2000) maintains that socioeconomic factors as well as the physical environment (e.g., unused and empty spaces, poorly lit areas, those obscured with trees and shrubs) contribute to stress from the fear of crime. Thus, efforts at regeneration urban neighborhoods that center on safety may help families in their coping and everyday functioning (Whitley & Prince, 2006).

At the same time urban and neighborhood planning and regulation, in terms of the location of shops, leisure facilities, residential areas, green spaces, and street connectedness (i.e., the design of the physical environment), have been found to influence our physical behavior such as walking (Shores & West, 2008) and our general health (Mitchell & Popham, 2007). This in terms acts on our social relationships, our sense of isolation or otherwise, our levels of obesity, and thus our general health and wellbeing. For instance, lack of physical activity such as walking and being sedentary may lead to cardiovascular disease and diabetes (U.S. Department of Health and Human Services, 2000). Also it has been found that areas of lower socioeconomic status tend to have a higher density of fast-food outlets and a lower availability of healthy foods for people with diabetes (Horowitz, Colson, Hebert, & Lancaster, 2004), as compared with neighborhoods of high socioeconomic status that often have a higher density of supermarkets and food stores (Cummins, McKay, & MacIntyre, 2005; Morland, Wing, Diez Roux, & Poole, 2002). All of this influences diet, health, and wellbeing.

Nature and *green space* have, in particular, been highlighted as a necessary resource for everyone during their life course. Much work has focused on the presence of parks, gardens, and allotments in neighborhoods and cities as places of leisure, play, and recuperation, focusing on the restorative and stress-reducing aspects of nature (Bird, 2007). Palka (1999) describes therapeutic landscapes as places that "promote wellness by facilitating relaxation and restoration and enhancing some combination of physical, mental and spiritual healing." Kaplan and Kaplan (1989) discuss attention restoration theory whereby nature provides recovery from attention fatigues, where individuals can distance themselves from routine activities and thoughts. Indeed, contact with nature was found to significantly reduce the psychological

problems caused by stress in children (even) in rural environments (Wells & Evans, 2003). Other work has found that patients with views of nature from their hospital beds recover more rapidly than those who do not (Ulrich, 1984) and dementia patients find gardens soothing as long as there is a level of familiarity.

Transport and *mobility* are major issues throughout the life course. Most individuals see the ability to move from one place to another, one city to another, and one country to another as essential. Most adults believe it is important to own and drive a car; it provides a level of independence and satisfies the desire to have control over where and when to move. Importantly, mobility enables individuals to socialize. For instance, use of buses by young adults in London (where there is free travel) was found to be a physically and socially active experience (Jones, Steinbach, Roberts, Goodman, & Green, 2012) even though we would encourage walking and cycling to enhance physical wellbeing. This aspect of mobility is also increasingly important as we age. Kendig and Stacey (1997), in their study of over-65-year-olds in Australia, found that independence, private car driving, and mobility were very important for older people living in the community, yet there were safety issues with dementia for those who drove and for those who had ceased driving but walked. Davey (2007) found the lack of a private car by older people in Canada to have a negative impact on quality of life, especially the ability to undertake discretionary trips. Whereas walking and cycling are of course recommended for physical wellbeing to ward off obesity and related diseases such as heart disease, it is clear that mobility enables us to socialize and therefore contributes to our mental wellbeing. Clearly, transport planners and urban designers must take notice of the transport as a determinant of wellbeing.

Future Planning for Sustainable and Low-Carbon Living

Globally we have the challenge of climate change and the need to move to more sustainable development and a way of living with less carbon consumption. However, without social acceptability any solution to deliver a lifestyle with reduced demands and impacts on the environment, however essential to society's long-term viability, is likely to be fatally compromised. Therefore, if we do not design environments that take into account the impact of the environment on our health and wellbeing we will not deliver the desired outcome for the planet or it inhabitants.

It must also be remembered that in terms of the environment and its impact on wellbeing this volume has been written mainly from the perspective of the developed world. We must also recognize that there are inequalities globally with regard to access to good-quality urban environments let alone access to the basic services of energy, water, infrastructure, food, and basic necessities. It is hoped that what we learn from the mistakes of the past and the relationship between humans and their environment can be taken into consideration as we plan the next generation of cities in both the developed and developing economies.

This volume attempts to draw together research related to many of the aspects of the environment that contribute to our health and wellbeing. It provides an overview of the environment and its relationship to wellbeing at neighborhood (Part 1) and building (Part 2) scales, while illustrating such intervening variables as green space (Part 3), and transport, crime, and the introduction of sustainable approaches to the climate-change challenge (Part 4). Many of the core concepts discussed above are developed and enhanced in this volume and this can be used as a basis for redesigning, developing, and enhancing our environment. However, it is clear there is a lot more to be done to understand the complex interaction between humans and their environment and to provide the evidence on which sound policy and design decision making can be based.

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Part 1

Wellbeing and the Neighborhood

2

Urban Neighborhoods and Mental Health across the Life Course

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Over the past 50 years the growth of urban environments worldwide has been substantial. As economic opportunities have shifted from rural to urban areas there has been 2–3% growth on average in urban populations across the United States and worldwide [United Nations, D.O.E.A.S.A., Population Division (United Nations), 2012]. Consequently, the proportion of the U.S. population living in cities has increased from 65% in 1950 to 82% in 2012 and is projected to be 89% by 2050 (United Nations, 2012). These numbers are consistent and often more striking in lower- and middle-income countries around the globe. For example, urbanization in Argentina has led to an increase in the percentage of the total population living in urban areas from 65% in 1950 to 92% in 2012 (United Nations, 2012) and is projected to be 95% in 2050 (United Nations, 2012). The urban environment, including both physical and social environment, presents a unique set of exposures that directly and indirectly affects the mental health of individuals over the course of their lives from prenatal to older age. Urban physical environments are primarily, if not entirely, confined to the *built environment* or the spaces and structures planned and created by humans (Evans, 2003; Renalds, Smith, & Hale, 2010). The built environment consists of anything from apartment and office buildings to sidewalks and transportation systems to sanitation and water systems to parks and other places of recreation. Individuals living

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in urban areas are exposed to dramatically different physical environments (compared to rural residents) including reduced access to green spaces (Maas, Verheij, Groenewegen, De Vries, & Spreeuwenberg, 2006) and increased exposure to air pollutants and other toxins (Calderon-Garciduenas et al., 2008; Haynes et al., 2011; Shen et al., 1998). Similarly, the urban social environment involves differences in social interactions (Brown et al., 2009), racial and ethnic diversity (Veling et al., 2008), and social norms (Karasek, Ahern, & Galea, 2012), which offer a different set of experiences for those living in cities. In this context, the social environment is often viewed as a proxy for group-level social control and agency, or the capacity of the group to make common choices and act (Dupere, Leventhal, & Vitaro, 2012; Kuipers, Van Poppel, Van den Brink, Wingen, & Kunst, 2012). As a growing proportion of the global population lives in cities, the imperative grows to better understand how complex urban environments work together to affect health.

Early contributions from urban health research explored intraurban differences in health, including primarily differences between urban neighborhoods (Galea & Vlahov, 2005). Many cities are characterized by dramatic inequalities in neighborhood socioeconomic status (SES), built environment, social disorganization, and collective efficacy, which, along with other physical and social factors, contribute to variability in health across neighborhoods. Broadly termed *neighborhood effects*, these neighborhood-level factors often have profound effects on both individual and population health (Gary-Webb et al., 2011; Renalds et al., 2010; Wandersman & Nation, 1998). Compared to those living in high SES neighborhoods individuals living in low SES areas may experience more air and noise pollution (Lercher, Evans, Meis, & Kofler, 2002; Trimmel, Atzlsdorfer, Tupy, & Trimmel, 2011), poorer education systems, less green space, greater residential instability, and more smoking. These environments then shape the physical and mental health of individuals growing up and living in these neighborhoods.

In general, untreated mental disorders represent 13% of the total global burden of disease and unipolar depressive disorder is the third leading cause of disease burden worldwide and the leading cause of disease burden in high-income countries (World Health Organization, 2008, 2012). Treating intraurban neighborhood variation as a natural experiment, it is possible to explore how different factors act individually and together to affect mental health. Over the past 10 years urban health research has explored the features of the physical and social environments that contribute to differences in mental health status with the hope of better understanding the causes of mental disorders (Downey & Van Willigen, 2005; Dupere

et al., 2012; Galea et al., 2007; Renalds et al., 2010). Recognition of the growing burden of disease attributable to mental health disorders has led to a more direct focus on understanding the origins of mental disorders (Prince et al., 2007; World Health Organization, 2011). Mental disorders include psychiatric conditions such as depression, anxiety, stress, substance abuse, and psychosis, as well as neurological disorders such as reduced cognition and dementia. Although these disorders can occur independently they often occur together, producing complex symptomatology that is difficult to diagnose and to treat. Many of those affected go undiagnosed, receiving little to no treatment (World Health Organization, 2011, 2012), often leading to severe interpersonal and work-related issues and reductions in the ability of the individual to function effectively in society and to make consistent economic contributions. The effect of mental disorders expands far beyond the individual, with effects seen on neighborhoods and across generations; recent work has shown that the children of adults with mental disorders are more likely to experience symptoms themselves (Pilowsky, Wickramaratne, Nomura, & Weissman, 2006; Solantaus, Paavonen, Toikka, & Punamaki, 2010; Weissman et al., 2006). Mental disorders are also directly related to physical health via biological and behavioral pathways (Geronimus, Hicken, Keene, & Bound, 2006; Kubzansky, 2011; Singh-Manoux, Adler, & Marmot, 2003). Research has linked mental disorders to cardiovascular disease (McEwen, 2003), obesity (Weissman et al., 2006), inflammatory processes (Schiepers, Wichers, & Maes, 2005), and reduced functioning of the immune system (Kapadia & Sakic, 2011; Uddin et al., 2010). Onset of mental disorders, therefore, can lead to lifelong individual and substantial societal burden. Estimates of the global economic cost of mental illness over the next 20 years run upwards of US$16 trillion with the majority due to indirect costs, such as lost wages (Bloom et al., 2011).

The relationship between the individual and the neighborhood environment is dynamic because both change over time. At each age and stage of development individuals interact with and are affected by different aspects of the physical and social environment depending on the biological and psychological processes occurring at the time. However, these environments are not stagnant and also change over time, building on and incorporating previous features to present new challenges to the population and the individual. A longitudinal approach to studying neighborhood effects is central to understanding how exposures at different points in life and over the course of life can lead to mental health outcomes. While an important starting point, cross-sectional studies that capture one time point (as many

early studies on neighborhood effects have done) can only begin to pull apart the complex and interacting nature of neighborhood effects. A more robust and useful perspective is a *life-course approach*, an inherently forward-thinking conceptualization that investigates how exposures throughout life, from preconception to adulthood, affect health later in life. A life-course perspective offers three approaches through which exposures act to affect change: (a) exposure at *critical periods* of physical or psychological development that alters the course of development and all future health outcomes, (b) initiation of a *chain of events* that directs the physical or social trajectory of a person's life leading to health outcomes, and (c) *accumulation* of one or more exposures over life that build above a certain threshold. To use a life-course approach when investigating neighborhood effects is to accept the dynamic and challenging nature of the physical and social environment.

This chapter is organized into four parts: (a) a review of significant urban exposures affecting mental health, (b) mechanisms involved, (c) a hypothetical case study, and (d) thoughts for future directions of neighborhood research. In the first section we consider some of the evidence supporting neighborhood effects on mental health, offering a brief look at the urban neighborhood effects on mental health across the life course: prenatal, perinatal, and infancy; early life; adolescence; adulthood; and older age. Using a life-course approach we will highlight some of the exposures in the physical and social environments that act both independently and jointly to influence mental health outcomes. These exposures are not inclusive of all potential neighborhood effects but rather represent those factors for which there is currently the strongest evidence. We will then briefly review some of the mechanisms through which neighborhoods might affect mental health, touching on the developmental, biological, and psychological processes mentioned above. We then provide, as an example, a hypothetical case study of two individuals growing up in vastly different neighborhoods. Here we aim to emphasize the effects of neighborhood environments through each stage of life and the importance of using a life-course model. Finally we propose recommendations for future research and potential interventions that may be beneficial.

Review of Urban Exposures

Prenatal, Perinatal, and Infancy

The prenatal, perinatal, and infant periods are some of the most influential for development. The prenatal period includes the entire gestation and the

perinatal period consists of the three months prior to and one month after birth; infancy includes the year following birth. The brain and neurological system more generally develop during all three periods with brain development beginning as early as the first week after conception. Exposures during these times, measured primarily through maternal exposure, reflect the critical periods model of the life-course approach as they alter developmental processes (Das & Basu, 2011), biological mechanisms (Lowe, Luheshi, & Williams, 2008), and gene expression (Heijmans et al., 2008).

Studies of *maternal infection* during pregnancy find that offspring experience mental disorders such as schizophrenia (Hoffmann, Grossman, Bokov, Lipitz, & Biegon, 2010; Lowe et al., 2008; Patterson, 2002), autism (Patterson, 2002), and other delays in verbal skills. Suggested pathways point to responses from the maternal immune system that affect fetal brain development during the early prenatal period. For example, one study found that fetuses of mothers infected with cytomegalovirus had significantly smaller temporal lobes than did controls, which could contribute to the development of schizophrenia in adulthood (Hoffmann et al., 2010). Because a significant part of brain development occurs during the first trimester, infections during this period have been found to have a greater effect on development than any other trimester (Hoffmann et al., 2010). Urban neighborhoods have the potential to increase the risk of infection as greater population density results in greater physical contact and interaction between individuals.

The detrimental effects of *lead* on physical and mental health have been accepted for over 30 years (Surkan et al., 2007). More recent evidence finds cognitive delays in infants born to mothers exposed to lead during pregnancy in children as young as three months (Shen et al., 1998). Cognitive delays during these critical periods can affect cognition throughout life and in turn lifelong mental health (Shen et al., 1998). Although lead has been removed from gasoline and paint, the primary sources of exposure in previous decades, it can still be found in outdoor paint, some toys, cosmetics, and indoor paint in older buildings (Levin et al., 2008). Many buildings in low-SES neighborhoods have not had the necessary renovations and are more likely to have walls covered in lead paint. Although this paint may be protected by multiple layers of non-leaded paint, deterioration of buildings leads to chipping that extends down to the layers of leaded paint. Neighborhood income and education level are therefore directly correlated to the condition of buildings, prenatal exposure to lead, and lifelong cognitive abilities.

Unsurprisingly *maternal nutrition*, specifically caloric and nutrient intake, has been found to be essential to proper fetal development (Roseboom, Painter, Van Abeelen, Veenendaal, & De Rooij, 2011). Innovative research in this field further points to the importance of specific nutrient intake at certain points in fetal development (Heijmans et al., 2008; Painter, Roseboom, & Bleker, 2005). Without these essential nutrients the fetus lacks the building blocks for successful progression through neurological development, which can lead to psychiatric disorders such as schizophrenia. Folate intake, for example, during preconception and the first few weeks of pregnancy is important for neural development and a folate deficiency has been found to be a cause of schizophrenia in adults (Czeizel & Dudas, 1992; MRC Vitamin Study Research Group, 1991; Smithells, 1982; Smithells et al., 1981). Although folate supplements are available at many health food and grocery stores, fresh leafy green vegetables are the best source of folate and other essential nutrients. For mothers living in middle- or high-income neighborhoods, grocery stores offering multiple options of leafy greens are numerous and easily accessible. However, mothers in low-income neighborhoods often experience neighborhood *food deserts* where grocery stores with fresh and affordable vegetables and other nutritious foods are few and fast food restaurants and corner stores are plentiful. Additional barriers to these foods can be low walkability and high levels of violence of the neighborhoods. Even if mothers are educated on proper nutrition during pregnancy, living in neighborhoods deplete of nutritious food may obstruct their consumption of nutrients such as folate, affecting fetal development and leading to psychiatric disorders later in the infant's life (Widener, Metcalf, & Bar-Yam, 2012).

Chronic *maternal stress* levels have been found to affect child cognition and stress response throughout life (King & Laplante, 2005; Louvart, Maccari, Vaiva, & Darnaudery, 2009). During gestation the information passing between the mother and the fetus is considerable. In a process known as *fetal programming*, maternal hormones secreted during gestation instruct the fetus as to what to expect in the outside world upon birth and effectively guide the development of necessary response systems (Barker, 1991). For offspring of mothers who experience chronic stress, development of hormonal response systems mirrors the mother's response. Several neighborhood-level social factors act to shape maternal stress levels, which in turn influence the child's stress response systems.

Early Life

Early life and childhood consist of the ages following infancy to the prepubescent years. These early years are critical as brain and psychological development continue throughout childhood. Young children are highly susceptible to assaults from poor physical and social environments such as exposure to air pollution and violence and the neighborhood in which a child grows influences development and subsequent mental health outcomes. Exposures during this period can act via the critical periods model or the chain of events model as many exposures initiate a sequence of events leading to mental disorders later in life.

Exposures to toxins, metals, and air pollution are detrimental to those in early life and vary based on the local built environment, neighborhood location, and SES level. *Lead exposure* affects not only growing infants, but also children less than 6 years of age, for whom significant cognitive delays have been found (Levin et al., 2008; Norman, Mathee, Barnes, Van der Merwe, & Bradshaw, 2007; Surkan et al., 2007). The current acceptable blood lead level (BLL) is less than 10 μg/dL. However, studies comparing children with BLLs of 5–10 μg/dL to children with BLLs of less than 1 μg/dL found significant reductions in IQ, reading and mathematics skills, and memory among the children with higher BLLs (Surkan et al., 2007). Children aged 1 and 2 are at the greatest risk of exposure due to their continuing brain development as well as their inclination to put items, such as paint chips, in their mouth. Recent studies like these have provided evidence to substantiate a lowering of the acceptable BLL to less than 2 μg/dL.

Air pollution has recently gained attention for its contributions to mental health disorders. A study examining healthy children and dogs in Mexico City found persistent white matter and lesions in the brains of those growing up in high-pollution areas (Calderon-Garciduenas et al., 2008), providing evidence that illuminates the effects of air pollution on brain development. Moreover, a study of children who grew up in neighborhoods with high air pollution showed positive associations between air pollution and neighborhood-level juvenile criminal activity as well as schizophrenia later in life (Haynes et al., 2011). Exposure and subsequent cognitive and behavioral outcomes vary by neighborhood as the level of air pollution depends primarily on the surrounding neighborhood built environment. Neighborhoods adjacent to or inclusive of a bus depot or a highway, for example, will experience higher levels of air pollution than neighborhoods far from road traffic.

Increased levels of *noise pollution*, present in most urban areas in the form of road and air traffic, are additional features of the neighborhood physical environment that affect mental health in early life (Stansfeld et al., 2005; Stansfeld, Haines, Berry, & Burr, 2009; Uran, Caceres, & Guelman, 2010). Like air pollution, level of exposure to noise pollution is dependent on the built environment of the surrounding neighborhood as well as residential buildings. Neighborhoods adjacent to an airport, often of lower SES, are subjected to higher levels of noise pollution than those with little air or road traffic. Residential buildings can also contribute to or reduce this exposure; higher-quality buildings can more effectively block out noise. Studies of children have shown that aircraft and road traffic disrupts sleeping patterns in children and affects focus in schools (Stansfeld et al., 2005; Szalma & Hancock, 2011; Trimmel et al., 2011; Uran et al., 2010). Moreover, children exposed to aircraft and road traffic noise during school have also shown cognitive and behavioral effects (Stansfeld et al., 2005). Noise pollution can alter brain development and can set the course for future learning and academic progress and cognitive abilities throughout life.

A positive social environment during early life is critical to brain development. Studies have shown that *neighborhood violence* is positively and directly associated with child stress levels (Karriker-Jaffe, Foshee, & Ennett, 2011). Neighborhood violence includes murder, theft, domestic abuse, and assault, among other things. Children from neighborhoods with high violence may experience greater stress and anxiety and may be more susceptible to other mental health outcomes later in life, such as posttraumatic stress disorder, the onset of which is affected by the number of traumatic events experienced in early life (Heim & Binder, 2012). In addition, neighborhood violence during early life may affect mental health in later life stages, such as substance abuse and depression during adolescence (Dupere et al., 2012).

Studies of mental health outcomes among immigrants indicate that neighborhood *racial/ethnic density* is important in early-life social interactions, psychological development, and subsequent mental health (Veling et al., 2008). Immigrants from non-Western countries who moved to Western countries at early ages have been found to have higher rates of schizophrenia than their nonimmigrant counterparts. However, immigrants living in high ethnically dense neighborhoods during youth appear to be protected against these serious mental illnesses. Following these findings, discriminatory exposures and perceived discrimination throughout life, particularly among minorities and immigrants, represent some of the suggested pathways to serious mental illness and higher rates of other mental disorders

such as depression and anxiety (Das-Munshi, Becares, Dewey, Stansfeld, & Prince, 2010; Veling et al., 2008). These neighborhood effects could be due to an exposure to negative social environments at critical periods of development along with an accumulation of exposures over longer periods of time.

Adolescence

Adolescence encompasses the time between puberty and adulthood. Although specific chronological ages may vary by person dependent on the biological development, adolescence is typically defined by age 13–18. These years are critical to psychological development and are especially sensitive to influences that affect behavior, such as substance abuse or eating disorders. For example, for those adults who are tobacco users, initiation of tobacco use most frequently occurred during adolescence (Aratani, Schwarz, & Skinner, 2011). Exposures and subsequent outcomes during adolescence can also be conceptualized using the chain of events model as they may initiate a sequence of events leading to mental disorders in adulthood.

By adolescence, most neurological systems are fully developed and exposures from the physical environment, such as lead, have less of an effect. There are, however, important aspects of the neighborhood physical environment that influence psychiatric processes and behaviors of adolescents. For example, *neighborhood quality* has influence on the initiation of behaviors such as substance use, depression, and violent behavior during adolescence (Galea, Ahern, Rudenstine, Wallace, & Vlahov, 2005). Adolescents from neighborhoods of poor quality, often defined by the amount of trash on the streets, buildings in disrepair, graffiti, and vandalism, are at a higher risk for depression and anxiety as well as dangerous alcohol, tobacco, and drug use (Evans, 2003).

The social environment is also important to adolescent mental health. Neighborhood social processes, for example, can promote or dissuade neighborhood unity and agency, which can in turn modify the individual sense of control and empowerment affecting adolescent depression, anxiety, and delinquency. *Neighborhood social disorganization* reflects the level of instability found in the neighborhood and includes residential and marital instability as well as adult and adolescent violence and crime. Several theories suggest mechanisms through which social disorganization may be associated with a higher level of community crime (Agnew, 1992; Sampson & Groves, 1989). For example, the "broken windows theory" suggests that small acts of violence and vandalism propagate increasing acts of crime at the

neighborhood level (Burdette, Hill, & Hale, 2011; Keizer, Lindenberg, & Steg, 2008). Neighborhoods with high levels of social disorder have been found to have higher levels of adolescent deviant behavior (Calvert, 2002; Wilson, Syme, Boyce, Battistich, & Selvin, 2005). Violence alone has been shown to affect adolescent depression, stress, and behavior (Calvert, 2002). Conversely, neighborhoods with high levels of *social cohesion* and *collective efficacy* have lower levels of deviant behavior and mental health disorders such as depression (Kruger, Reischl, & Gee, 2007; Sampson, Raudenbush, & Earls, 1997). Social cohesion represents the connectedness and solidarity of the neighborhood residents, while collective efficacy takes this idea one step further and includes the importance of shared values and the ability of the group to accomplish common goals. Social environments with high levels of social cohesion and collective efficacy are able to implement effective social controls, allowing residents to monitor adolescent behavior and reduce levels of deviant behavior and possibly to effect change on some of the aspects contributing to social disorganization. *Social networks*, the social ties between individuals and groups in a neighborhood, are another avenue of improving the social environment and adolescent mental health (Kawachi & Berkman, 2001). These networks can also provide high levels of social support, which has been found to reduce the effect of traumatic and stressful life events and to improve access to resources for individuals (Achat et al., 1998; Brugha et al., 2005). Together with social cohesion and collective efficacy, social networks protect the mental health of adolescents via psychological processes. In addition, *social norms* shape the accepted behaviors in the neighborhood. Social network theories explain that behaviors are contagious particularly during adolescence, which is a critical period for behavioral development (Christakis & Fowler, 2008; Mason, 2010). Neighborhoods with high levels of smoking or substance use have been found to have greater initiation of smoking and substance use among teenagers (Ahern, Galea, Hubbard, & Syme, 2009; Karasek et al., 2012).

Adolescents living in neighborhoods with positive social environments are protected from the strain of having inadequate resources and support to accomplish their own individual goals. Although there are many aspects of the social environment, they are all intimately related. A chain of events can be initiated for an adolescent growing up in a neighborhood with poor physical quality and high social disorder that leads the adolescent to develop depression and high levels of stress along with deviant behavior and substance use. This person may in turn remain in this neighborhood throughout his life, never breaking from the poor environment and the debilitating effects

on mental health. However, if an adolescent is surrounded by a social environment of high collective efficacy and strong social networks, they may be protected against depression and anxiety, buffered against the consequences of negative life events or poor physical environment.

Adulthood

Adulthood can be measured through chronological, social, or biological age. Chronological age simply measures age by number of years lived. While this is the more conventional approach, it says nothing about the psychological or physical health of the adult. Social age is measured by stages of life and psychological maturity while biological age represents the body's systemic development and deterioration. When thinking about neighborhood effects on adults, it is important to remember that an individual's life does not start at adulthood. Adults have accumulated exposures throughout life that shape their experience and mental health up to adulthood and although physical and social environments of the neighborhood may be similar to that experienced during childhood or adolescence, the accumulation of exposures combined with the stage of psychological or physical development could produce effects that vary in magnitude.

As most neurological development has completed by adulthood, the features of the physical environment that most affect adult mental health are those that affect pathologies responsive in the short term to changes in the environment, principally behavioral disorders. Neighborhood quality includes household disrepair, litter on the streets and buildings in deteriorating conditions. Like adolescents, adults living in neighborhoods with poor quality have been found to be at higher risk of depression and substance abuse (Burdette et al., 2011). Because most studies are cross-sectional with little information on lifetime exposure, these findings could be due to exposure during adolescence that affects psychological development or, alternatively, could be the result of accumulation of exposure to poor neighborhood quality throughout adolescence and adulthood. Noise pollution from air and road traffic also affects adult mental health (Al-Mutairi, Al-Attar, & Al-Rukaibi, 2011; Stansfeld et al., 2009; Szalma & Hancock, 2011). Studies have found that adults exposed to higher noise levels, such as low-intensity aircraft noise, experience cognitive impairment and reduced work performance as well as increased stress response measured by fluctuations in heart rate (Szalma & Hancock, 2011). In addition, increases in noise levels for short durations were found to be stress-inducing and disruptive to job

performance (Szalma & Hancock, 2011). Higher levels of noise pollution follow lower neighborhood SES as those neighborhoods situated directly adjacent to bus depots or airports are generally lower SES.

Greater amounts of green space have been found to be associated with fewer stressful life events (Groenewegen, van den Berg, De Vries, & Verheij, 2006; Guite, Clark, & Ackrill, 2006; Lee & Maheswaran, 2011; van den Berg, Maas, Verheij, & Groenewegen, 2010; Woo, Tang, Suen, Leung, & Wong, 2009). Green space includes parks, trees, and grass that are accessible to the neighborhood. Not only does green space provide an environment for stress-reducing activities such as exercise, simply the presence of green space on the neighborhood level acts to reduce the effects of stress-inducing events (van den Berg et al., 2010). Unfortunately, in many urban areas across the world the amount of green space is not only inversely related to neighborhood SES but also decreases per capita as population density increases (Fuller & Gaston, 2009).

Many of the same features of the social environment that are important for adolescent mental health are also central to adult mental health, although the effects of these features manifest very differently in adults and adolescents. Adults, for example, may not be as malleable to the influence of social networks about factors such as the initiation of substance use as are adolescents. They do, however, experience the pressure and influence from neighborhood social norms. Within social networks behaviors such as physical activity have been found to be contagious across individuals (Rosenquist, 2011), and studies show that neighborhoods with prohibitive smoking social norms have higher rates of smoking cessation among adults (Karasek et al., 2012). The level of social cohesion and collective efficacy, described above, are also important for adult mental health as lower levels of each are associated with greater risk of depression (Chou, 2012). Again, depression and other mental disorders could have onset during earlier life stages or could have been due to an accumulation of exposure beginning in earlier life stages. Social networks are the social structures of ever-changing groups that provide ties and connections between individuals (Achat et al., 1998; Brugha et al., 2005; Crooks, Lubben, Petitti, Little, & Chiu, 2008; Das-Munshi et al., 2010). Participation in a strong and dynamic social network can improve access to support and resources that are critical for maintaining mental health throughout life. Additionally, adults experiencing stress or trauma in life can turn to their social network for emotional or other informational support such as available resources (Brugha et al., 2005; Das-Munshi et al., 2010; Wandersman & Nation, 1998; Yip et al., 2007). The perception of control

and the ability of the individual to act on and fulfill goals goes a long way to reducing mental disorders like depression (Ozer, Fernald, Weber, Flynn, & Vanderweele, 2011; Rosenbaum, White, & Gervino, 2012).

Older Age

As with adulthood, "older" age "elderly" can be defined chronologically, measured in years; socially, such as age at retirement; or biologically, such as the age at which a person becomes frail. As the lifespan increases and a greater proportion of our population is reaching older age, understanding how neighborhood environments affect the mental health of older individuals is becoming increasingly more important. Studies have shown that certain features of the built environment increase the risk of developing depression and other mental health disorders among aging populations (Mamplekou et al., 2010; Saarloos, Kim, & Timmermans, 2009). Supporting the mental and physical health of our aging population will reduce the financial and physical burden currently placed on families and society as a whole.

For older adults, the built environment has a dramatic affect on mental health as it promotes or constrains physical activity and social experiences (Brown et al., 2009). Neighborhood and building design can affect interaction between older adults and the community, influencing their perception of social cohesion and social support. While the independence that is possible in urban areas keeps many older adults mentally and physically fit, there are several features of the urban built environment that restrict older adults from leaving their apartments (Cunningham & Michael, 2004). Older apartment buildings may not provide elevator access, leaving adults with physical impairments without a way to get out of their building. Neighborhoods with poor quality or no sidewalks and long distances to retail shops like grocery stores also do not allow for easy walkability for older adults. Often these adults find themselves stuck in their apartments for weeks with little to no social interaction. However, buildings that have visual access to the community or porches on which older adults can sit promote an "eyes-on-the-street" environment for older adults. It has been shown that this serves as a buffer against psychological stress among older adults (Brown et al., 2009).

The frequency of social interactions for older adults is important to maintain positive mental health and cognition (Winningham & Pike, 2007; Saarloos et al., 2009). Low levels of social interaction for older adults often contribute to development of depression and neurological disorders like dementia and Alzheimer's disease (Crooks et al., 2008; Pillai & Verghese,

2009; Ybarra et al., 2008). Older adults living in neighborhoods with high levels of social cohesion and collective efficacy are more likely to maintain interactions with neighbors as the neighborhood experiences greater interaction overall. Moreover, high neighborhood collective efficacy also supports the initiation of programs that support residents including the older adults. For example, community adult day care services have started in urban areas across the world, leading to improved social interactions for older adults living in cities (Melis et al., 2008; Shannon & Van Reenen, 1998).

Mechanisms

An emerging body of research is beginning to identify and unravel the mechanisms that may explain the link between neighborhood effects and mental health. Strong evidence suggests several developmental, biological, and genetic pathways linking environmental exposures with mental health outcomes. These pathways involve processes throughout the life cycle from neurogenesis during fetal development to modification of gene expression in adulthood. Here we touch on just a few of the biological and genetic mechanisms implicated in the development of mental health disorders that may be influenced by features of the urban neighborhood environment.

Exposure to toxic fetal environments during early development can affect the development of vital organs in the body and in particular can affect the development of the brain and neurological systems in general. During specific points of gestation, neurons are generated in a process known as *neurogenesis* (Das & Basu, 2011). Early stages of fetal development, particularly throughout neurogenesis, are highly sensitive to the maternal environment. Viral infection of the mother has been shown to have a number of effects on the central nervous system development with the specific effects dependent on the type of virus (Das & Basu, 2011). Long-term mental disorders associated with such infection include behavior problems, learning deficits, brain defects, depression, bipolar disorder, and schizophrenia.

A growing body of research indicates a bidirectional relationship between the brain and the *immune system* (Capuron & Miller, 2011; Kapadia & Sakic, 2011; Schiepers et al., 2005). Immune system responses to pathogen invasion, such as air pollution (Campbell, 2004; Lucchini, Dorman, Elder, & Veronesi, 2011), tissue injury, or psychological stress (Uddin et al., 2010) activate proinflammatory proteins that communicate with the brain, initiating cellular responses to the challenges along with behavioral changes

necessary for recovery. Chronic exposure to inflammation can lead to long-term behavioral and cognitive changes (Calderon-Garciduenas et al., 2008; Campbell, 2004; Kapadia & Sakic, 2011). Indeed, the literature is rich with examples of behavioral changes and depression among those with chronic illness such as cardiovascular disease (Gothe et al., 2012; Silverman & Sternberg, 2012).

In a process known as gene expression, genes provide instructions to maintain and regulate the body's systems, creating proteins by reading the DNA sequence of genes. *Epigenetic changes* are changes in gene expression caused by factors other than DNA sequence that occur from the prenatal period throughout life. Epigenetic changes can effectively alter physiological and psychological processes throughout the life course. Recent studies have started to examine the effect of the social and physical environment on gene expression and the resulting effects on mental health (Allardyce & Boydell, 2006; Toyokawa, Uddin, Koenen, & Galea, 2012; Uddin et al., 2010; Williamson, Sholar, Mistry, Smith, & Bilbo, 2011). Studies of patients with schizophrenia whose mothers were exposed to famine during pregnancy found changes in the expression of genes associated with development of the disease, suggesting that a lack of certain nutrients during gestation affects neurological development through epigenetic changes (Heijmans et al., 2008). Additional epigenetic studies have examined the correlation between potentially traumatic events, such as assaultive violence, and changes in gene expression among those with and without posttraumatic stress disorder (PTSD) (Uddin et al., 2010). Findings show that those with PTSD had significantly more genes with strong correlations between epigenetic changes and the number of potentially traumatic events, suggesting the importance of epigenetic changes in the role of environmental effects on mental health.

Increasingly it is recognized that no one biologic or environmental process acts in isolation. Genes and environments *jointly* influence the development of mental health. Studies of the serotonin transport gene, for example, have found that when combined with early-life stressors or adversity certain gene types are associated with higher risk of depression, PTSD, and substance abuse (Heim & Binder, 2012; Xie, Kranzler, Farrer, & Gelernter, 2012). Moreover, in several adoption studies an adverse adoptive home was found to be a risk for mental disorders like schizophrenia and antisocial behavior among those with a genetic predisposition to the disorder as measured by diagnosis of the biological parents (Tsuang, Bar, Stone, & Faraone, 2004).

Case Study

As seen above, neighborhood effects on mental health are complex and integrated not just at one point in life but throughout the life course. We have here presented these effects by discussing each major life stage separately and exploring some aspects of the physical and social environment that affect mental health. However, individual life stages are not lived in isolation of the others. Exposures and outcomes in each preceding life stage affect mental health of all stages that follow and occur within a constantly changing environment. Figure 2.1 illustrates how neighborhoods can change over time, altering the environment and exposures for the residents. To help understand how the individual and the changing neighborhood environment function together to affect mental health throughout the life course we

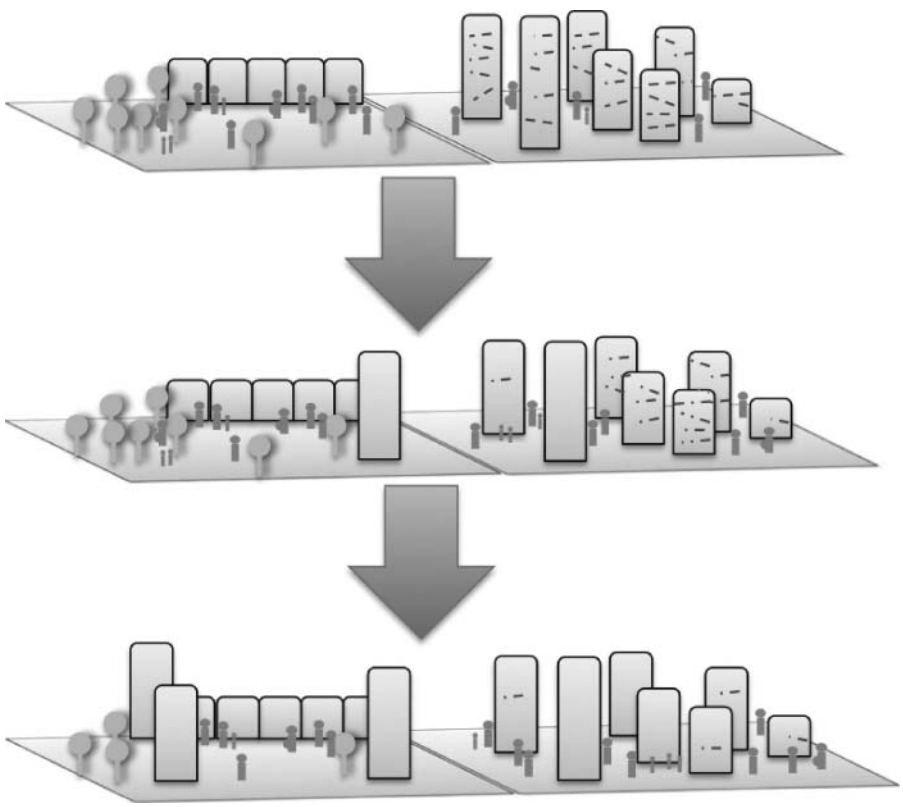

Figure 2.1. Progression of Neighborhood Social and Physical Environments over Time.

present two hypothetical case studies of young men who grew up in drastically different neighborhoods in the same urban area.

Steve was born in a low-income urban neighborhood. During pregnancy, his mother received notice that her apartment building had layers of leaded paint, but she could not afford to move. She had no grocery store within walking distance and could not get fresh fruits or vegetables regularly. Throughout his childhood, Steve lived in this same building, which had layers of dirt and a heating system that broke frequently. Sidewalks in the neighborhood were broken and litter covered the streets. Exhaust and loud noises from the local bus depot polluted the air and Steve could not run outside without coughing. His school, also an older building, had peeling paint on the walls and overcrowded classrooms. During classes Steve was distracted by airplanes that flew overhead. He had trouble in school and frequent outbursts often landed him with a suspension. Because of violence in the neighborhood, Steve's mother, like most residents, did not allow him to play outdoors often. Most people did not talk to each other and his mother did not know any neighbors. As Steve grew, school did not become any easier and his mother did not know where to turn and could not find anyone to help understand why Steve has such difficulty learning and controlling his behavior. Over the years, Steve became more frustrated and anxious about his future prospects. There was nowhere for him and his friends to play and he began to join other teen boys in vandalizing abandoned buildings for entertainment. He saw other teens and many of the neighborhood residents smoking and began to smoke and later drink. As he reached the end of adolescence, Steve dropped out of high school and already had several arrests. He had no friends to help him and no opportunities for changing his situation. He began to feel an overwhelming weight fall over him and drank heavily each day. Through adulthood, he became more and more of a recluse. As an older man, a bad hip prevented him from walking down the three flights of stairs regularly and he relied on a supply of canned and preserved food. Often weeks passed in which he did not talk to another person. He became more anxious and paranoid and developed dementia over time.

In another neighborhood of the same city, Joseph's mother was pregnant. She began taking supplements and eating only organic food purchased from the local green markets as soon as she found out she was pregnant. She avoided using any insecticides and was assured by her landlord that her recently renovated building was lead free. Joseph grew up in a middle-income neighborhood with three parks and playgrounds within walking distance of his house. He and his mother walked frequently down the tree-lined and

cleaned streets to play dates with other families. The neighborhood was friendly: people greeted each other on the street and frequently exchanged information on schools, services, and other neighborhood activities. Community planting programs were an annual occurrence in the neighborhood and landlords maintained the buildings with freshly painted gates. Neighborhood and condominium associations ensured that all buildings and outdoor spaces were properly maintained. The neighborhood was, overall, very quiet as it is separated from major traffic areas and public transportation. Joseph's school was a bright and active place. Classrooms were kept at a manageable size and parent and neighborhood involvement as well as high-quality teachers kept the school up to date on all technology. Joseph excelled in several areas of school and for those in which he struggled another parent recommended a tutor to his mother. Joseph had high hopes of attending a state college and pursued extracurricular activities that would bolster his resume. During his teen years, besides his school work and activities, Joseph spent time with his friends in the neighborhood, where there was always at least one neighbor keeping watch. While it was rare to see someone smoking or drinking, many people could be seen frequently running, carrying groceries, or walking with their children. After college Joseph returned to his neighborhood a happy and healthy man. Thus far, he was able to accomplish every goal he had set if he worked hard enough. Upon his return, a family friend called a connection to help Joseph find a good paying job in his field. Throughout adulthood, like most of his friends and neighbors, Joseph pushed himself to stay mentally and physically fit, taking advantage of the local parks and recreational activities offered by the neighborhood. When he faced stressful periods, during extreme heat waves for example, he found help from friends and neighborhood groups. As Joseph reached older age he was happy that he lived in a building with few stairs. He received help carrying groceries and was generally able to live independently. He enjoyed spending afternoons on his stoop watching teenagers and children play.

These case studies are meant to illustrate the extent of the variation in contexts that individuals face throughout the life course and their potential impact on health. Steve was at risk for severe cognitive delays and behavioral problems due to lead exposure as well as stress and behavioral problems due to noise in the school environment and the neighborhood violence. The social disorganization and low levels of neighborhood social cohesion and collective efficacy influenced his delinquent behavior in adolescence. As he reached his teen years Steve was sensitive to the social norms and this combined with possible depression could have led him to smoking and

alcohol use and abuse. Steve was also at risk of developing schizophrenia in adulthood because of his mother's poor nutritional intake during pregnancy. Because he remained in the same neighborhood during his adult years Steve experienced chronic stress and depression and did not have any environmental buffer like green spaces to reduce the effects of his neighborhood environment or any additional life stressors he experienced. Conversely, Joseph's neighborhood was a source of positive physical and social environments that provided stress reducing and health promoting activities. His mental health was supported from conception as his mother had access to all the nutrients necessary for development. His social and educational goals were encouraged with the help of strong social cohesion and an active social network. The neighborhood kept him out of trouble and active through his teen years and the social norms of the neighborhood contributed to his staying away from risky behaviors like substance use. Through his adulthood and older age Joseph found a community with a built and social environment that allowed him to maintain a sharp mind and an independent lifestyle.

Implications for Future Research and Prevention Efforts

The case studies paint a picture of how neighborhood physical and social environments shape mental health over the life course. During the prenatal period and early life, development of psychological and neurological systems is still active. Adverse physical and social environments directly affect these processes leading to mental disorders emerging in childhood and later in adulthood. Exposures to poor social environments and social norms like smoking can act via developmental pathways to lead to the initiation of tobacco smoking and other substance abuse. As individuals age, development slows but the neighborhood environment continues to affect mental health through genetic and psychological processes, leading to chronic stress, anxiety, and depression. Multidisciplinary studies pulling from biology, genetics, sociology, and psychiatry are beginning to emerge, helping to paint a more in-depth picture of how physical and social environments interact with individual differences to affect mental health. Indeed, an emphasis on understanding the protective factors of neighborhoods and individual resilience to poor neighborhood environments has pushed research to embrace more of a multidisciplinary approach. Yet the full scope of these processes remains unclear. Although strong evidence supports an association between the neighborhood social environment and

mental disorders, effects of the social environment, especially on biological or genetic mechanisms, are still relatively understudied. Until the field fully supports research of both the physical and the social environments the aim to understand fully and—moreover—prevent the negative effects of neighborhood environments on mental health will go unmet.

While the science has gone far to discuss the complex etiology of mental disorders, most existing studies remain cross-sectional in nature and are therefore limited in their view and ability to assess prenatal and early-life exposure or the accumulation of exposure over time. Longitudinal research will allow researchers to explore neighborhood mental health associations using a life-course approach. In schizophrenia studies from the Netherlands, historic and current medical records were used to establish the level of nutritional intake of mothers during pregnancy and to assess the mental health outcomes of offspring later in life (Stein, Susser, Saenger, & Morolla, 1975). This study was possible because medical records from the Dutch national health care system were available for the entire population and were diligently maintained. While many studies have successfully used these data to assess life-course effects on health (Painter et al., 2005; Roseboom et al., 2011; Stein et al., 1975; Susser, Hoek, & Brown, 1998) they are still limited to the population and context studied. Although biological mechanisms are not likely to differ drastically between groups, context-specific pathways dependent on the physical and social features of the neighborhood often lead to varying mental health outcomes. Future research should focus on longitudinal data collection of exposures at multiple levels, particularly embracing the neighborhood and individual differences and aiming to flush out physical and social pathways. These designs are fundamental in gene studies as parental and offspring baseline gene type and expression can both be measured at birth or in early childhood and can be followed over time with environmental exposures to assess epigenetic changes or gene–environment interactions.

Keeping in mind the urban structural barriers that prevent positive neighborhood environments is also crucial to unraveling the full extent of these effects. These barriers, which include a poor education system, minimal involvement from local governments, inequality in local funding to address crime and pollutants, and reduced access to health care, have led to neighborhoods with high levels of air pollutants, toxins, delinquent behavior, neighborhood disorder, and substance abuse and lower levels of collective efficacy, green space, and social networks. Study after study shows that poor physical and social environments are concentrated in neighborhoods with the

lowest SES and that adverse conditions and the subsequent mental disorders are not equitably distributed across urban areas (Evans, 2003; Galea et al., 2005, 2007; Gary-Webb et al., 2011; Karriker-Jaffe et al., 2011). Those born and living in these neighborhoods are at higher risk of mental health disorders, creating a large subset of the population with higher rates of preventable mental disorders and little-to-no available treatment. As the cost of mental illness increases worldwide and in the United States (Bloom et al., 2011; World Health Organization, 2011, 2012) these populations and the resource inequalities that, at root, give rise to the poor neighborhood conditions cannot be ignored. Future research and interventions that fully address the comprehensive set of features of the neighborhood environment that influence mental health can provide insight leading to efforts that optimize the mental health of populations over the life course.

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3

The Impact of the Local Social and Physical Local Environment on Wellbeing

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Introduction

In the United Kingdom mental health problems constitute 23% of the total burden of disease (a composite measure of premature mortality and reduced quality of life), costing 11% of all spending of the National Health Service (NHS) secondary health-care budget (Department of Health, 2011). This figure does not include costs to primary care or increased costs elsewhere caused by poor mental health exacerbating other health problems (Naylor et al., 2012). There are also the wider costs to employment and workplace productivity as well as the informal care provided by family members and others (McCrone, Dhanasiri, Patel, Knapp, & Lawton-Smith, 2008).

The prevalence and experience of poor mental health is not distributed evenly across populations. Associations between higher frequencies of common mental disorders (depression and anxiety) and material disadvantage have been found in a number of European studies (Fryers, Melzer, Jenkins, & Brugha, 2005). In Scotland, poorer mental health is higher among women and those individuals living in deprived areas (Scottish Executive, 2011). A number of studies have shown that area of residence is associated with mental health even after taking individual characteristics such as gender, age, income, and social class into account (Kim, 2008). There is growing interest

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in which features of the local residential neighborhood are important for mental health; either directly, for example via the positive benefits accrued by living in a pleasant safe environment; or indirectly, for example by living in a neighborhood that is conducive to walking, which may promote increased levels of walking (Berrigan, Pickle, & Dill, 2010) and in turn promote good mental health (Camacho, Roberts, Lazarus, Kaplan, & Cohen, 1991), or which might operate through increased social contact which is consequently important for good mental health (House, Landis, & Umberson, 1988).

A growing number of studies have shown that the ways in which individuals perceive their local neighborhood can influence their health (Parkes & Kearns, 2006; Weden, Carpiano, & Robert, 2008) and health behaviors such as smoking (Ellaway & Macintyre, 2009; Miles, 2006; Shareck & Ellaway, 2011). With regard to mental health in particular, there is increasing evidence that how one perceives elements of the local environment in terms of aspects such as housing and neighborhood quality are important for mental health (Ellaway & Macintyre, 2001, 2004; Ellaway, Macintyre, & Kearns, 2001; Sooman & Macintyre, 1995). Some studies have explored objectively measured features of the local environment such as access to green space and found they may be important in the promotion of good mental health; Barton and Pretty (2010), for example, found that physical activity undertaken in green spaces improved self esteem and mood.

In this chapter, the effects on residents' wellbeing of different features of the local social and physical environment are explored in relation to subjective perceptions by residents—with their response to a range of questions on their local area—and, using a range of routinely available data, objectively measured aspects of the local neighborhood such as street connectivity, proximity to green space and vacant and derelict land. As there is growing evidence that environmental effects may be gendered (Ellaway & Macintyre, 2001; Stafford, Cummins, Macintyre, Ellaway, & Marmot, 2005), the extent to which different groups vary, for example women compared to men, are also examined.

Study Design and Methods

Study Population

The Health and Well-Being Survey (Jones et al., 2003), conducted in 2002 by the Greater Glasgow Health Board (GGHB), was used to examine associations between wellbeing and the local social and physical environment.

The Health and Well-Being Survey sample was stratified proportionately by the local authority and area deprivation category, with addresses selected randomly. Over two thirds (67%) of individuals contacted took part in the study which lead to 1802 face-to-face interviews with adults in the GGHB in 2002. Data were gathered on individuals' sociodemographic characteristics, health and health behaviors. Data were weighted to ensure that they were representative of the adult population in this area (Jones et al., 2003). Here we use only Glasgow City respondents ($N = 1{,}149$). Socioeconomic position was represented by an occupationally based Socio-Economic Group classification, which had been grouped into three categories (A/B/C1, C2, D/E). Street maps (including point addresses) from the U.K. Ordnance Survey (Ordnance Survey, 2006) were obtained, and ArcGIS version 9.1 software used to geocode respondents by their unit postcodes (the smallest postal geography in the United Kingdom). Respondents were also matched to datazones; these are formed from groups of output areas for the 2001 Census, and are the key small-area statistical geography in Scotland (Scottish Executive, 2004). They are nested within local government boundaries, and where possible they were defined in such a way as to respect physical boundaries and natural communities and contain households with similar social characteristics.

Objective Measures of Physical Environment

Street connectivity.

The indicator of street connectivity was developed using two georeferenced datasets (datazone boundaries and Ordnance Survey Mastermap Network Layer), which have been linked and overlapped applying global information system (GIS) functionalities (ArcGIS 9.0). Following Leslie et al. (2007), the index developed for each datazone consisted of seven different network connectivity measures: direction density, intersection density (for three or more directions of travel), cul-de-sac density, street density, length density, Beta index, and Eta index. At each intersection, directions are defined as possible choices of available routes. Direction density is the total number of directions available at each intersection divided by the area of the datazone. Intersection density for three or more directions of travel was calculated by dividing the total number of intersections with three or more directions of travel by the area of the datazone. Only intersections with three or more directions of travel were taken into account to eliminate cul-de-sacs and intersections with two directions of travel, since they imply no choice of

direction. Street density is the number of streets, defined as a unique link between two intersections, divided by the area of the datazone. Length density is the total length of streets within each datazone divided by the area of the datazone. Cul-de-sac density is the total number of cul-de-sacs divided by the area of the datazone. Beta index is the ratio between the streets (links) and intersections (nodes); the Eta index is the average length per street (link). Intersection density, direction density, street density, length density, and Beta index are directly related to network connectivity. An increase in one or more of these measures leads to a corresponding increase in the connectivity index. Cul-de-sac density and Eta index are inversely related to street connectivity since they imply fewer choices of direction and longer distances between intersections. These seven measures were calculated for each datazone and then ranked into deciles. A value of 1 was assigned to datazones within the lowest decile of walkability and a value of 10 assigned to those within the highest decile, except for cul-de-sac density and Eta index for which the opposite applied. The connectivity index was calculated as the sum of these seven scores, assuming values of between 7 and 70. The street connectivity measure was divided into quartiles for analysis.

Proximity to green space.

A number of studies have shown that proximity to green space is associated with better mental health (Hartig, 2008; Hartig, Book, Garvill, Olsson, & Garling, 1996). The distance between a respondent's location (using the centroid of their unit postcode) and nearest green space was calculated to ascertain whether or not a respondent resided within half a mile of green space, using straight-line buffers.

Proximity to vacant/derelict land.

Living in a rundown unkempt environment has been shown to be related to wellbeing and improvements to vacant sites in the local neighborhood has been shown to be related to a range of health-related indicators such as reduced stress and levels of vandalism (Branas et al., 2011). Using data provided by Glasgow City Council, the distance between a respondent's location (using the centroid of their unit postcode) and nearest vacant/derelict land was calculated to ascertain whether or not a respondent resided within half a mile of vacant/derelict land, using straight-line buffers.

Subjective Perceptions of Residents

Neighborhood perceptions.
Perceived neighborhood perceptions were measured by two items in the questionnaire. The first of these asked respondents to state about how common a range of problems were in their area using the following options: "very common," "fairly common," "not very common," "not common at all," or "don't know/unsure." "Don't know/unsure" was grouped with "not common at all." The neighborhood problems were burglaries, vandalism/graffiti, assaults/muggings, drug activity, excessive drinking, young people hanging around, and car crime. The second question asked about how common environmental problems were in their area. The problems included rubbish lying about, noise and disturbance, poor street lighting, vacant/derelict land, vacant/derelict buildings, dog feces, abandoned cars, and traffic. Using factor analysis, three domains of perceived incivilities emerged from the 15 items: antisocial/criminal behavior (comprising burglaries, vandalism/graffiti, assaults/muggings, drug activity, excessive drinking, young people hanging around, and car crime), dilapidated (poor street lighting, vacant/derelict land, vacant/derelict buildings, and abandoned cars), and environmental incivilities (rubbish lying around, noise, traffic, and dog feces). For each of these three domains a score was constructed by summing responses to each item comprising the domain. The three scores were each subsequently divided into quartiles with those in the lowest quartile reporting the most positive views and those in the highest quartile reporting the most negative views about their local area.

Health Outcomes

Depression

We used the depression subscale of the Hospital Anxiety and Depression Scale (HADS) (Snaith & Zigmond, 1994). A review of 747 identified studies concluded that "The HADS was found to perform well in assessing severity and 'caseness' of depression in both somatic, and psychiatric cases and [not only in hospital practice for which it was first designed] in primary care patients and the general population" (Bjelland, Dahl, Haug, & Neckelmann, 2002). This scale comprises seven items (e.g., "I feel as if I am slowed down," "I feel cheerful," "I still enjoy the things I used to enjoy"). Each item had been answered by the respondent on a four-point (0–3) response category

so the possible scores ranged from 0 to 21. A score of 0–7 was regarded as being in the normal range, a score of 8–10 being just suggestive of the presence of depression, and a score of 11 or higher indicating probable presence ("caseness") of the mood disorder.

General Mental and Emotional Wellbeing and General Physical Wellbeing

Wellbeing was measured in this survey by presenting respondents with the Faces Scale (Andrews & Withey, 1976) comprising a set of seven faces ranging from a face that is discernibly smiling to one that is evidently unhappy. Respondents were shown a card showing the Faces Scale and asked "Which face best rates your general physical wellbeing?" and "Which face best rates your general mental or emotional wellbeing?" Responses were then scored from 1 ("very happy") to 7 ("very unhappy").

The distribution of the wellbeing measures by individual sociodemographic variables is shown in Table 3.1. Looking firstly at the mean HADS depression score, it can be seen that women have significantly higher scores than men, and that depression increases with age. Higher scores were also observed among people in groups of lower social class and among those living in deprived areas (with the exception of the small group of respondents living in the more affluent area who reported higher scores). Turning now to general mental or emotional wellbeing, there were no significant gender differences in this measure; however, it was associated with age, showing an increase from younger age groups to middle age (40–59 years) and then decreasing, in contrast with the steady increase by age observed in the HADS depression score. Lower mental and emotional wellbeing scores were observed among those in higher social class groups and those living in more deprived areas. Again the pattern was not linear for area deprivation. No significant gender difference was observed for general physical wellbeing. Unsurprisingly, it was patterned by age with older age groups in the main reporting lower levels of general physical wellbeing. Similarly, with social class, lower-social-class groups reported poorer general physical wellbeing, as did those living in deprived areas.

Looking now at perceived neighborhood problems (Table 3.2), perceived environmental problems varied little by gender. However, looking at age, the oldest age group (over 70) reported the lowest level of problems and those in the middle age groups reported the highest overall scores. Interestingly, there was no significant difference by social class, although

Table 3.1. Mean Mental Health and Wellbeing Measures by Sociodemographic Characteristics.

	n	HADS depression, mean	General mental or emotional wellbeing	General physical wellbeing
Gender		*P*<0.001		
Men	435	3.5	2.7	3.0
Women	655	4.0	2.8	3.1
Age (years)		*P*<0.001	*P*<0.001	*P*<0.001
16–19	45	1.4	2.4	2.1
20–29	160	1.9	2.4	2.6
30–39	193	3.3	2.8	2.8
40–49	158	4.1	3.0	3.1
50–59	128	4.8	3.1	3.4
60–69	165	4.2	2.8	3.2
70+	241	5.0	2.8	3.4
Social class group		*P*<0.001	*P*<0.001	*P*<0.001
A/B	97	2.1	2.4	2.7
C1	271	2.8	2.5	2.7
C2	247	4.1	2.8	3.1
D/E	475	4.6	3.0	3.3
Area deprivation		*P*<0.001	*P*<0.006	*P*<0.001
1, More affluent	10	4.0	2.3	2.5
2	39	1.7	2.5	2.8
3	21	3.7	2.6	2.9
4	210	3.0	2.5	2.6
5	83	3.9	2.7	3.0
6	278	4.5	2.8	3.1
7, More deprived	449	4.0	3.0	3.2
All respondents	1090	3.8	2.8	3.0

groups of lower social class did report higher levels. Much larger differences were seen by area of residence with the more positive view of the local environment (at least in terms of the domains of noise, traffic, and dog feces). Perceived antisocial problems varied little by gender although slightly higher scores were observed among men. Again, the older respondents did not have as negative a view as younger ages on this domain. As with environmental problem, there was no significant difference by social class, although lower social class groups were more negative, this did not reach statistical significance. A much steeper difference was seen by area deprivation: while not completely linear, people living in the more deprived

Table 3.2. Mean Perceived Neighborhood Problems by Sociodemographic Characteristics.

	n	Environmental problems	Antisocial	Rundown
Gender				
Men	435	9.4	17.3	7.3
Women	655	9.4	16.8	7.1
Age (years)		*P*<0.001	*P*<0.001	*P*<0.001
16–19	45	9.6	18.0	7.7
20–29	160	9.4	18.0	7.3
30–39	193	10.2	18.4	7.6
40–49	158	9.7	18.3	7.3
50–59	128	10.0	18.5	7.4
60–69	165	9.3	17.0	7.0
70+	241	8.4	13.5	6.4
Social class group				*P*<0.019
A/B	97	9.2	16.2	6.8
C1	271	9.4	16.5	6.8
C2	247	9.4	17.3	7.3
D/E	475	9.5	17.3	7.4
Area deprivation		*P*<0.001	*P*<0.001	*P*<0.001
1, More affluent	10	7.2	12.4	5.1
2	39	7.2	12.1	6.7
3	21	9.1	16.0	6.6
4	210	8.6	15.1	6.0
5	83	9.7	16.5	7.2
6	278	10.0	17.4	7.6
7, More deprived	449	9.6	18.3	7.6
All respondents	1090	9.4	17.0	7.2

areas were much more negative about the level of antisocial behavior in their area. Turning now to perceived dilapidated neighborhoods (poor street lighting, vacant/derelict land, vacant/derelict buildings, and abandoned cars): again, men reported higher levels than women, although it was not a statistically significant difference. The oldest age group was the least negative and the youngest age group scored higher than the other ages on this domain. Social class differences were observed, with lower social classes reporting much higher levels than higher social classes. As with the other perceived problems, those living in the more deprived areas reported the most negative views of this aspect of their neighborhood.

Turning now to Table 3.3, which shows the sociodemographic patterning of the "objective" neighborhood measures: proximity to green space and to

Table 3.3. Proportion Living Within Half a Mile of Green Space and Vacant/Derelict Land.

	n	Green space within 1/2 mile, %	Vacant/derelict land within 1/2 mile, %	Street connectivity, mean
Gender			*P*<0.030	
Men	435	66.9	79.3	16.2
Women	655	69.3	84.0	16.6
Age (years)		*P*<0.034		*P*<0.001
16–19	45	*80.0*	88.9	18.0
20–29	160	68.8	81.3	17.9
30–39	193	72.5	80.3	17.0
40–49	158	74.7	84.8	16.0
50–59	128	68.0	78.9	16.0
60–69	165	62.4	81.2	15.3
70+	241	62.7	83.4	15.9
Social class group			*P*<0.001	*P*<0.001
A/B	97	75.3	66.0	17.2
C1	271	71.2	77.5	17.9
C2	247	65.6	80.2	15.6
D/E	475	66.7	89.1	15.9
Area deprivation		*P*<0.001	P<0.001	P<0.001
1, More affluent	10	10.0	20.0	20.0
2	39	82.1	64.1	18.6
3	21	61.9	19.0	13.2
4	210	78.6	70.5	17.9
5	83	55.4	62.7	16.4
6	278	72.3	85.3	17.0
7, More deprived	449	63.9	95.1	15.3
All respondents	1090	68.3	82.1	16.4

vacant/derelict land, it can be seen that a slightly higher proportion of female respondents were located within half a mile of green space than were male respondents in this study. There was no clear pattern by age, although the older age groups were less likely to reside closer to green space than other age groups. While not statistically significant, a lower proportion of respondents in lower social classes lived within half a mile of green space. Looking now at patterning by area deprivation, a rather mixed picture can be seen, with a small proportion (10%) of those living in the more affluent area located near green space compared to 80% of those in the next most affluent group.

With regard to proximity to vacant/derelict land, there was little difference by age, but a higher proportion of those in lower social classes lived closer to vacant/derelict land compared to higher social classes. Striking differences by area deprivation were observed, with a small proportion (20%) of those in the more affluent area living within half a mile of vacant/derelict land compared to 95% of those in the more deprived area.

Associations between Neighborhood Measures and Wellbeing

The next step was to examine whether there were associations between the mental health and wellbeing measures and the subjective and objective neighborhood measures, after taking into account age, gender, and socioeconomic group (Table 3.4). Looking firstly at HADS depression (adjusted mean scores) it can be seen that significant differences were observed for respondent-assessed antisocial problems, dilapidated area, and perceived environmental incivilities. Those with the most negative views of the neighborhood on these domains had the highest HADS depression scores in the main. However, it was a complex pattern as those with the less negative scores also had high HADS scores for perceived antisocial problems and perceived environmental problems. Turning to general mental or emotional wellbeing, it was only the perceived antisocial problems that were significantly associated with general mental or emotional wellbeing: those with the most negative view of antisocial problems in their area had poorer health. With regard to general physical wellbeing, both antisocial problems and a dilapidated neighborhood were associated with poorer physical wellbeing.

Looking now at the objective neighborhood measures, whereas higher HADS depression scores were observed among those who lived further from green space or who were closer to vacant/derelict land and lived in areas with lower street connectivity, no significant statistical associations were seen for this health measure. Similarly with general mental or emotional wellbeing, those residing in areas with higher street connectivity and further from vacant/derelict land had a more positive view of their own health, but again it was not statistically significant. Stronger relationships were seen for the general physical wellbeing health measures, with those living in areas with high street connectivity having better health, but, paradoxically, those living nearer to green space reported poorer physical health.

Table 3.4. Associations between Neighborhood Measures and Health Outcomes; Mean Scores Adjusted for Age, Gender, and Socioeconomic Group.

	HADS depression score	General mental or emotional wellbeing	General physical wellbeing
GIS measures			
Within 1/2 mile green space			*P*<0.026
Yes	2.8	2.6	2.8
No	2.9	2.5	2.6
Within 1/2 mile vacant/derelict land			
Yes	2.8	2.6	2.8
No	2.9	2.4	2.6
Street connectivity			*P*<0.035
1 Lower	3.0	2.6	2.8
2	2.6	2.6	2.9
3	3.0	2.6	2.8
4 Higher	2.8	2.4	2.6
Respondent assessed			
Antisocial	*P*<0.001	*P*<0.006	*P*<0.004
1 Lower	3.2	2.5	2.6
2	2.3	2.4	2.6
3	2.5	2.5	2.7
4 Higher	3.4	2.8	3.0
Dilapidated	*P*<0.001		*P*<0.013
1 Lower	2.9	2.4	2.6
2	3.0	2.5	2.6
3	1.7	2.6	2.7
4 Higher	4.1	2.7	3.0
Environmental incivilities	*P*<0.001		
1 Lower	3.2	2.5	2.7
2	2.2	2.5	2.7
3	2.2	2.6	2.8
4 Higher	3.2	2.6	2.8

When these associations were examined separately for women (Table 3.5) and men (Table 3.6), stronger associations were observed for women. For example, among women, better general physical wellbeing was significantly associated with living *further* from green space, whereas higher street connectivity was associated with better general physical wellbeing. Perceived antisocial neighborhood problems were associated with general physical wellbeing among men whereas it was associated with general mental or

Table 3.5. Associations between Neighborhood Measures and Health Outcomes; Mean Scores Adjusted for Age and Socioeconomic Group (Women Only).

	HADS depression score	General mental or emotional wellbeing	General physical wellbeing
GIS measures			
Within 1/2 mile green space			$P<0.003$
Yes	3.7	2.8	3.0
No	3.5	2.7	2.7
Within 1/2 mile vacant/derelict land			
Yes	3.5	2.8	3.0
No	3.8	2.7	2.8
Street connectivity			$P<0.005$
1 Lower	3.9	2.8	3.0
2	3.3	2.9	3.0
3	3.7	3.0	3.1
4 Higher	3.4	2.6	2.6
Respondent assessed			
Antisocial	$P<0.019$	$P<0.008$	
1 Lower	4.0	2.7	2.9
2	3.0	2.5	2.7
3	3.2	2.8	3.0
4 Higher	4.1	3.1	3.1
Dilapidated	$P<0.001$		
1 Lower	3.8	2.7	3.0
2	4.0	2.8	2.9
3	2.4	2.8	2.9
4 Higher	5.0	3.0	3.1
Environmental incivilities	$P<0.006$		
1 Lower	4.1	2.8	3.0
2	2.8	2.6	2.7
3	3.2	2.9	3.0
4 Higher	4.0	2.8	2.9

emotional wellbeing among women. Among women, HADS depression scores were higher for those with a more negative view of antisocial problems and living in a dilapidated neighborhood. For both men and women, perceived environmental problems were associated with HADS depression scores but not necessarily among those with the most negative views of this aspect of their local neighborhood.

Table 3.6. Associations between Neighborhood Measures and Health Outcomes; Mean Scores Adjusted for Age and Socioeconomic Group (Men Only).

	HADS depression score	General mental or emotional wellbeing	General physical wellbeing
GIS measures			
Within 1/2 mile green space			
Yes	2.8	2.4	2.7
No	2.6	2.4	2.7
Within 1/2 mile vacant/derelict land			
Yes	2.8	2.5	2.8
No	2.7	2.2	2.5
Street connectivity			
1 Lower	2.6	2.6	2.7
2	2.5	2.5	2.9
3	2.8	2.3	2.5
4 Higher	2.9	2.3	2.7
Respondent assessed			
Antisocial			$P<0.032$
1 Lower	3.1	2.4	2.5
2	2.2	2.4	2.7
3	2.5	2.3	2.6
4 Higher	3.4	2.7	*3.1*
Dilapidated	$P<0.001$		$P<0.004$
1 Lower	2.8	2.2	2.4
2	2.7	2.4	2.5
3	1.7	2.5	2.6
4 Higher	3.8	2.6	3.2
Environmental incivilities	$P<0.008$		
1 Lower	3.2	2.4	2.5
2	2.5	2.5	2.9
3	1.8	2.4	2.7
4 Higher	3.2	2.5	2.8

Discussion

The results of this study show that a number of aspects of the local environment are associated with health and wellbeing, after taking individual characteristics into account such as age, gender, and social class. Fewer objectively measured features such as proximity to green space or vacant/derelict land were associated with respondents' wellbeing compared to their own

perceptions of their neighborhood such as problems with antisocial behavior or the dilapidated nature of their local area. A more mixed picture was seen for perceived environmental incivilities with little variation observed between social classes, although a much more differentiated picture was seen by area deprivation with residents of more deprived areas reporting a more negative view of their aspect of their local neighborhood. When this was explored in relation to health and wellbeing measures, however, there was little difference in health and wellbeing between those who had a more positive view and those who had the most negative view. Perceptions of some environmental problems may be less important for health and wellbeing than others; for example, in a Scotland-wide study, "infrastructural problems" such as the presence of phone masts in the area were not related to health whereas perceived "street-level incivilities" such as litter and graffiti and "absence of environmental goods" such as safe play areas for children were both strongly related to health (Ellaway et al., 2009).

Gender differences in experiences of neighborhood and associations with health and wellbeing were observed in this study, often in a complex way, with some aspects of the local environment such as proximity to green space being associated with poorer health. Although a number of studies have found green space to be related to a range of health outcomes (Maas et al., 2009), other studies have found that use of green space is not necessarily a positive experience for some groups (Milligan & Bingley, 2007), or that a park and other green space may be located nearby but the residents may feel it is "not for them" and hence do not use it (Seaman, Jones, & Ellaway, 2010).

Although this study has shown the existence of cross-sectional associations between wellbeing and respondents' perceptions of the local environment, this does not necessarily prove that the latter causes the former. In particular, it is possible that those with low self-reported health and who feel that their environment is poor may simply be reflecting a general underlying pessimism; that is, they feel negative about all aspects of their lives (Stansfeld, Davey Smith, & Marmot, 1993). This is often referred to as same-source bias, which is an important limitation for studies using subjectively measured constructs (Weden et al., 2008). However, as shown in a previous study (Ellaway & Macintyre, 1998), subjectively assessed neighborhood stressors and several physical health outcomes remain independently associated, controlling for mental health outcomes, suggesting that, although it is important to be mindful of such issues, associations between self-reported neighborhood conditions and self-reported wellbeing may be quite robust.

It is also possible that people in poor health end up in rundown neighborhood areas; that individuals are "sorted" into neighborhoods on the basis of their education, income, and social class. Cross-sectional studies therefore are unable to rule out self-selection, the possibility that people will be selected or select themselves into residential areas on the basis of their health or individual characteristics which are themselves related to health (Plantinga & Bernell, 2007). However, among the few longitudinal studies that have examined this issue, living in a poor neighborhood has been shown to be associated with poorer health over time. For example, using multilevel growth curve models, a 40% probability of reporting poor health was predicted among residents of more deprived areas at an earlier age (66 years) compared to those living in more affluent areas (83 years). Wider area differences were seen for men than for women (Ellaway, Benzeval, Green, Leyland, & Macintyre, 2012).

In conclusion, how people perceive and experience their residential neighborhood is related to their health and wellbeing, with aspects such as antisocial behavior of other residents and rundown unkempt surroundings being particularly important for mental wellbeing. These are features which are amenable to change and suggest that investing in improving the local area through tackling antisocial behavior and neighborhood management may bring about improvements in health.

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4

Density and Mental Wellbeing

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Introduction

In late winter, one of the authors was walking down a prominent street in Manchester city center. It was around 5:30 P.M., just about the time that offices were closing for the day and people were heading out for other destinations, like home. According to the U.K. Office for National Statistics, Manchester, England, is a dense city, with almost 34 persons per hectare (the average population density in England is 3.77 persons per hectare; Office for National Statistics, 2004). However, on that late winter day in the afternoon, the prominent street was dead. There were five other people walking in front of the author and no one else behind. The street was pedestrianized, which accounted for the reason why no vehicles joined the pedestrians, but a cross street allowed vehicles. This, too, was dead. A few cars drove past, but the overall feeling was of eerie quiet. How could this be a dense city?

About 3 weeks later, the same author was walking down another prominent street in Manchester city center, this time coming from the main train station. It was around 6:30, and, like before, offices were closing for the day and people were heading home and to other places. Rather than it being dead, the street was teeming with people going to and from the train station as well as up and down various side streets. Private vehicles, taxis, and buses were gridlocked in traffic. Exhaust fumes could be seen and smelled. Various languages were overheard. Footsteps plodded, danced, and galloped to and fro. *This* was a dense street in a dense city.

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Given the above two experiences, how could the same, dense city on two different days feel poles apart in terms of density? And how do our perceptions of, and experiences with, density and crowding impact our mental illbeing/wellbeing as we navigate through our urban environments? This chapter attempts to find answers to these questions. The first section defines terms to be used throughout the chapter, such as mental wellbeing, illbeing, crowding, and density. The second section provides information to answer the first question by exploring the concept of intensity and how it informs our feelings and perceptions of the density in a city. The third section provides empirical evidence for a relationship between density and mental illbeing/wellbeing, illustrating that density and crowding can indeed impact our mental illbeing/wellbeing in various ways. The chapter concludes with some thoughts on what built-environment professionals can do to improve how cities are planned and designed in terms of an appropriate balance between density and wellbeing.

Definitions

The authors decided to focus on *mental wellbeing*, as opposed to physical or overall wellbeing, because not enough is known about the relationship between the urban environment and individuals' levels of stress, anxiety, depression, and so forth. In addition, the world is changing: populations are getting older (particularly in more developed countries), people are working different in ways (e.g., more part-time shift work), public services are responding to increasing consumer demands for greater choice and "co-production," societies are becoming more diverse, expectations around lifestyle are evolving, new science and technologies are being introduced at a rapid rate (Government Office for Science, 2008), and more and more people are living in cities than ever before (United Nations Population Fund, 2007). These drivers of change are creating substantial challenges for countries, cities, neighborhoods, and households, and understanding individual and collective mental wellbeing will be critical for addressing them (Government Office for Science, 2008). Thus, for the purposes of this chapter, *mental wellbeing* may be defined as:

> [A] dynamic state in which the individual is able to develop their potential, work productively and creatively, build strong and positive relationships with others, and contribute to their community. It is enhanced when an individual

> is able to fulfil their personal and social goals and achieve a sense of purpose in society.
>
> Government Office for Science (2008), p. 10

Thus, mental wellbeing is concerned with people's lived experiences, rather than the objective facts about their lives. Even if someone's objective circumstances are dire (e.g., living in a neighborhood that scores high on the English Indices of Multiple Deprivation (Communities and Local Government, 2011), he or she may still have a sense of wellbeing, which may be associated with positive functioning. Likewise, someone living in favorable conditions may have a poor sense of wellbeing, feeling empty or stagnant. Such feelings may lead to poorer functioning and health and a lower life expectancy (Government Office for Science, 2008).

Illbeing, on the other hand, refers to a state of worry, negative affect, and somatic complaints that arise from a low sense of personal competence, a lack of control and planning over one's life, and poor socioeconomic and family circumstances (Headey, Holstrom, & Wearing, 1984, 1985). Illbeing also may include depression, low self-esteem, pessimism, or self-dissatisfaction (Scheff, 1999). A sense of illbeing, then, is likely to occur when one experiences dissatisfaction with one's health or material standard of living (Headey et al., 1984, 1985; Nyman, 2002). It should be noted, however, that illbeing is not the opposite of wellbeing. Rather, both concepts have different causes, are correlated with different variables (Bradburn, 1969; Bradburn & Caplovitz, 1965; Headey et al., 1984, 1985), and may be affected temporally in different ways (Diener & Emmons, 1985). Given that most of the research on wellbeing relates to the *prevention* of physical or mental illbeing (e.g., anxiety, stress) (Anderson, 2011), and that much of the research presented in this volume chapter highlights negative aspects of the built and ambient environment that promote illbeing, it makes sense that this chapter should be as much about illbeing as it is about wellbeing.

Crowding denotes a difference between the amount of actual social contact in a situation and the amount of desired social contact, with the former exceeding the latter, thus reducing privacy and increasing stimulation overload (Altman, 1975). There also is a spatial component to crowding: that is, individuals experience crowding when their demands for space, required for specific activities, exceed available supply. The experience of crowding, then, may be seen as a motivational state in which individuals attempt to alleviate perceived restrictions or breaches via increasing the supply of space or adjusting social and/or personal variables to minimize

the inconveniences of a lack of space (e.g., reducing social interference so that one may perform tasks on time) (Stokols, 1972). Scholars also have shown the connection between—and distinction with—density: density is viewed as a physical condition whereas crowding is seen as the perception of limited space to undertake activities (Freedman, 1979; Gove, Hughes, & Galle, 1979; Stokols, 1972, 1976).

Finally, *density*, in a spatial sense, may be defined simply as the number of units in a given area. However, there are many different definitions depending on what *kind* of density is being sought (e.g., dwelling density, bone density, mineral density). For the purposes of this chapter, density is viewed in light of the urban environment; thus, the density of homes, people living in a neighborhood, rubbish bins, green spaces, trains, and suchlike are important (Cooper & Boyko, 2012).

In urban environment terms, density is used to describe, predict, and control the use of land (Berghauser Pont & Haupt, 2007; Department of the Environment, Transport and the Regions, 1998). Density also shapes how cities look, feel, and are experienced in obvious and subtle ways, and research has shown that it impacts our quality of life as well as our mental and physical illbeing/wellbeing (see the section on research about the relationships between density, crowding, and mental illbeing/wellbeing). As part of a study on density for the Urban Futures project,[1] the authors created a taxonomy of density that divides the term into several, broad dimensions. The dimensions allow the different kinds of density that are used in everyday practice and in research within the urban environment to be organized (Boyko & Cooper, 2011). These dimensions include those shown in Table 4.1. From Table 4.1 we can see a split between two, overarching density dimensions: those densities that are more or less permanent or have the capacity to be more static in cities (i.e., built form, natural form, and static form), and those densities that are more temporary or dynamic in cities

Table 4.1. A Taxonomy of Density.

Density dimension	Example of density type
Built form	Dwelling density
Natural form	Green-space density
Static form	Road density
Mobile material form	Traffic density
People*	Population density, employment density

*People density can be further subdivided into individual, and social and organizational.

(i.e., mobile material form and people). One can argue that even buildings, roads, and green spaces are not permanent, but are part of the constantly changing fabric of cities. In comparison to the movement of people and traffic, however, the former have more permanence in a short-term sense. It is these latter densities, those that are more temporary and dynamic, to which we now turn our attention.

Intensity as Temporary Density

From a built-environment perspective, unsurprisingly, cities are mainly comprised of buildings, spaces, and infrastructure. It is in the spaces between buildings and on the infrastructure—such as streets and pavements, a city's most vital organs (Jacobs, 1961)—that the "ebb and flow of human exchange" occurs (Carr, Francis, Rivlin, & Stone, 1992, p. 3). This exchange involves planned, casual, and serendipitous social encounters that draw people together on a daily basis (Carr et al., 1992; Loukaitou-Sideris & Ehrenfeucht, 2009). The opportunity to see, hear, and meet others (Gehl, 1987), from close friendships to passive contacts and strangers (Gehl, 1987; Lofland, 1998; Loukaitou-Sideris & Ehrenfeucht, 2009), in relative closeness is one of the most important attractions of urban environments (Gehl, 1987). These opportunities create a myriad of stories that unfold continuously and daily on city streets and pavements, offering exploration and discovery as well as the unexpected, the unregulated, the strange, the novel, the risky, and the surprising (Franck & Stevens, 2007; Loukaitou-Sideris & Ehrenfeucht, 2009).

Part of the appeal of urban environments, according to Gehl (1987) and others, is the chance to gather and move with people in an intimate, private, and social fashion (Jacobs, 1961). Urbanites value fleeting, ephemeral interactions, such as greeting familiar people, "people watching," and crossing paths with strangers (Loukaitou-Sideris & Ehrenfeucht, 2009), and respond to high-density situations and a range of stimuli by coming together (Gehl, 1987; Whyte, 1980, 1988). It is this concentration of people that is a source of vitality, variety, and flourishing city life. Even the mere acts of running errands or trying to find food and drink in cities attract people to other people and remove them from the isolation of suburban privacy (Jacobs, 1961). These are potential moments of intensity.

When conceptualising intensity, scholars often have articulated the term in the form of events, such as festivals, parades, protests, and funerals. In

these events, people are *momentarily* united with a sense of commonality in a physical space (although people in virtual spaces also may be involved in such events) and share roles that they might not otherwise with strangers or unfamiliar others (Carr et al., 1992; Loukaitou-Sideris & Ehrenfeucht, 2009). These intense gatherings break ordinary rhythms, yet are not perceived as disturbing the normal urban order because they are temporary and often nonthreatening (Loukaitou-Sideris & Ehrenfeucht, 2009). Flashmobs, in which people self-organize for the purposes of entertainment, often via mobile communication, are a good example of a nonthreatening event that brings a group of people together for a short period of time (Nicholson, 2005).

Although it makes sense that intensity may occur when events happen, we propose that it does not *only* occur in special circumstances. Rather, moments of intensity happen daily on city streets and pavements. For example, a nondescript, vehicular accident on a busy road brings a temporary surge of cars, lorries, and vans together until those involved in the accident have been moved to the shoulder or the police have cleared the scene. A throng of people may come out of a train station and, for a moment, they all head in the same direction before splitting off, along a variety of paths (see Whyte, 1988, for an example from Grand Central Station in New York City). And before the licensing laws changed in the United Kingdom, 11 P.M. saw a routine pouring out of people from pubs and onto the street before they staggered home. None of these examples are events per se, but are part of the rhythm of urban life and, as such, display elements of intensity as discussed by scholars; that is, often nonthreatening, temporary, involving the sharing of roles with potential strangers and occurring in a physical space.

What also proves interesting is that one might think that the daily moments of intensity we experience are often going to be stressful, chaotic, and wreak havoc on the rhythm of urban life because of the perceived loss or absence of personal control due to crowding (Lowry, 1991; see Mitchell, 1971, as cited in Mitchell, 1971, who connects intensity with *congestion*, which is defined as the making of simultaneous demands for the use of very limited resources). Whereas the cognitive complexity of these occurrences may be greater than in uncrowded situations because there are more elements in our environment (e.g., more people or traffic) and more behavioral uncertainty abounds (Saegert, 1973), people may not necessarily become stressed and the everyday rhythm may not always be interrupted. Milgram (1970) suggests that individuals experience an overload situation when this occurs, but that people adapt by using different strategies to ones employed

in simpler settings (Saegert, 1973), such as only processing some of the total information in the person environment, and ignoring, preventing, or not responding to other information (Milgram, 1970). Jacobs (1961) goes one step further by proposing that there is indeed an order, consisting of movement and change that is likened to a dance: an intricate ballet in which individual dancers and groups all have distinctive parts that support each other and comprise an orderly whole. As with ballet, the intensity of urban life never repeats itself and is replete with improvization.

So how do moments of intensity in cities, like the ones described above, contribute to our overall perceptions of density? As stated before, there already exists a more permanent or static density in cities via the concentration of buildings, infrastructure, and nature in an area that can be calculated fairly objectively (e.g., adding up the number of office buildings and dividing it by a predetermined area in which those office buildings reside gives office building density). We also may mentally compare the city in which we currently reside with other cities and make a more subjective reading or decoding about its density (Rapoport, 1975), or simply make a guess based on cultural or past experiences. Beyond this base level density is the concentration of temporary, moving things, such as people and traffic. This more dynamic density, what we are calling intensity, is constantly changing and is subject to our awareness, via our senses, of other people and of moving objects in shared space. It also relates to recognized relationships that we share with others in physical space, agreed-upon rules, appropriate cues, symbols, markers, and defences we use to control situations. Thus, when we see, hear, and experience fast tempos and rhythms of activity in certain urban spaces and at certain times, this may contribute to our overall perception that a city is dense (Rapoport, 1975). The fact that these intense tempos and activities may take place at the same time and place every day (e.g., evening rush-hour pedestrian traffic going to train stations), or may occur at any time or place in a 24-hour period (e.g., a group of loud revellers returning to their city center flat from a night out at 3 A.M.), helps to explain why the same city can feel more dense or crowded at different days of the week.

Another factor surrounding intensity that may contribute to our perceptions of high density and crowdedness in cities is whether or not the people involved in "intensity activities" are similar to us along certain dimensions (e.g., having similar value systems, age, or nonverbal communication systems). For example, if we encounter a group of emotional and inebriated football supporters on a street and we do not support that team, we may

experience some anxiety and create an artificial social division between "us" and "them." Seeing this group as "them" may lead us to perceive the supporters as unwanted and uncontrollable, thus producing feelings that the street is dense or, rather, crowded (Rapoport, 1975). Moreover, if we feel restricted in our movement on that street because of the supporters' behavior, we may wish to "fan out" and protect our personal space; nonetheless, we still may feel crowded because we are unsure of what the supporters will do (Stokols, 1972). As before with the daily rhythms of urban life, this loss of perceived control about what to do in the high-density/crowded situation may produce stress (Aiello, Baum, & Gormley, 1981; Altman, 1975; Baron & Rodin, 1978; Baum & Valins, 1979; Cohen, 1981; Glass & Singer, 1972; Rodin, 1976).

Our perceptions of, and experiences with, high density (including intensity) in cities most certainly will have direct impacts on our illbeing/wellbeing. Feelings of anonymity, anxiety, and fear that something bad will happen to us in a dense place (e.g., we get mugged and no one will help us) can play on our sensibilities and lead to mental illbeing. Equally, high-density urban environments have the capacity to evoke a range of positive feelings, such as vibrancy, creativity, and excitement, that can feed our mental wellbeing. Additionally, there may be other variables that intervene in the density/crowding–illbeing/wellbeing relationship. We now turn to the academic literature to understand the relationship in more detail and uncover some of the variables that moderate or mediate the relationship.

Research about the Relationships between Density, Crowding, and Mental Illbeing/Wellbeing

As stated above, most of the research on the relationships between density, crowding, and wellbeing tends to focus on *illbeing*; that is, the negative effects that density—mainly higher densities—have on how individuals or groups live and function. This body of research, conducted for more than 70 years, has tended to focus on two groups—children and adults—and how density and/or crowding has contributed to their illbeing. Although most researchers have shown this link, other scholars have suggested that density and crowding only exert an extremely modest effect, if at all, on the social and mental pathology of humans (Adams, 1992; Chadwick, 1972; Fischer, Baldassare, & Ofshe, 1975; Freedman, 1975; Lindheim & Syme, 1983).

There appears to be a strong literature pertaining to children, density/crowding, and illbeing/wellbeing (see Dockery et al., 2010; Evans, 2006), with three studies highlighting *positive* associations between higher densities and wellbeing. Bernard (1939), as cited in Gleeson and Sipe (2006) sampled 420 school boys and girls about their neighborhood activities and attitudes and found that children in groups of lower socioeconomic status (SES) were more likely to have stronger social contacts within their neighborhood than children from higher-SES groups. The author surmised that population density played a role: the lower-SES groups lived at higher population densities with more opportunities for contact whereas the higher-SES groups lived at lower densities and, therefore, had fewer opportunities for social interaction. Moore's (1986) study supports these findings, as the author discovered a positive relationship between density and the development of children's friendship networks in terms of facilitating groups of friends and siblings to engage in outdoor play. Silburn et al. (2006) also found a positive relationship between density and wellbeing among Aboriginal children in Australia. From a survey of 1999 households with Aboriginal children under 18 years of age, the authors discovered that indigenous children living in high-density households were 50% less likely to be at risk of emotional or behavioral difficulties than those children who lived in low-density households.

Most studies exploring the relationship between children, density/crowding, and illbeing/wellbeing have highlighted a more negative association. For example, Loo (1972) found that crowded conditions increased children's levels of social withdrawal. This finding was echoed by Evans, Lepore, Shejwal, and Palsane (1998), who noticed withdrawal among children between 10 and 12 years old; Hutt and Vaizey (1966), who noted withdrawal among autistic children; and Liddell and Kruger (1989), who discovered a positive association between crowding at home and social withdrawal among children during the first weeks of nursery school. Another negative issue found in the literature is parent–child interaction: parenting styles that are more punitive negatively mediate the relationship between residential density and psychological distress (Evans, Lercher, & Kofler, 2002; Evans, Saegert, & Harris, 2001;), including irritation and withdrawal (Galle, Gove, & McPherson, 1972). This finding has been known to occur among low-income children between 8 and 10 years old (Evans & Saegert, 2000) and children between 10 and 12 regardless of income. Evidence also suggests that punitive parenting mediates the relationship between residential density and teacher evaluations of

behavioral disruption in the classroom (Evans et al., 1998). Moreover, in crowded homes with poor interior design, mothers have been found to be less responsive to their children, which can negatively impact children's cognitive development (Dockery et al., 2010; Evans et al., 2010).

Finally, Murray (1974) observed that primary school children suffered higher levels of neuroticism when living in crowded homes versus children who lived in less crowded dwellings. Children living in crowded conditions also experience greater psychological distress (Evans et al., 2001, 2002; Evans & Saegert, 2000; Rutter et al., 1975) and poorer behavioral adjustment in school (Booth & Johnson, 1975; Evans et al., 1998, 2002; Saegert, 1982), although the former may be mediated by housing type (i.e., larger, multifamily dwellings may exacerbate distress; Evans et al., 2002) and noise (Evans, 2001). Additional research on the negative relationship between density and learning, performance in school, and perception of competence in class suggests that residential crowding plays an important role in childhood cognitive development. (e.g., Booth, 1976; Bradley et al., 1994; Essen, Fogelman, & Head, 1978; Evans et al., 1998; Evans & Saegert, 2000; Goduka, Poole, & Aotaki-Phenice, 1992; Gottfried & Gottfried, 1984; Goux & Maurin, 2005; Hassan, 1977; Heft, 1979; Ray, Wandersman, Ellisor, & Huntington, 1982; Rutter et al., 1975; Saegert, 1982; Wachs, 1978; Wedge & Petzing, 1970). These findings also have been replicated with *classroom* crowding in place of residential density (Krantz, 1974; Maxwell, 1996).

In addition to children, density and overcrowding have been studied with other populations, again, with occasionally positive associations with wellbeing (vs. illbeing). For example, Halpern (1995) states that high-rise living—high-*density* is inferred here—may lead to *greater* social ties and cooperation among residents. High-density, mixed-use living also is purported to increase positive social interaction (Talen, 1999; Young & Willmott, 1957). However, most studies point to negative connections between density, overcrowding, and illbeing.

Gabe and Williams (1993), Ineichen (1993), Kellett (1984), and Ross and Jang (2000) suggest that overcrowding may contribute to psychological distress in adults (see also Martin, 1977; World Health Organization, 1987). Through his study of residents living in Hong Kong, Mitchell (1971) discovered a positive relationship between high densities and emotional strain and emotional illnesses (e.g., worry, unhappiness), particularly for people who were not living with members of their family and/or who were the poorest

members of high-density neighborhoods. The author also highlighted that residents living on upper floors of multistorey buildings are more likely to develop emotional illnesses than those living on lower floors. Others have found similar linkages between interior residential density (i.e., the number of persons per room) and impaired mental wellbeing, mild depression, and anxiety (Edwards, Fuller, Sermsri, & Vorakitphokatorn, 1996; Fuller, Edwards, Sermsri, & Vorakitphokatorn, 1993; Gabe & Williams, 1993; Gove et al., 1979; Guite, Clark, & Ackrill, 2006; Hassen, 1977; Jain, 1987; Lakey, 1989; Lepore, Evans, & Schneider, 1991; Marsella, Escudero, & Gordon, 1970; Spring Rice, 1939/1981). Four studies—conducted by Baldassarre (1979), Booth (1976), Freedman (1975), and Levy and Herzog (1974)—did not show the same relationships with density; however, a further study by Baldassarre (1981) was able to illustrate that low-status individuals in households (i.e., individuals living either with the younger or older generation, or nonrelatives) and women with young children were prone to more dissatisfaction and poorer mental wellbeing when they lived in high-density dwellings. Gove and Hughes (1983) provided additional nuance by stating that married women with children experienced poorer health in crowded dwellings when other adults in the household in addition to the partner were present. Wells and Harris (2007) found that low-income women experienced decrements in psychological distress when they moved from more crowded to less crowded and improved housing. Finally, Brown, Brolcháin, and Harris (1975) found higher rates of depression among working-class women when they lived in dwellings with housing problems, such as overcrowding, physical shortcomings, noise, and insecure tenure.

Further research with adults in relation to density and crowding at the neighborhood or area scale has yielded similar results. Cramer, Torgersen, and Kringlen (2004) found that people living in high-density, inner-city areas, versus those living in lower-density areas, experienced lower quality of life, which was measured via a presence/absence scale of negative life events as well as a subjective wellbeing scale. Poor, inner-city neighborhoods that are subject to a combination of crowding, noise, and danger also are more likely to foster chronic mental fatigue among residents, especially when residents are single parents (Kuo, 1992). In terms of admission rates to hospitals, which is sometimes used as a proxy for poor mental wellbeing, research has shown that inhabitants of dense city centers have high admission rates for schizophrenia (Faris & Dunham, 1939), psychiatric impairment (Duvall & Booth, 1978; Paulus, McCain,

& Cox, 1978), and psychoses among the elderly (Gruenberg, 1954). In a study of high-density neighborhoods, Fleming, Baum, and Weiss (1987) discovered that people living on streets with shops also reported elevated levels of somatic distress, depression, and anxiety compared with people living on streets without shops. Also within neighborhoods, Gómez-Jacinto and Hombrados-Mendieta (2002) showed an interaction effect between community and residential density relating to psychological stress: that is, when *both* types of density are high in a neighborhood, strong negative effects result (although as a main effect, only community density had a strong, negative effect on psychological stress). Furthermore, Dempsey, Brown, and Bramley (2012) revealed that residents interacted less with neighbors in high-density versus low-density areas, and that the social interaction likely would be more negative in nature (i.e., neighbor avoidance, neighborhood is unfriendly).

Finally, among older adults, La Gory, Ward, and Sherman (1985) discovered a negative relationship between neighborhood age density (i.e., the percentage of people aged 60 and over in an area) and satisfaction. That is, older people who lived in age-dense neighborhoods experienced lower general satisfaction, felt more unhappy with their neighbors, and more unsafe than older people in less, age-dense neighborhoods. This finding contradicts earlier research, which states that higher neighborhood density is positively associated with wellbeing among older people living in social, sheltered, or retirement housing (Lawton and Nahemow, 1979; Lawton, Nahemow, & Yeh, 1980; see also Siegel, 1985).

Conclusions

This chapter sheds light on the important, but often overlooked, relationships between spatial density, crowding, and mental illbeing/wellbeing in urban environments. Key terms in the relationship are defined and a new concept is added that addresses the fleeting and dynamic aspects of density in cities: intensity. This term suggests that there is something beyond the more or less static base layer of density that is found in the urban built and natural fabric of a place. It is the density of those things that *move* throughout cities—people and traffic—that add to this base layer and provide us with another sense of density or crowdedness in a particular space and time. This dynamic intensity may be why we can experience the same city as quite dense on one day and quite sparse on another day. It also may, although in

the absence of empirical evidence, play a role in how we feel in terms of our mental wellbeing.

We have seen from the studies in the last section that high density and overcrowding often have a deleterious effect on our mental health and wellbeing, and that various groups are affected more than others, including children, low-income adults, women, and older people. Evidence is not entirely conclusive that the relationship between density and wellbeing is always negative, however, because there are instances in which high densities promote stronger social interaction and networking among those living closer together. Moreover, most of the research discussed in this chapter illustrates *direct* correlations between density and/or crowding and mental wellbeing. Aside from a few intervening variables found in the above studies—namely, shops on residential streets, living on upper floors of multistorey buildings, noise, housing type, and parenting style—and theoretical or conceptual discussions of intervening variables (e.g., Desor, 1972; Stokols, Rall, Pinner, & Schopler, 1973), not enough research has been conducted that explores the mediating and moderating influence of other variables on the density/crowding–mental wellbeing relationship (see studies on the relationship between mental wellbeing and other issues, such as noise, access to nature, dwelling type, and lighting, which have shown both direct and indirect effects; see Cooper, Boyko, & Condihoto, 2008). In addition, save for Mackintosh, West, and Saegert (1975), there have not been any empirical studies undertaken that examine the notion of intensity as it relates to mental wellbeing. Several scholars, such as Lowry (1991), Mitchell (1971), and Wilner and Baer (1970), have loosely discussed the concept and/or related ideas (e.g., congestion); however, there is a need to better understand intensity and its connections with mental wellbeing through research (e.g., is there a cumulative effect on mental wellbeing from moments of intensity experienced in urban environments throughout the day? How do individuals' affective norms and expectations, combined with their movement requirements and the information in the person environment, impact mental wellbeing? Mackintosh et al., 1975). Perhaps the emerging field of mobilities studies can provide some answers (see Hannam, Sheller, & Urry, 2006; Urry, 2007; Watts & Urry, 2008).

From a practical perspective, the information gleaned from this chapter may be useful to built-environment professionals as they plan, design, and manage spaces and places to support mental health and wellbeing. First, high-density housing should be constructed of better-quality materials; for

example, soundproofed walls, so that noise cannot travel as easily between dwellings. Spaces within homes also should be designed with flexibility in mind to accommodate individuals throughout their life course. Moreover, the design should be easily maintainable, both in terms of durability and cost (Cooper, Boyko, & Cooper, 2011).

Second, cities should be clearly signed and articulated so as to be legible for people in crowded, intensity-provoking spaces. Doing so can help reduce information overload and unwanted stimulation, allowing people to concentrate on tasks, goals, and so forth. Clear signage and articulation also would give people a more accurate picture about what the environment affords them as they move about and through crowded spaces (Mackintosh et al., 1975).

Third, if cities continue to accommodate an ever-increasing urban population, densities will likely increase. In order for these urban environments to "work," they need "escape facilities" (Chu, Thorne, & Guite, 2004). Having access to green space and open space (Anderson, 2011; Chu et al., 2004; Cooper et al., 2008; Deary, Whiteman, Starr, Whalley, & Fox, 2004), allotment gardens (Wiltshire & Azuma, 2000), and areas for children to play (Bartlett, 1998) may act as a buffer to residential noise and crowding (Wachs & Gruen, 1982); provide opportunities for relaxation, quiet reflection, and fresh air (Anderson, 2011; Chu et al., 2004; Cooper et al., 2008; Evans, Wells, & Moch, 2003); help reduce levels of depression (Mutrie, 2000); support physical exercise and longevity (Takano, Nakamura, & Watanabe, 2002); create opportunities for social interaction (Burgoyne, Woods, Coleman, & Perry, 2008; Chaix, Lindstrom, Rosvall, & Merlo, 2008); and allow people to connect with nature (Gesler, 1993). If these escape facilities are to function well, however, they must be of sufficient size, design quality, and accessibility (Rodin, Soloman, & Metcalf, 1978). Built-environment professionals need to engage with other key decision makers, such as health-care professionals, social workers, and the police, to ensure that such spaces, services, and facilities are available to everyone. They also need to press for changes to policies so that retained and newly created green spaces are multifunctional (e.g., meeting places, allotments), inclusive, and fun (Cooper et al., 2011).

Through further collaboration with a variety of people at the practical level and continuing to empirically explore the direct and indirect relationships between density, crowding, intensity, illbeing, and wellbeing, urban decision makers can move toward finding a better balance between density and wellbeing in cities.

Note

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5

Neighborhoods and Social Interaction

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Introduction

In 1961, Jane Jacobs issued a clarion call. In her enormously successful book, *The death and life of great American cities*, she drew upon her extensive, detailed, and intimate observations of daily life in New York City, her experience as an urban design and architecture critic, and an analytical, activist approach to launch what she called an "attack on current city planning and rebuilding," with the intent "to introduce new principles of city planning and rebuilding" (Jacobs, 1961/1992, p. 3). She focused on "how cities work in real life," which she believed was "the only way to learn what principles of planning and what practices in rebuilding can promote social and economic vitality in cities, and what practices and principles will deaden these attributes" (pp. 3–4).

Jacobs (1961/1992) concentrated on "great cities" and urban neighborhoods because of the imminent destruction that was taking place through urban renewal and highway construction projects, and she believed that planning theory had completely overlooked the nature of these conditions (p. 16). Although she cautioned against applying her observations to the planning of small cities, towns, and suburbs, she acknowledged that her work might achieve a "somewhat wider usefulness as time passes" (p. 16). She recognized that many of the parts of the cities that were particularly troubled in 1961 had once been "suburbs or dignified, quiet residential

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areas," and she presciently concluded that what were then new suburban areas eventually would "be engulfed in cities and will succeed or fail in that condition depending on whether they can adapt to functioning successfully as city districts" (p. 16). In the 50 years since, the conditions of urban sprawl have expanded to such an extent globally that Jacobs's observations have proved to offer useful guidelines not only for understanding the essential elements of urban neighborhoods but also as a framework for understanding the social interactions of most neighborhoods that gather dwellings together into blocks and along streets.

Jacobs opens a valuable window into the complex world of neighborhoods and social interaction. She is unique among urban theorists in that she wrote from the personal perspective of a life lived. She was an empiricist before there were truly empiricists in this area of urban planning and social/health impact. Furthermore, her book has had a powerful and sustained impact since its initial publication in 1961. Translated into multiple languages, *The death and life of great American cities* has consistently remained in print with a Modern Library edition released in 1993 and a 50th anniversary edition in 2011. Given the foundational contribution of her work, this chapter draws upon Jacobs's book as an entry point into the growing field of research in this area. Her observations provide an accessible and still salient view of the elements essential to social interaction in neighborhoods.

This chapter begins with a review of Jane Jacobs's observations, followed by a summary of research on social interaction and health, a development that evolved more fully in the mid-1970s and 1980s. The next section of the chapter reviews research-validated neighborhood characteristics, originally identified by Jacobs and, over the last two decades, found to be significant to social interaction. This list is not all-inclusive, but covers the bedrock elements. A brief conclusion alludes to the areas that merit follow-up through local observation, in order to fully understand a particular condition, bringing full circle the process of observation, theory, research validation, and further observation.

Early Observations

Jane Jacobs developed a set of theories based on her observations of the elements she identified as essential to vital cities. As promised, she also levelled an attack on then current planning practices. She offered multiple examples of the abysmal performance of the professions working in the built

environment, a group she castigated for attempting "to shape or reshape big-city neighborhoods into versions of two-variable systems, with ratios of one thing (as open space) depending directly and simply upon an immediate ratio of something else (as population)" (Jacobs, 1961/1992, pp. 433–436). She believed that anyone attempting to engage in the built environment required a baseline understanding of the "organized complexity" that it is a city. Jacobs called on professionals to halt the wholesale destruction of cities in the name of "urban renewal," or for the dominant purpose of highway construction to move automobiles across large distances regardless of the human cost, and to pay attention to the social life of cities—the actual habits and practices of its residents and visitors—at the level of the street, sidewalk, and neighborhood.

Arguing against the "towers-in-the-park" versions of public housing then popular with designers, Jacobs (1961/1992) revealed the "intricate ballet" of an urban neighborhood which illustrated both the breadth and depth of her insight as well as the shallowness of fashionably abstract diagrams (p. 50). Her observations consistently address the relationship between the built environment and social interaction. Jacobs understood that social interaction was the life blood of the city, and she studied closely the aspects of neighborhoods that encouraged, as well those which diminished, social interaction. She called on citizens, government agencies, and design professionals to reconsider plans based on anything but close observation of successful places; that is, the parts of cities that offered safety, pleasure, and trust.

Jacobs (1961/1992) explained that the "trust of a city street is formed over time from many, many little public sidewalk contacts" (p. 56). She described the multiple opportunities for interaction in great detail and offered a snapshot of the sidewalk encounters and conversation characteristic of the era, some of which might differ today, although more in the details than the essential interaction:

> getting advice from the grocer and giving advice to the newsstand man, comparing opinions with other customers at the bakery and nodding hello to the two boys drinking pop on the stoop, eying the girls while waiting to be called for dinner, admonishing the children, hearing about a job from the hardware man and borrowing a dollar from the druggist, admiring the new babies and sympathizing over the way a coat faded.
>
> Jacobs (1961/1992), p. 56

She acknowledges that most of this interaction "is utterly trivial but the sum is not trivial at all," and theorized that:

> the sum of such casual, public contact at a local level—most of it fortuitous, most of it associated with errands, all of it metered by the person concerned and not thrust upon him by anyone—is a feeling for the public identity of people, a web of public respect and trust, and a resource in time of personal or neighborhood need.
>
> Jacobs (1961/1992), p. 56

Furthermore, Jacobs (1961/1992) warned that "the absence of this trust is a disaster to a city street" (p. 56). Based on her observations of daily life and urban form, she outlined a theory of these neighborhood networks, which she identified as "a city's irreplaceable social capital" a term that would be developed by subsequent generations of social science researchers as an indicator of neighborhood health (p. 138).

Jacobs (1961/1992) also observed that this trust "implies no private commitments" (p. 56). Noting the web of relationships that spring from the casual encounters of urban life, she valued the combination of "opportunities for public contact in the enterprises along the sidewalks, or on the sidewalks themselves as people move to and fro or deliberately loiter when they feel like it" (p. 62). She described the important role of "public hosts," individuals whose establishments enabled people "to hang around or dash in and out, no strings attached" (p. 62). She determined that the successful city street enables a network of relationships "without unwelcome entanglements, without boredom, necessity for excuses, explanations, fears of giving offense, embarrassments respecting impositions or commitments, and all such paraphernalia of obligations which can accompany less limited relationships," and explains that these relationships "can, and do, endure for many years, for decades," relationships which "form precisely because they are by-the-way to people's normal public sorties" (p. 62).

Sociologist Mark Granovetter later would identify these relationships as "weak ties." In his seminal article, "The strength of weak ties," Granovetter (1973) distinguished between bonds that represent close interpersonal relationships, and bridges, the weak ties which extend across networks. He defined the strength of a tie as "a (probably linear) combination of the amount of time, the emotional intensity, the intimacy (mutual confiding), and the reciprocal services which characterize the tie" (Granovetter, 1973, p. 1361). His intent was to focus on a "limited aspect of small-scale interaction—the strength of interpersonal ties—and to show, in some detail, how the use of network analysis can relate this aspect to such varied macro phenomena as diffusion, social mobility, political organization, and social cohesion in general" (Granovetter, 1973, p. 1361).

Granovetter's findings confirm Jacobs' theory of the benefits of casual encounters of neighborhood life. He also develops a theory about how the absence of weak ties might diminish neighborhood organization. Jacobs presaged his theory with her observations on the negative effect of their absence. She pointed out that "when an area of a city lacks a sidewalk life, the people of the place must enlarge their private lives if they are to have anything approaching equivalent contact with their neighbors" (Jacobs, 1961/1992, p. 62). She believed that the absence of regular, casual encounters forced people either into a form of "togetherness," in which "more is shared with one another than in the life of the sidewalks," or a "lack of contact," both of which she said produced "distressing results" (Jacobs, 1961/1992, p. 63). Granovetter (1973) determined that "weak ties are more likely to link members of different small groups than are strong ones, which tend to be concentrated within particular groups," a condition that diminishes community organization and trust (p. 1375). He speculates that the inability of Boston's West End to organize against the destruction of an urban renewal project could have been linked to the tightness of its small cliques, and its inability to host a network of weak ties (Granovetter, 1973, pp. 1373–1375). Granovetter (1973) also refers his readers to "Jane Jacobs's excellent, intuitive, discussion of bridging ties" (p. 1375), acknowledging the validity of her observations.

Essential Elements

Based on her detailed observations, Jacobs identified the elements that she believed essential for the social interaction of urban neighborhoods. We briefly summarize several of these essential elements of neighborhoods identified by Jacobs as important for social interaction, as follows.

Safe Streets

Jacobs (1961/1992) began with what she called the bedrock, the safe street, a place which she explained must be "equipped to handle strangers" (p. 35). The safe street is the foundation for all that follows. She was clear that the safe street is not a random occurrence, but that many factors contribute to the design and organization of the street "to make a safety asset, in itself, out of the presence of strangers, as the streets of successful city neighborhoods always do" (p. 35). To achieve this fundamental starting point, she described

the manner in which a street must clearly demarcate public and private space. She explained that "public and private spaces cannot ooze into each other as they do typically in suburban settings or in projects" (p. 35). This clarity, which in an urban neighborhood typically produces a building situated along a sidewalk, or a fence and gate along the sidewalk marking private property from the public walkway, establishes the ground for the relationship of observer and observed, the essential "eyes on the street" that provide a measure of safety and interest.

Eyes on the Street

Jacobs (1961/1992) articulated in detail her theory of "eyes upon the street, eyes belonging to those we might call the natural proprietors of the street" (p. 35). She understood that in order to bring eyes to the street, buildings "must be oriented to the street. They cannot turn their backs or blank sides on it and leave it blind" (p. 35). Finally she determined that "the sidewalk must have users on it fairly continuously, both to add to the number of effective eyes on the street and to induce the people in buildings along the street to watch the sidewalks in sufficient numbers," noting that no one "enjoys sitting on a stoop or looking out a window at an empty street," and that "large numbers of people entertain themselves, off and on, by watching street activity" (p. 35).

Mixed Use and Connectivity

Jacobs (1961/1992) also argued that once safety is assured, a city's next priority is to "foster lively and interesting streets" (p. 129). These streets, diverse in character and use, provide the wellspring for all of urban life. She therefore advocates streets that form "as continuous a network as possible" (p. 129). Easily accessible within this network should be public gathering spaces. Jacobs (1961/1992) advised the careful placement of "parks and squares and public buildings as part of this street fabric," in order "to intensify and knit together the fabric's complexity and multiple use" (p. 129). She very specifically argued against any location of cultural facilities or parks into separate districts isolated from neighborhoods and thus removed from the benefits of mixed use. She cautioned her readers not to "island off different uses from each other, or to island off subdistrict neighborhoods" (p. 129), but instead to embed cultural facilities and parks within neighborhoods lively with mixed use in order to "ensure the presence of people who go

outdoors on different schedules and are in the place for different purposes, but who are able to use many facilities in common" (p. 150).

Short Blocks and Density

Moreover, Jacobs (1961/1992) argued that short blocks (populated with diverse building purposes and occupants) present another opportunity for greater social interaction; as Jacobs noted, "streets and opportunities to turn corners must be frequent" (p. 150). Similarly, she promoted the "closely-grained" co-mingling of historic and new buildings and a "sufficiently dense concentration of people, for whatever purposes they may be there" and, in particular, residents (pp. 150–151).

Preservation of Historic Neighborhoods

Facing a tsunami of powerful political and professional alliances, Jane Jacobs urgently pressed the case to halt the "renewal" and highway construction projects that were cutting through urban neighborhoods, initiatives which she called "the sacking of cities" (Jacobs, 1961/1992, p. 4). Most vociferously, she argued against single-use zoning, an application of policy which transformed diverse, mixed-use neighborhoods into single uses, with housing, offices, and cultural facilities standing alone in single-use zones, turning previously lively mixes of all aspects of life into what she called "dull gray areas" (p. 41). Her passionate *cri de coeur* incited community activists; her informed analysis inspired new research and practice. Meanwhile, social scientists, epidemiologists, and physicians had begun to focus on the health impacts of social interaction and its obverse, social isolation.

Social Interaction and Health

In the period following Jacobs's (1961) published observations on the relationship of neighborhood characteristics to social interactions there began to be accelerating interest on the part of medical and health professionals on the relationship of neighborhood social interactions to health. Throughout the 1970s researchers and physicians turned attention to early studies that related health outcomes to an individual's social support and network of social contacts.

Sydney Cobb's presidential address to the Society of Psychosomatic Medicine in 1976 marked a turning point in the field of psychosomatic medicine in that he specifically called upon the society's membership to investigate the impact of social support. Cobb, a psychiatrist, focused on the impact of social support in times of crisis and advised his audience that while the evidence made "clear that social support is not a panacea," numerous studies had demonstrated the beneficial influence of social support in protecting "people in crisis from a wide variety of pathological states: from low birth weight to death, from arthritis through tuberculosis to depression, alcoholism, and other psychiatric illness" (Cobb, 1976, p. 310). He identified the potential for social support to reduce "the amount of medication required and accelerate recovery and facilitate compliance with prescribed medical regimens" (p. 310).

About the same time as Cobb's impactful address to medical professionals, John Cassel, a prominent epidemiologist and physician, presented his theory of how social interaction might affect health in the prestigious public forum of the American Public Health Association's Fourth Wade Hampton Frost Lecture. His talk on "The contribution of the social environment to host resistance," subsequently published in 1976 in the *American Journal of Epidemiology*, outlined a "concept of the potential role of the social environment in disease etiology" (Cassel, 1976, p. 108).

Years later, the 2010 Wade Hampton Frost Lecture award recipient, Leonard Syme, described the Cassel lecture during his own address to the association as "one of the classic papers in epidemiology" (Syme, 2010, p. 3) and a direct inspiration for Syme's work with Lisa Berkman on a much cited paper, also published in the *American Journal of Epidemiology* (Berkman & Syme, 1979). Berkman and Syme (1979) reported that in the population sample they studied in Alameda County, California, "the most isolated group of men was found to have an age-adjusted mortality rate 2.3 times higher than men with the most connections; for women who were isolated, the rate was 2.8 times higher than the rate for women with the most social connections" (p. 201). They concluded "that social circumstances such as social isolation may have pervasive health consequences," which they believed to support "the hypothesis that social factors may influence host resistance and affect vulnerability to disease in general," and they called for more data "on physiologic mechanisms capable of mediating the relationship between social events and disease outcomes" (p. 203).

Within the next 10 years, social interaction—and, in particular, social support—emerged as an important determinant of health and wellbeing.

In a seminal article in *Science* in 1988, House, Landis, and Umberson reviewed the methods and results of multiple investigations into the relationship between social isolation and morbidity. They acknowledged the foundational work of Sydney Cobb and John Cassel, who they believed had "indicated that social relationships might promote health in several ways, but emphasized the role of social relationships in moderating or buffering potentially deleterious health effects of psychosocial stress or other health hazards" (House, Landis, & Umberson, 1988, p. 541).

House et al. (1988) described the concept of social support, as "something that maintains or sustains the organism by promoting adaptive behavior or neuroendocrine responses in the face of stress or other health hazards," and they assessed the contributions of Cobb and Cassel as "a general, albeit simple, theory of how and why social relationships should causally affect health" (p. 541). The House team sought to address questions raised about the earlier studies which did not decisively address issues of causality regarding the relationships of social support to health. House et al. (1988) determined that these questions had been addressed through the collection of new data, as well as field experimental studies involving both humans and nonhuman animals, and therefore proceeded to review the mortality studies of human populations.

As noted by the review of House et al. (1988), a major limitation of Berkman and Syme's (1979) prior Alameda study of social relationships and mortality concerned the validity of self-reported health information collected at the baseline interview of this study. House, Robbins, and Metzner (1982) therefore designed a study (subsequently included in House et al.'s 1988 review) to replicate and expand on the Alameda results, examining the relationship of social relationships to health in a sample of 2,754 adults ages 35–69 years who had received (objective) physical examinations and given interviews in 1967–1969 as part of the Tecumseh (Michigan) Community Health Study (House et al., 1982). Controlling for a number of biological parameters (e.g., blood pressure, cholesterol, electrocardiograms) as well as age and multiple self-reported risk factors of mortality, House et al. (1982) found results that were similar to the ones for Alameda; that is, social relationships and activities were inversely associated with mortality over a 10–12-year period.

House et al. (1988) also examined results from the Evans County (Georgia) Cardiovascular Epidemiologic Study, in which Victor Schoenbach and his team had reported findings that were similar to Alameda with respect to white males only (Schoenbach, Kaplan, Fredman, & Kleinbaum,

1986, p. 588). House et al. (1988) discussed possible reasons for the Evans County variance from the Alameda results with respect to women and African Americans. The Schoenbach team determined that the most significant finding in the Evans County study was "the elevated mortality risk in subjects aged 60 and above with the fewest social ties" (Schoenbach et al., 1986, p. 589).

Additionally, House et al. (1988) reviewed the 1987 Swedish study conducted by Kristina Orth-Gomer in Stockholm and Jeffrey Johnson in Baltimore, who "examined the relationship between social network interaction and total and cardiovascular mortality in 17,433 Swedish men and women between the ages of 29 and 74 during a 6 year follow-up period," based on data from the Swedish National Survey of Living Conditions (Orth-Gomer & Johnson, 1987, pp. 949–950). Orth-Gomer and Johnson (1987) found that "low social support, as indicated by a relatively low level of social interaction and few social ties, was associated with an excess mortality risk of approximately 50% after adjustment for the effects of age and sex had been performed" (p. 955).

While House et al. (1988) noted the limitations of each study, they ultimately determined that there was a "remarkable consistency of the overall finding that social relationships do predict mortality for men and women in a wide range of populations, even after adjustment for biomedical risk factors for mortality" (p. 542). The thorough, critical analysis, as well as the prestige of the journal *Science* and the accumulation of new data, reinforced the impact of the team's conclusion "that social relationships, or the relative lack thereof, constitute a major risk factor for health" (p. 541).

Noting significant demographic changes occurring in the population in the late 1980s, House et al. (1988) also predicted a particular challenge facing the twenty-first century when the numbers of older individuals would dramatically increase, while support networks would diminish. They acknowledged that "just as we discover the importance of social relationships for health, and see an increasing need for them, their prevalence and availability may be declining," calling attention to the potential for enhancing life, "if the quantity and quality of social relationships were also improving" (p. 544).

Carrying this work forward, Bassuk, Glass, and Berkman (1999) in a study of 2,812 elders who were interviewed in their homes over a 12-year period from 1982 to 1994, found that "elderly persons with fewer types of social contacts remained significantly more likely to decline or to die in any given interval than those with more extensive ties" (p. 169). Addressing the challenges of an aging population facing the debilitating

disorders of Alzheimer's disease and dementia which can affect 2% of the 65–75 population and 20% of the over-80 population (Mitchell, Burton, & Raman, 2004, p. 89), Fratiglioni, Paillard-Borg, and Winblad (2004) conducted a review of "the published longitudinal studies of lifestyles and cognition and dementia" (p. 343). They found "enough evidence to support the hypothesis that an active and socially integrated lifestyle in late life seems to protect against [Alzheimer's disease] and dementia" (Fratiglioni et al., 2004, p. 351).

Community-Level Social Interactions and Health

In more recent work, there has been a growing interest in the role that communities or neighborhoods might play in residents' social interactions, and how these positive social interactions and social ties in turn might impact residents' health. Mair and Thivierge-Rikard (2010) looked more closely at the urban to rural continuum to assess the impact of social interaction among elders. These authors offer a refined spectrum for the design of beneficial interventions and ultimately determined that for older adults in rural, suburban, and urban conditions, "encouraging face-to-face visits, in particular, may yield the strongest positive results" (Mair & Thivierge-Rikard, 2010, p. 138).

Most recently, in 2011, Fiorillo and Sabatini studied "a pooled cross section sample of 216,994 observations collected in the years 1993, 1995, 1998 and 2000" in order "to test the relationship between the frequency of social interactions and perceived health in Italy" (Fiorillo and Sabatini, 2011, p. 1645). They found that "social isolation is confirmed to be an important predictor of poor health," and that "a significant and positive association between several measures of the quantity of social interactions and self-rated health in Italy supports the claims on the beneficial role of social capital and community cohesion" (p. 1650).

Sawada, Shinohara, Sugisawa, and Anme (2011) conducted a 6-year follow-up study on 219 Japanese elders, finding a beneficial impact of social interactions, including those occurring at the neighborhood level, on elders' physical functioning, which was measured by a mobility survey. Interestingly, Sawada et al. (2011) noted that, 6 years out, several items specific to social interaction at the neighborhood level—including "desiring an active lifestyle, taking an active approach, following a routine . . . feeling important, interacting with nonfamily persons, and participating in neighborhood

affairs"—had a significant effect on positive physical functioning (p. 172). These results correspond to impacts of neighborhood social capital on health.

Thus, by the late 1990s (and continuing to the present day), researchers had begun to study neighborhood differences in "social capital," defined broadly across numerous studies, but generally measuring the level of trust and engagement people feel in their own neighborhoods as well as perceptions of connectedness to others, the aspects that Jane Jacobs had described 30 years earlier, which found a new audience through the 1992 reprint of *The death and life of great American cities*. Subsequent generations of researchers expanded the research on social interaction and individual health to explore the link between a neighborhood's social capital and health.

As studies extended from individual social networks to community-level social constructs including social support among neighbors (the sense or actual quantification of how often neighbors help each other; e.g., Thompson & Krause, 1998), social capital (defined above; Kawachi, Kennedy, & Glass, 1999; Putnam, 1995), and collective efficacy (neighbors' willingness to come together for the common good; Sampson, Morenoff, & Earls, 1999; Sampson, Raudenbush, & Earls, 1997), factors of neighborhood design emerged as subjects of interest with respect to social interactions. Beginning with the now-established assumption that social support and related positive social interactions and social ties are beneficial to health, teams of researchers sought to identify characteristics of neighborhoods that contribute to beneficial levels of the larger dimensions of social capital and related community-level social constructs. By the opening of the twenty-first century, public health researchers increasingly expanded the number of studies exploring associations of neighborhood, the built environment, and health.

Research-Validated Neighborhood Characteristics

Jane Jacobs, in 1961, had identified the elements of urban neighborhoods that she herself had observed were essential for social interaction, based on "ground truthing" or monitoring social interactions at the street or sidewalk level, but the empirical evidence base was not yet amassed at that time. By the early twenty-first century, the beneficial health impacts of social interaction had become more widely accepted knowledge. Researchers

have subsequently developed a significant body of knowledge regarding the aspects of the built environment associated with the broader concepts of social capital and collective efficacy. More recently, investigators have begun to look closely at specific neighborhood factors associated with these impacts on social interaction, which in turn may impact residents' health and wellbeing.

Neighborhood Pedestrian Activity, Social Interactions, and Health

Concern for rising obesity rates and the deleterious effect of limited to no physical activity in the population has prompted extensive study in the early twenty-first century (e.g., Frank, Andresen, & Schmid, 2004; Handy, 2005; Saelens, Sallis, Black, & Chen, 2003) on the association between neighborhoods and physical activity. Studies on this topic span the globe (Oyeyemi, Adegoke, Sallis, Oyeyemi, & De Bourdeaudhuij, 2012; Sallis, Tomten, & Bergman, 2009), and walking, as the primary form of physical activity among adults (e.g., Lee & Vernez-Moudon, 2004), is the subject of significant study. The coinciding of walking with social interaction in neighborhoods thus brings these two areas of investigation together.

More than 50 years ago Jane Jacobs identified the significance of mixed use, eyes on the street, population density, short block lengths, connected networks of streets, embedded presence of cultural facilities and parks, and the preservation of urban neighborhoods. Reviewing both the early observations of Jacobs (1961/1992) and evidence from a selection of the most current studies on built-environment pedestrian behavior (i.e., walking), social interactions, and health, it is possible to coordinate Jacobs's list of essential elements with research-validated findings. Following are brief summaries of some of the research that validates her observations and offers professionals and communities a checklist of items that are necessary to provide a level of social interaction that benefits the quality of the neighborhood as well as individual and collective health.

Mixed Use, Supportive Social Interactions, and Walking

Jacobs (1961/1992) had observed that social interaction in neighborhoods was the result of people walking on sidewalks in places that provided safety, pleasure, and trust. This interrelationship of social interaction

and physical activity through walking in a neighborhood was simply assumed to be true and beneficial by Jacobs. Subsequent empirical research published in peer-reviewed journals began confirming her assumptions, most immediately her observation regarding the importance of mixed use—buildings: shops, cafes, offices, schools, etc.—in close proximity to residences.

In fact, one of the leading indicators of a neighborhood's rate of walking is the presence of mixed use. A significant number of studies verify that residents of mixed-use neighborhoods are more likely to walk more frequently than residents of single-use or residential-only neighborhoods (e.g., Frank et al., 2004; Handy, 2005; Saelens et al., 2003). Researchers further explored the connection between more walking, greater opportunities for social interaction, and thus more social support or connectedness.

Leyden (2003) conducted analyses of nearly 300 residents of neighborhoods in Galway, Ireland, that ranged from the city center outward to older first-ring and beyond to newer, car-dependent suburbs. He found that higher numbers of walkable destinations near homes—in other words, mixed use—was related to greater social connectedness, as measured by social capital (i.e., social cohesion and trust). Residents living closer to mixed-use destinations were more likely to know their neighbors, participate politically (a measure of civic participation), and report greater trust in others.

Based on this view as well as findings that built-environment characteristics such as mixed-use are associated with walking, Kaczynski and Glover (2012) explored whether perceived neighborhood social connectedness was related to neighborhood walkability as well as "the compounding effects of neighborhood walkability and social connectedness in predicting neighborhood-based physical activity (PA)" (p. 2). These authors found that perceptions of walkability and social connectedness were related for both genders and across most age groups. Additionally, they found that, among participants who rated their neighborhoods more positively with respect to both walkability and social connectedness, there were higher levels of neighborhood-based PA, for recreation as well as for transport (e.g., walking for leisure, as well as to travel from one location to another such as when running errands). Kaczynski and Glover (2012) recommend that "attention to the social landscape of a neighborhood, despite its complexities, poses greater opportunities to increase neighborhood PA and therefore ought to receive more attention from researchers, planners and elected officials who are serious about advancing active living" (p. 6).

Mixed Use and Eyes on the Street

While retail is generally associated with higher levels of walking, the position and design of the store with respect to the sidewalk is particularly relevant to ensuring eyes on the street. Lisa Wood and colleagues (2008), studying "social capital and feelings of personal safety in 335 residents of three suburbs in metropolitan Perth, WA" (Western Australia) (p. 15), found that while "proximity to a local shop had a positive effect on social capital" (p. 23), quantity alone does not predict social capital, and that "the type and quality of destinations" matters (p. 24). This is consistent with other studies, such as the work of Ford and Beveridge (2004) who suggested that higher levels of collective efficacy were associated with lower levels of fast food (and undesirable businesses) in a neighborhood.

Subsequently Wood, Frank, and Giles-Corti (2010) conducted a study of 609 Atlanta residents to examine whether neighborhood design characteristics were related to residents' sense of community and walking behavior. They specifically explored the relationship of retail to sense of community and found that that "the presence of retail may benefit [sense of community] when the retail areas are designed to be walkable with less surface area dedicated to surface parking" (Wood et al., 2010, p. 1389). This study reinforces the importance of understanding the interrelationship of the features that encourage social interaction in a manner that supports neighborhood and individual wellbeing, and quantifying capacity for eyes on the street may be a valuable tool in assessing the effectiveness of mixed use.

Eyes on the street implies a naturally occurring level of surveillance which results from windows and doors adjacent to sidewalks, along with building uses which inspire and support pedestrian activity and supportive social interactions on the street. José Szapocznik led an interdisciplinary team (including the authors of this chapter) in a study to examine the relationship between block-level mixed use and the school conduct grades of all 2,857 public school children residing in a 403-block community known as East Little Havana, one of Miami, Florida's first-ring suburbs and now a low-income, Hispanic neighborhood (Szapocznik et al., 2006).

East Little Havana was selected for study because at the time it was homogeneous on neighborhood sociodemographic characteristics (i.e., approximately 95% Hispanic; and with one of the highest poverty rates in the City of Miami; U.S. Census Bureau, 2000) and yet differed substantially from block to block on built-environment characteristics (ranging from completely residential blocks to blocks with a combination of residential, commercial, and

institutional uses). Since school conduct grades are predictors of various future health, psychological, and social outcomes, including school dropout, substance abuse, delinquency, and unsafe sexual behavior (Gruber & Machamer, 2000; Jimerson, Egeland, Sroufe, & Carlson, 2000; Williams, Ayers, Abbott, Hawkins, & Catalano, 1999), the team theorized that the presence of mixed use in close proximity to residences on the same block could provide a beneficial effect to children's development, based in part on Jacobs's (1961/1992) observations that storekeepers and community members walking from homes to businesses and civic uses throughout the day and evening hours provide more *eyes on the street*, or continuous monitoring of the activities of the neighborhood, which may lead to better outcomes for children.

In the selected neighborhood of East Little Havana mixed use most commonly takes the form of a corner store, usually operated by an owner/proprietor. The corner store typically is a neighborhood gathering spot and, as such, could provide children with greater opportunity for adult supervision and social interaction, which was theorized to be beneficial; and evidence of those benefits might be seen through higher conduct grades in school.

Szapocznik et al.'s (2006) study results supported the authors' hypothesis, in that there were higher conduct grades for children living on mixed-use blocks, which was contrary to popular opinion at the time that residential-only use is always associated with optimal child outcomes. By comparison, there were statistically significantly lower conduct grades for those living on *exclusively* residential blocks within this same Hispanic, low-socioeconomic-status neighborhood of East Little Havana.

However, a somewhat surprising finding emerged in a follow-up analysis of the same data set, which examined children's conduct grades with regard to the specific proportions of street frontage associated with residential, institutional, or commercial use on the blocks in which these children resided (Spokane et al., 2007). When Spokane and colleagues (2007) conducted this "finer-grained analysis," it was found that there were "disproportionately large changes in grades at extreme values of institutional use, and interactions between residential and institutional use" (Spokane et al., 2007, pp. 238–240). Furthermore, blocks with high levels of institutional use, to the exclusion of other uses, were associated with the poorest school conduct grades among children. In the context of this neighborhood, a school and family clinic represent the two dominant institutional uses. Both facilities consume much of the block on which they reside. Each is set back from

the sidewalk with a single gated entrance. There are few windows directly on the street and both buildings, at the time of the study, were unused and empty after working hours.

It is easy to see how such a large void in the fabric of the neighborhood would affect adjacent and nearby residents. Lengths of inaccessible building façades cannot deliver the visual interest or destinations that encourage walking, and limited numbers of walkers over the course of the entire day diminish the capacity for social interaction. Since the block dimensions, sidewalks, and context are nearly identical in the study neighborhood it is possible that it is the degree of social interaction that explains some of the beneficial effects on the mixed-use block and the detrimental effects on the institutional blocks.

Institutions, however, can occupy blocks in a manner that encourages social interaction. Jane Jacobs contrasted Carnegie Hall, surrounded by a dense neighborhood of studios, shops, restaurants, offices, hotels, and apartments, with the isolated superblock of Lincoln Center (Jacobs, 1961/1992, p. 168). Today, institutions can develop a limited block frontage footprint and include mixed use along the block faces to enhance eyes on the street and limit the potential harm of a large single use and, typically, its correspondingly single entry on the block.

Eyes on the Street: Building Features and Social Interaction

The same East Little Havana neighborhood was also the site for a study of older people aged 70 and above (Brown et al., 2008, 2009; Spokane et al., 2007). The team randomly selected one elder on each of the neighborhood's 273 blocks on which a Hispanic elder resided, seeking to determine built-environment impacts on social and behavioral health outcomes. Beginning in 2002–2004, Hispanic elders completed four annual assessments of neighborhood social climate (i.e., residents' perceptions of the quality of their neighborhood social environment; Brown et al., 2011), as well as elders' self-reported social support, psychological distress (i.e., depressive symptoms, anxiety), and performance-based measures of cognitive functioning (e.g., memory, attention) and physical functioning (e.g., walking speed, grip strength) (Brown et al., 2008, 2009; Spokane et al., 2007).

As the individual assessment data were examined in relation to the built-environment assessments for the 3,857 lots of the 403-block area of East Little Havana from 2000 to 2002 (described in the preceding section), the

team discovered, in terms of the elders' mental health (i.e., lower levels of psychological distress), that "the highest benefits for elders appear to occur on blocks with a greater number of positive front-entrance [eyes on the street] features," which in this neighborhood are features such as porches, stoops, and above-grade construction (i.e., buildings that sat at least 0.3 m above the level of the sidewalk) (Brown et al., 2009, p. 242).

A related analysis by Brown et al. (2008) focused on these same "eyes on the street" building features in relation to elders' physical functioning: elders living on blocks marked by low levels of positive front-entrance features (e.g., few porches or stoops on the block) (<10th percentile) were 2.7 times as likely to have poor subsequent physical functioning compared with elders living on blocks with greater numbers of positive front-entrance features (odds ratio = 2.7) (Brown et al., 2008). Brown and colleagues also found the potential for deleterious impact on both mental health (Brown et al., 2009) and physical functioning (Brown et al., 2008) on blocks with "ground-floor parking," which is a special case of above-grade construction when the first floor of the building is one story above the sidewalk, and a parking lot occupies most of the ground floor space beneath the structure (Brown et al., 2008, 2009). Conversely, building elements such as balconies and porches that provide a space for safe social interaction demonstrate clear benefits in various conditions (Brown et al., 2008, 2009; Spokane et al., 2007).

Continuous Network: Density, Block Connectivity, and Short Blocks

Jane Jacobs (1961/1992) pointed out the benefits of increased social interaction in the small blocks of Greenwich Village and Boston's North End, in which a high density of residents engage in multiple activities with a high degree of connectivity through a network of small gridded blocks. Li, Fisher, Brownson, and Bosworth (2005) surveyed 577 older residents (mean age 74 years) "in 56 city defined neighborhoods in Portland, Oregon, USA" to examine the relationship between a number of built-environment features and "walking activity at both the neighborhood and resident level" (p. 558).

Li et al. (2005) found that neighborhoods with high-density levels of employment and households, as well as higher numbers of street intersections and recreational greens, were associated with higher levels of walking. Focusing on the resident level, the team determined that "perceived safety

from traffic in residents' areas containing greater numbers of street intersections (that is, within a half mile radius of their residence) was associated with a greater amount of neighborhood walking by older adults" (p. 563). Li and colleagues (2005) observed that the variables combined to produce a collective impact, which they believe explains variations among the neighborhoods.

Mitchell et al. (2004) conducted a 3-year study to determine design factors that render the built environment more navigable for elders and individuals with dementia. Working with a study sample of 45 elders, 20 of whom had dementia and 25 who did not (Mitchell et al. 2004, p. 91), the authors found that "most participants, especially those with dementia, showed a preference for short, narrow and gently winding streets rather than long, wide or straight streets" (p. 95). The authors reported that the short blocks were "perceived to be more interesting and therefore helpful in maintaining the concentration people with dementia rely on to avoid losing the way" (p. 95).

Just as Jane Jacobs (1961/1992) noted with respect to the small end blocks of Greenwich Village, Mitchell et al. (2004) found that the shorter blocks "appeared easier to navigate as the end of the short street and the environmental cues along the narrow and winding streets were more visually accessible" (p. 95). Conversely, the authors "found that the people who lost their way on the accompanied walks all live in neighborhoods with complex street layouts and poor street connectivity" (p. 95). While dementia is a special case, visual access and connectivity are aspects of streetscape safety. The combination of higher density with shorter blocks and a high level of connectivity are associated with more walking, which is the base for neighborhood social interaction.

Continuous Network: Public Space, Cultural Facilities, Parks, and Community Gardens

Jane Jacobs (1961/1992) explained the importance of the edges of public space with her observations on the success of Philadelphia's Rittenhouse Square, as well as the failure of Franklin Square. Rittenhouse Square was, and is today, surrounded with densely populated, mixed-use blocks. Franklin Square, which Jacobs referred to as a Skid Row park, had been left with indiscriminate edges after the destruction of its surrounding row-house blocks for the building of the Ben Franklin Bridge, and later the Independence Mall (in 2006, Philadelphia began a redevelopment of the square to

address the problem). Whereas Jacobs (1961/1992) understood that each park is distinctly local in its character and role in the city, she observed that as a general principle both parks and cultural facilities need the many eyes and activity of mixed use nearby to function as safe and beneficial resources (pp. 91–111).

Leyden, Goldberg, and Michelbach (2011) subsequently studied the impact of cultural facilities and parks in relation to residents' happiness. Using the Gallup Organization's 2008 Quality of Life to study results from a sample of residents in New York, London, Paris, Stockholm, Toronto, Milan, Berlin, Seoul, Beijing, and Tokyo Leyden et al. (2011, p. 867) sought to determine the leading aspects of a city that are associated with individual levels of happiness, surveying urban residents across the globe. They found a "significant relationship between happiness and access to cultural amenities," and "suggest that these aspects of the built environment affect social connections and arguably connections to places that are important for happiness" (Leyden et al., 2011, p. 882).

This capacity for the community benefit has been validated for parks in multiple studies. Cohen, Inagami, and Finch (2008), using Sampson et al.'s (1997) definition of collective efficacy as "social cohesion among neighbors combined with the willingness to intervene on behalf of the common good," (Cohen et al., 2008, p. 199) found that the neighborhoods with higher numbers of parks within a half-mile boundary were "strongly associated with higher levels of reported efficacy" (p. 204). Sugiyama and colleagues (2010) added the measure of "attractiveness" as assessed by park users and found that people were willing to travel further for a park that was considered more attractive. Although the study does not define the specific characteristics of attractiveness and relies on the user's own rating of attractiveness, the authors found that quality of attractiveness emerged as a more significant factor than distance in predicting higher levels of recreational walking.

In a related study, Fan, Das, and Chen (2011) used a community health survey with data on social support, and stress to determine the method by which neighborhood green spaces might directly and indirectly impact stress levels. Based on 1,544 respondents, Fan et al. (2011) determined that parks "directly promote physical activity, and indirectly mitigate stress via the spaces' positive impact on social support" (p. 1209). They also found that defined park space demonstrated a "much more positive impact on health and wellbeing than the overall neighborhood vegetation level" (p. 1209).

A study by Broyles, Mowen, Theall, Gustat, and Rung (2011) sought to determine whether the concept of social capital could be applied to the community of a park. They questioned whether the social environment of the park itself could have an impact on physical activity. Working with a sample of 27 neighborhood parks in New Orleans, they surveyed 222 adult, non-first-time park users to assess "park-based social capital," based on six questions that addressed aspects of "social cohesion" and "informal social control" by park users (Broyles et al., 2011, p. 523). They observed park users to count the numbers of users and assess physical activity levels. Broyles et al. (2011) found that "parks with higher than the mean level of social capital had greater than 3.5 times more park users observed and yielded greater than four times the volume of physical activity, compared to parks with lower levels of social capital" (p. 526). They also found that parks with higher social capital drew users from longer distances, which theoretically would introduce activity to the nearby neighborhood.

Amenity-oriented greens, such as dog parks, add another level of diversity to park identity. Drawing on findings that walking with a dog provides health benefits for humans, and "can facilitate social interactions among people," Christian, Giles-Corti, and Knuiman (2010) determined that dog "owners are more physically active than non-owners" (p. 44). They also found that dog owners were more likely to walk their dog regularly if they perceived greater social support for walking their dog as well as having a dog-supportive park in their neighborhood (p. 50).

Developing defined greens into community gardens can also produce an asset that enhances neighborhood social interaction. Assuming the foundations of safety found in proximate activity and eyes on the street, community gardens have been shown to enhance neighborhood social capital. Alaimo, Resichl, and Allen (2010) examined associations between participation in community gardens and perceptions of social capital at both the neighborhood and individual levels in Flint, Michigan, United States. They found "that organizing neighborhoods for gardening and beautification can improve perceptions of social capital among those who participate, and that more people attending neighborhood meetings within a neighborhood improves the perceptions of linking social capital even among those who do not participate" (Alaimo et al., 2010, p. 512).

Other studies have examined the relationship between community gardens and social interactions in a neighborhood. Nicole Comstock and her coauthors (2010) surveyed 410 residents on 45 blocks east of I-25 in Denver, Colorado, to study the relationship between community gardening

and neighborhood attachment, based on the assumption that neighborhood attachment is a marker for higher engagement and social interaction which benefits both the individual and the neighborhood. Typically, length of time in residence and home ownership are associated with neighborhood attachment; Comstock et al. (2010, p. 439), however, found that community garden participation had greater impact than home ownership and neighborhood attachment. These findings suggests that the introduction of community gardens into neighborhoods can engage tenants as well as owners, and proposes that if "renters can become involved in meaningful neighborhood activities such as gardening and thus strengthen their sense of collective efficacy, it may be possible to enhance their sense of attachment" (Comstock et al., 2010, p. 439).

Conclusions

The studies discussed here represent a small segment of a rapidly growing body of literature on neighborhood characteristics, social interactions, and health. The results of these investigations provide substantial evidence that the built environment affects social interaction in neighborhoods with direct and indirect impacts on individual and community health. Barriers to walking and impediments to social interaction are specifically associated with negative health effects: disease and mortality. Inducements to walking that form a framework for social interaction, such as the list of elements discussed in this chapter, demonstrate positive effects: better physical and psychological health for individuals as well as vitality for the community.

Designers can rely on this evidence to convince private and public clients to intervene in ailing neighborhoods with a kit of parts that include strategies to achieve the safety, pleasure, and trust that enables social interaction. The fundamental aspect of safety—eyes on the street—requires people walking along the street and people watching others walk. A mix of building uses, shorter blocks, and enhanced street connectivity have been associated with both higher levels of walking and greater social support and social cohesion. The insertion of cultural facilities and parks into neighborhoods can be beneficial if the first order of eyes on the street is applied with nearby mixed-use buildings that both provide the sidewalks with activity as well as people to watch the activity.

From the precise placement of individual, mixed-use buildings, to the sidewalks of a highly linked street network of short blocks and diverse

uses, the intertwined goals of walkability and increased pedestrian activity can successfully provide places that enable, support, and enhance the social interaction of neighborhoods. There are many more detailed, quantitative aspects to the research-validated neighborhood characteristics. Retail specialists, for example conduct analysis on the specific ratios of various uses most likely to generate pedestrian activity in a given location. There also are qualitative aspects, such as the particular toy store that attracts children of all ages or the bakery that offers the best bread. And there are other smaller grained elements that need to be studied to provide communities and professionals with effective tools to assess design impact. Some of these can be generalized across certain locales, such as sidewalk widths, curb heights, and the quantity of curb cuts, while others may be highly localized, such as the precise distance a pedestrian will walk before losing interest in a façade, or the character of a street most likely to attract activity.

Identifying and analyzing successful places represents the detailed observation that Jane Jacobs (1961/1992) exemplified as a method of understanding the complex physical and social phenomena of neighborhoods. Her directive to look closely at the elements of successful places identifies an ongoing resource that invites continued analysis and provides local identity. Jacobs urged highly refined observation and admonished those who would seek to reduce the elements of a neighborhood to simplicity.

Each of these elements interacts and accumulates to make the built environment safe, pleasurable, and trustworthy: characteristics essential to pedestrian activity, which is the foundation of social interaction in neighborhoods. First, however, it is important to establish the goals. The evidence of the last 50 years validates and reinforces the conviction laid out by Jane Jacobs that the first priority should be safe, lively, and interesting streets. If all the elements are in place to support this goal, all else will follow.

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6

Living in the City

Mixed Use and Quality of Life

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Introduction

More than 50% of the world's population now lives in cities and by 2050 this is forecast to reach two thirds of the global population: in the United Kingdom 90% of people already live in urban and suburban areas, or more if we include those who travel to the city or town for work. Over 40 years ago Henri Lefebvre (1968) maintained that society had become completely urbanized: this urbanization was virtual then but would become real in the future. This urban state is not just an administrative city or urban agglomeration, but essentially one of urban society and social relations and the effects of industrialization, which has absorbed agricultural production and the countryside, including its recreational and "greenbelt" role, for urban dwellers and urban development.

When Dickens wrote a *Tale of Two Cities* (1859), London had become the first industrial world city with over a million inhabitants; now this world city is outstripped by megacities of Asia, Africa, and South America: from Lagos to Sao Paolo and from Mumbai to Mexico City. Regional geographers and economists now talk of city regions as the real powerhouse of the weakening nation state, with long-distance daily commuting extending the city boundaries: over 1 million people travel to London each day. In Mexico City the average daily commute is 2.5 hr and by 2050 in the United Kingdom it is forecast that the average time an urban dweller will spend

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in traffic jams will be 106 hr a year: three times more than today (IBM produce an annual Commuter Pain Index, which ranks the emotional and economic toll of commuting in international cities). Mayors of both cities are preoccupied with the same concerns: transport, pollution, crime, and the quality of life of residents, including growing obesity epidemics in children (Delpeuch, Maire, Monnier, & Holdsworth, 2009). Together these make up many of the key elements and indicators of urban wellbeing.

How wellbeing is defined and measured is beyond our scope here, but it is generally referred to through the proxy quality of life, combining physical, material conditions—and mental health and social perceptions of wellbeing—although there is no consensus over what defines "quality of life" (Bowling, 1998). Built-environment factors associated with mental wellbeing include density, floor level, noise, and environmental qualities (Cooper, Boyko, & Codinhoto, 2007), but even these are context-specific; for example, a 20th-floor penthouse compared with a council block, or dense communal versus atomized living. The experience of different built-environment configurations is both subjective and individualistic, depending on social conditions and relations, irrespective of the degree of density or mixed use. The combination of uses, occupants, and activity seldom feature, however, in studies of housing and wellbeing (Garcia-Mira, Uzzell, Eulogio Real, & Romay, 2005, p. 1), with the dwelling treated as an immutable form irrespective of the mix of residential/nonresidential uses within and in adjoining buildings. Crude measures of density only reflect dwelling or population per hectare, which do not take into account ambient factors such as open space, public realm, views, amenity, and so forth. (Bibby, 2006). This is despite the fact that "mix" has been a more common element of the urban living condition than studies of urban morphology and city life tend to reflect, in large part due to the spatial separation of land/building/economic uses from the industrial and particularly the modern town-planning eras.

Elements that feature in resident assessments of liveability also reflect social as much as physical conditions (Figure 6.1). Environment, amenities, and services feature highly and how these factor in mixed-use areas and living will be considered further here through our empirical investigation.

From classical times to industrial and postindustrial eras, the city has also been presented as a dichotomy and a source of dialectical discourse; that is, we either hate them or love them and we change our feelings and behavior towards them throughout our lives. Given the extent and longevity of urbanization, however, we have little choice but to try to improve the city rather than escape from it (although we try harder and

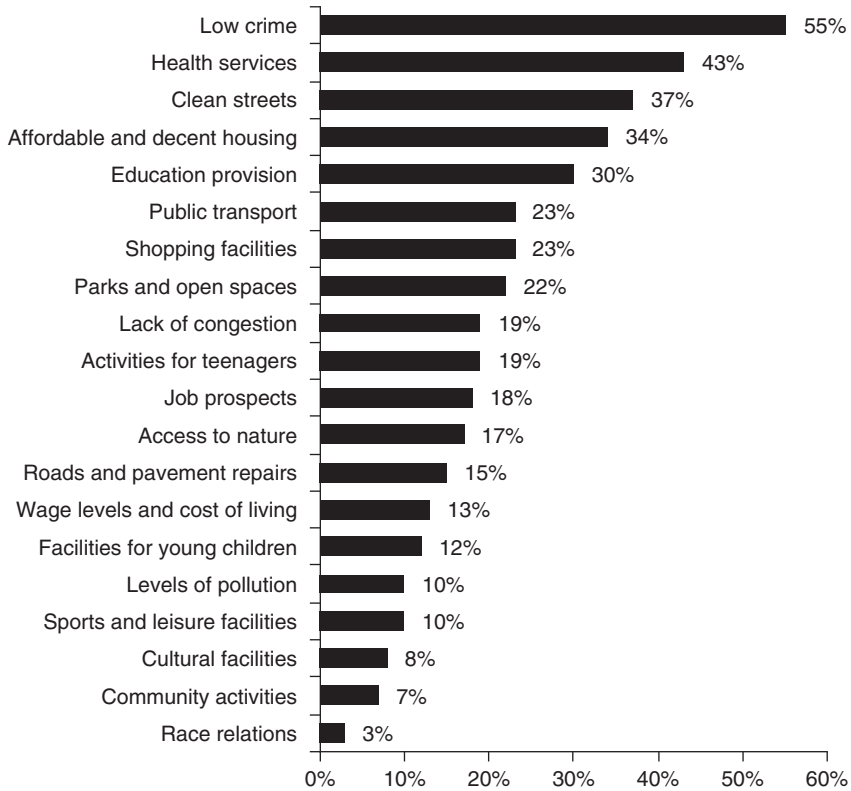


Figure 6.1. Attributes that Contribute to Making Space and the Physical Environment a Good Place to Live (BVPI, 2007).

harder to do so with diminishing success). This of course explains our desire and basic need to recreate the countryside in our cities through public and private parks and gardens, including hanging baskets, allotments, and city farms, and the rediscovery of the amenity value of waterside developments overlooking rivers, canals, and postindustrial docklands: common locations for commercial mixed-use developments and new apartment housing.

Another observation is that cities seem to be bad for us, or at least our mental health. Studies carried out in Sweden, Germany, and the United Kingdom in the last decade (Sundquist, Frank, & Sundquist, 2004; Van Os, 2004; Van Os, Driessen, Gunther, & Delespaul, 2000) have made the causal link between the incidence of the onset of schizophrenia (perhaps as high as 30% of cases in Sweden), heightened stress, hospitalized depression and urban living—when compared to more rural living—even after discounting other explanatory factors, such as genetics or birth defects. In

the case of residents of socially fragmented areas, being socially isolated or in a subordinate position seem to be important, along with population density, ethnic density, deprivation, and reduced social capital and cohesion; thus, *area* rather than individual characteristics were the main determinants. This is perhaps neither new nor surprising. Georg Simmel, over a hundred years ago in *The metropolis and mental life* (1903) viewed the city not just as a site of modernity but a disorienting space that produced agoraphobia and claustrophobia. His solution was to adopt a blasé attitude and detached nonchalance, and perhaps this explains our lack of conversation and conviviality in public today, and our growing atomization, both in and out of the home. Although familiarity and modern technological advances have eased postindustrial city living, these feelings can still be experienced from time to time in less familiar situations and particularly by the more excluded and vulnerable individuals and communities.

One finding from this "urbanicity" research (Van Os, 2004) is that a key environmental driver of stress is *noise*, and it is interesting to note that this is by far the most common complaint that environmental health officers now receive locally (see later in this chapter). This is also validated conversely by studies of amenity value in terms of our proximity to trees, green space, and even views, measured by quality of life, health, and property values; values that change significantly as proximity alters over very small distances (CABE Space, 2005; De Rosiers, Theriault, Kestens, & Villenneuve, 2002; Greater London Authority, 2003; Luttik, 2000). So the local, the neighborhood, and the everyday are most important, with over two thirds of our trips taken under 8 km in distance. Walking to the shops or school has, however, declined in favor of the car, so planners, urban designers, and government all look to the compact city model and greater public transport and walkability as a panacea for urban sustainability (Evans, Aiesha, & Foord, 2009). Mixed use has been one of the prime design and development vehicles to combine efficient use of land and space through lower space standards and the synergies from mixed-use commercial schemes (retail, office, leisure, residential) and apartment blocks.

Conceptualizing Mixed Use

The architectural and planning response to incremental urbanization and densification—manifested in a new hybrid practice of urban design and its scalar equivalent, "masterplanning"—has thus been a reconceptualizing

of the compact city requiring higher density and mixed land and building uses. As well as higher density and intensive use of existing space, the compact city as promoted by Richard Rogers and the Urban Task Force (1999) is predicated on living and working in close, ideally walkable/cycling proximity, thereby reducing car use and therefore pollution and accidents, as well as reducing street crime and revitalizing local economies. A particular design and built-environment solution has been the mixed use of buildings and blocks, both vertically and horizontally. This looks to the continental nineteenth century mixed-use plot and building, with greater apartment living and mixed use of premises. However, despite its ubiquitous adoption by government, planners, and developers alike, making it a commonplace development type, Rowley (1996) concluded that "the concept of mixed-use is ambiguous . . . subject to simplistic analysis and wishful thinking . . . nostalgia and propaganda overtaking research and analysis" (p. 85), a policy panacea without a sound evidence base or detailed design guidance (Evans et al., 2009, p. 198). "Mixed use" as a development and design form and its social and environmental consequences are therefore the subject of this chapter.

Mixed land use, linked to high residential density and extended temporal use of space, are one of the core elements of the compact city ideal, and this has been widely identified as a useful mechanism for delivering urban sustainability objectives including urban vitality, "liveability," efficient use of urban utilities and social cohesion. At the sharp end of planning practice the sustainability agenda is often reduced to specific identifiable interventions that can be enforced and measured. Breheny (1996) foresaw this response when he suggested that ". . . [t]he effectiveness of grand urban sustainability strategies may rest or fall on the degree [to which] modest sounding initiatives—densities, car parking standards, mixed uses—can be made to 'stick'" (p. 26).

The promotion of mixed use as a planning concept emerged alongside a dismissal of CIAM[1] functionalism. In the seminal *Green Paper on the Urban Environment*, the Commission of the European Communities insisted on the "mixing of urban uses—of living, moving, working," taking as its model "the old traditional life of the European City (e.g. Vienna, Barcelona, Berlin, Budapest) stressing density, multiple use, social and cultural diversity" (Commission of the European Communities, 1990, p. 43). A key objective of European urban policy ever since has been to raise the quality of urban life by (re)creating compact European townscapes with integrated mixes of residential, commercial, and public amenity uses

(European Commission, 2009). In the United Kingdom, the urban white paper *Delivering the urban renaissance* (HMSO, 2000) adopted a similar approach and in so doing addressed a reform of planning by advocating the promotion of "mixed development, so homes are closer to jobs and services" (para 4.24). Likewise in North America cities already concerned about the decentralizing effects of megamalls and edge cities (Garreau, 1991) have introduced mixed-use zoning (Grant, 2004). In many places mixed-use development is now the planning norm rather than the exception.

However, definitions and typologies of mixed use remain muddled. For Rowley (1996) mixed use needs to be understood in terms of its grain, density, and permeability; setting or scale (building, block, street, or neighborhood); location (central, inner, or suburban/edge); existing and future residential and commercial tenures; processes by which mixing takes place (conservation, incremental change, or wholesale redevelopment); and forms and management of temporal space sharing. It is, he argues, the combination of these factors that influences the character and quality of mixed use. Likewise Rodenburg and Nijkamp (2004) attempt to represent the complexity of space, activity, scale, and time of multifunctional (mixed) land use by prioritizing two processes: an increase in spatial heterogeneity over time and the "economies of synergy" emerging from relationships between copresent land uses. Neither approach has led to a workable definition or typology. Sieverts asks the pertinent question: "what type of mixture is meant: is it a mix in the building itself, in the interaction with the street or in the urban quarter?" (Sieverts, 2003, p. 33). From the urban environment and wellbeing perspective, all of these scales are of concern and combine to represent the mixed-use living experience.

The contemporary idea of mixed use has also been given its greatest impetus from the rediscovery of Jane Jacobs' nostalgic depictions of 1950s New York inner city neighborhoods (Aldous, 1992; Biddulph, Tait, & Franklin, 2003; Congress for New Urbanism, 2001). Jacobs' declaration that short blocks, assorted building types, and varied street morphology created (the conditions for) economic and social diversity (and therefore animation and security) have been widely reproduced by a new generation of urban policy makers. Although Jacobs' original description of mixed-use streets failed to recognize the wider context of postwar social and economic restructuring (Breheny, 1996, p. 20) it did coalesce with late twentieth century analysis of the new urban economy (Hutton, 2008; Scott, 2000) and the emergence of an "urban idyll" inhabited by consumption-orientated subcultures (Allen, 2007; Featherstone, 2007; Hoskins & Tallon, 2004).

An important incentive for promoting the idea of mixed use was therefore the remaking of the inner city in response to the new economic aspiration of small enterprises, services, and creative industries, and a new urbane, cosmopolitan population.

Practicing Mixed Use

Research into current forms and outcomes of mixed-use practice is also limited. One review of 12 new-build mixed-use schemes and one mixed-use neighborhood found that the most common combination is a dual mix of market housing and office development. There is reluctance on the part of planning authorities to approve schemes including industrial or leisure activities (commonly perceived as incompatible with residential use) (Office of the Deputy Prime Minister, 2003). Regardless of spatial scale, the desired vitality outcomes of these schemes are only delivered when "uses visibly activate[d] the ground floor level of buildings and the street environment in a positive and integrated way" (Office of the Deputy Prime Minister, 2003, p. 10). Most schemes struggle to generate the desired integration while poor synergy with the surrounding urban landscape is cited as detrimental to the overall success of a scheme or neighborhood. Where the existing urban fabric provides a well-founded structure within which a new mixed-use scheme is developed, there appears to be a greater chance of mixed use adding value to the urban experience. This is confirmed by research into mixed-use streets where the compatibility of activities and traders was found to be critical in fostering appropriate levels of vitality (as opposed to intense forms of overuse/abuse) throughout the day and evening (Jones, Roberts, & Morris, 2007).

Delivering street-level occupancy has generally proved problematic. Mixed-use development schemes in London completed between 2001 and 2005 had vacancy rates of 34% for office space and 27% for retail space (Giddings & Craine, 2006) and still today many of these developments display empty ground floor premises, reducing street life, surveillance and the amenity of upstairs occupants. In a comparative study of Sheffield, Manchester, and London, Evans et al. (2009) also found high levels of ground-floor commercial vacancy, particularly in areas targeted for mixed-use regeneration. The quality of architectural and urban design can influence the vitality potential of nonresidential uses and the degree to which integration with the surrounding urban landscape is achieved (Coupland, 1997).

Mixed use has also been associated with urban intensification policy. However, a national survey of residents living in intensifying neighborhoods found no evidence of the oft-cited benefits: increased neighborliness and social cohesion. Increases in the disbenefits of intensification—overcrowding, increased environmental wear and tear, and conflicts over parking, traffic, and noise—were more likely (Williams, 1999, p. 172). Noise generated by groups of late-night drinkers has also been found in intensifying areas with a mix of nighttime economy and residences (Roberts & Gornostaeva, 2007), as discussed below. Likewise, reductions in daily car use linked to intensifying mixed-use urban forms have been counteracted by increases in weekend trips to suburban and edge-city retail destinations and short- and long-haul air travel (Frank & Pivo, 1994; Holden & Norland, 2005; Saelens, Sallis, & Frank, 2003).

Most studies of mixed-use (city-center) residents focus on the lifestyles that appear to fuel particular forms of culture-led gentrification (Allen, 2007; Howley, 2009; Smith, 2008). However, it is important to stress that many mixed-use schemes and areas accommodate a wider range of ages and income levels than this work implies. For most ordinary residents of mixed-use schemes and areas it is the everyday services and facilities that are valued most (local shopping, services, and amenities including open space, local leisure, and entertainment including bars, cafes, and cinemas) (Office of the Deputy Prime Minister, 2003). Nongentrifying mixed-use city-center residents cite "mundane, banal and routine aspects of city life such as the convenience of being close to points of employment and consumption" as the main reasons for living in a mixed environment (Tallon & Bromley, 2004, p. 784). However, families with children are underrepresented in mixed-use environments, particularly in city centers. The absence of family accommodation and the paucity of educational provision (priced out by higher rents from school buildings and from private housing and advanced producer services, e.g. architects) in many inner and central urban locations raise doubts about the way in which current mixed-use practice delivers on social sustainability (Silverman, Lupton, & Fenton, 2005; Unsworth, 2007) and, more generally, social inclusion (Bramley & Power, 2008; Camina & Wood, 2009; Graham, Manley, Hiscock, Boyle, & Doherty, 2009).

This growing body of research questions both the assumptions of planning policy and its ability to deliver sustainable mixed use, at least in the short term. Despite the widespread policy agenda supporting mixed use there is insufficient evidence to firmly establish the positive impact of mixed use on urban vitality, utility use, or wellbeing.

Clerkenwell: Mixed-Use "Urban Village"

The relationship between urban diversity and quality of life is a recurring assumption in mixed-use policy. However, how land-use diversity enhances the quality of urban life is poorly understood. Our first case study aim was to investigate the spatial dimensions of mixed use, diversity and vitality. Clerkenwell (see Figure 6.2), to the north of the City of London, was chosen primarily for its long history of dense (compact) mixed residential and industrial activity and as a site of current processes of economic restructuring and gentrification (Hamnett & Whitelegg, 2007; Hutton, 2008). It was also one of the first "urban villages" identified by proponents of New Urbanism in the 1980s (Aldous, 1992).

There are approximately 20,000 people in over 10,000 households living in the Clerkenwell case study area at densities of 116 people per hectare/55 households per hectare, more than double those for London. Although most of the population is relatively young and of working age (38% aged between 20 and 34 years old and 28% aged between 35 and 54) there are still approximately 3,500 children under the age of 15, and 2,000 people over the age of 65 living in this mixed-use neighborhood. Most live in rented flats and fewer than 3,000 households have access to a car. The Mosaic consumer lifestyle classification identifies most households as falling within one of four "lifestyle types," highlighting the polarized pattern of gentrifying affluence and relative poverty (Figure 6.3).

To assess the experience of living in Clerkenwell, a household questionnaire was administered, face to face, with a sample of 80 residents. Shorter "vox pop" surveys were also administered at successive exhibitions at the London Architecture Biennales in 2004, 2006, and 2008, held in the area. Access to residents was managed initially through contact with local gatekeeping organizations (residents' associations; social clubs; play, children's and youth groups; tenants' groups; local representatives) and subsequently through snowballing. Particular effort was made to find "hard-to-reach" residents.

Of those respondents in work, the majority (63%) worked outside Clerkenwell with most either walking or using public transport (mostly buses) to reach work. Respondents were rarely able to find work and housing in the same neighborhood. Many newly arrived residents (less than 1 year) reported changing their main mode of transport for their journey to work, using a car less, walking more, and increasingly catching the bus (i.e., compact city "gain"). But this positive sustainable behavior did not derive from

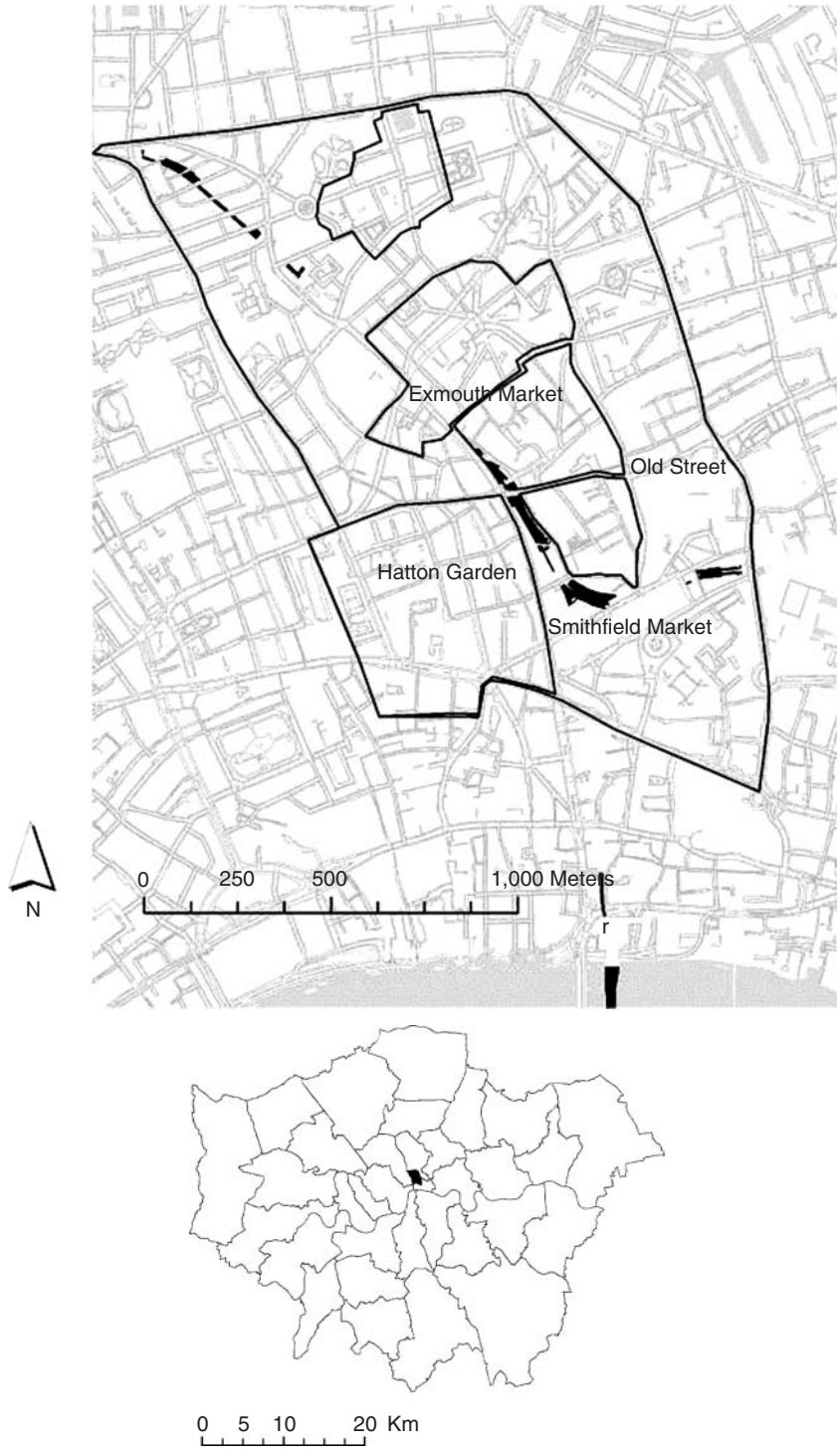
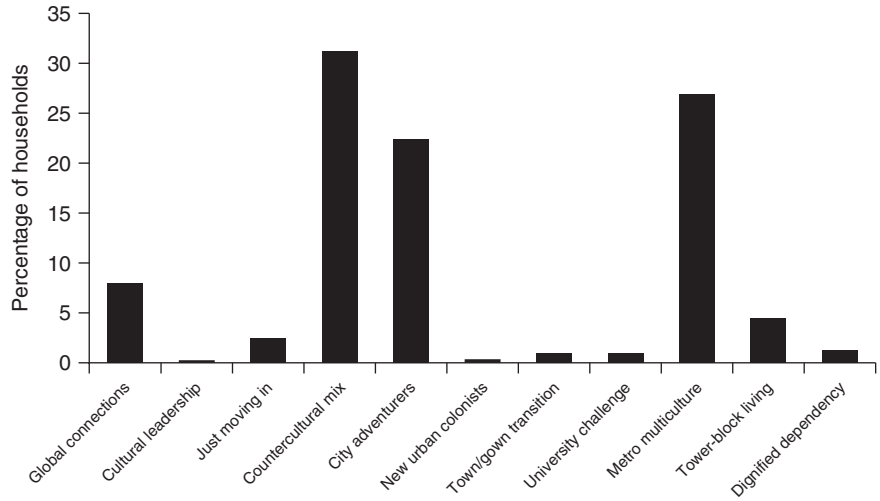


Figure 6.2. Clerkenwell Study Area. Top: District Boundaries, UK Borders ESRC/JISC Agreeement. Bottom: OSMatermap Ordnance Survey Crown Copyright.



Global connections	Extremely expensive housing, mostly in central London occupied by rich from abroad and by childless older people on extremely high incomes.
Countercultural mix	A mixture of young professionals in rented flats, ethnic minorities sharing large older houses, and poor tenants in council flats: characteristic of less-well-off areas surrounding central London.
City adventurers	Twentysomething singles who command extremely high salaries working in high-pressure jobs in central London. Most spend very small amounts of time in their smart studio flats.
Metro multiculture	People who rent public housing in the inner areas of London where a particularly high proportion of the population belongs to minority ethnic communities.
Tower-block living	Areas where the majority of the population live in high-rise flats and experience high levels of social and economic deprivation.

Figure 6.3. Mosaic Lifestyle Types. Source: Experían Limited Demographic Data, ESRC/JISC Agreement.

Clerkenwell's compact mixed-use form but from its geographical location on the edge of central London.

Respondents were asked which nonwork activities they were able to undertake within the neighborhood and which ones took them further afield. Most everyday activities could be accomplished within Clerkenwell, including grocery and household shopping, appointments with health and social services, and visits to a park (Figure 6.4). Many residents made good use of the local pubs and restaurants with only shopping for clothes/shoes and larger household items predominantly taking them elsewhere. However, most of the activities undertaken in Clerkenwell were also undertaken elsewhere in London, including trips for everyday necessities such as shopping for food and groceries and using professional services such as lawyers, accountants, or advice services. Despite a wide variety of local entertainment and eating venues, a significant proportion of respondents reported going

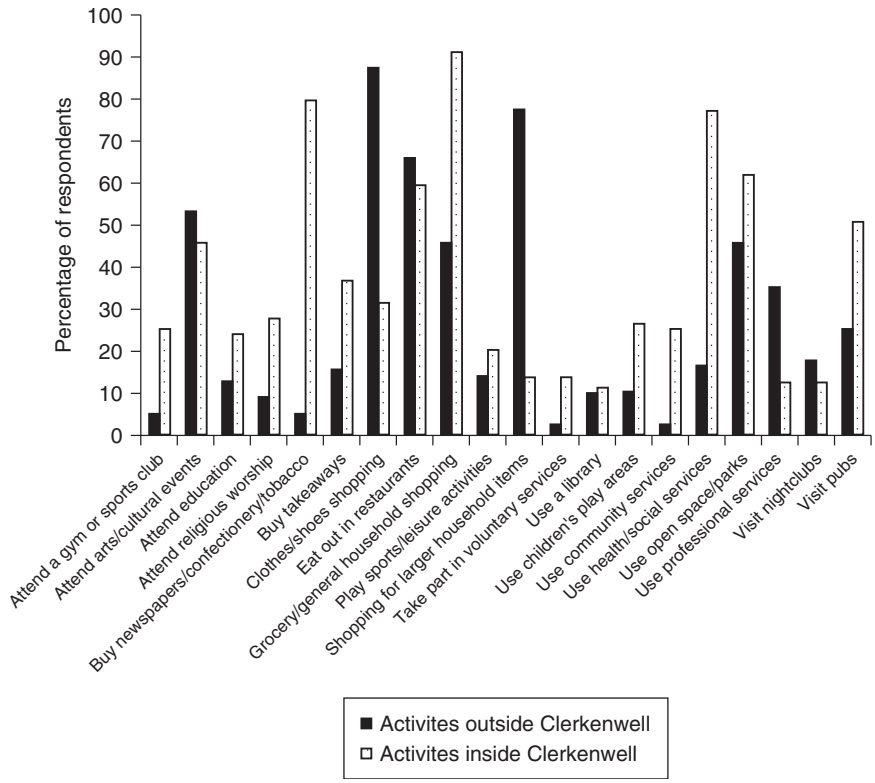


Figure 6.4. Activities Inside and Outside Clerkenwell.

elsewhere when choosing a place to socialize with family, friends, or work colleagues. This suggests that, while the study area is characterized as a compact mixed-use area, it is also extremely permeable. Not all needs were adequately met within the neighborhood. For some residents this permeability enabled them to take full advantage of Clerkenwell *and* the wide choice of jobs, services, entertainment, and goods available in north and central London (and beyond):

> Everything is within walking distance. We have six tube stations, Kings Cross, Farringdon, Barbican, Moorgate, The Angel, Old Street: six within walking distance. It takes 15 minutes to walk to Liverpool Street, you have all the buses you need, buses that take you anywhere in London, you have Liverpool Street, Farringdon takes you to Luton, Brighton, Gatwick Airport, Kings Cross takes you to Heathrow . . . ."
>
> Resident

For others, permeability was forged out of necessity. Inadequate product ranges and poor choices or value for money in local food and other household retail outlets meant they had to leave the neighborhood to obtain daily necessities. Respondents reported recent changes in the local area, forcing them to go farther afield for basic supplies:

> There's Exmouth Market, 25 years ago it was a market, you had food stores and utility stores, somewhere to get your boots sorted or your clothes and there was a Woolworth's at the end of the road. . . . Now you have wine bars and flash restaurants . . . ."
>
> Resident

However, when identifying possible benefits of living in a mixed-use neighborhood, residents were most likely to say "convenience of shops and services," "more people around," followed by "lively and vibrant atmosphere." When asked at what time they benefited most from living in a mixed-use area, the highest percentage of respondents selected a benign category, "throughout 24 hours," although significant percentages of respondents identified the categories "during the day," "early evening," and "late evening" (Figure 6.5). This suggests that mixed use provided an animated backdrop to everyday life and convenience when needed.

A quarter of the respondents lived in mixed-use buildings: flats in converted nineteenth-century industrial buildings with offices, shops, or restaurants at lower levels or post-2000 new-build schemes. For these residents the primary benefits of mixed use were slightly different: for this group having more people around, good nonresidential neighbors, and added security scored highly suggesting particular benefits relating to their specific building. They were also more likely to experience these benefits during the day, signalling a positive support for everyday activities rather than a "lifestyle."

Local disadvantages of living with non-residential activities were more numerous, including several that created a noise nuisance either directly or indirectly (litter/rubbish, noise/vibration, noise/disturbance from customers/clients, antisocial behavior, deliveries/loading/unloading) (Figure 6.6). Respondents were more able to select a specific time of day or night when they were disturbed. Resident comments included:

> I hear the dustmen clanking around quite late at night. Sometimes there are drunk students shouting to each other down the road. It's quite a nice street but it's a thoroughfare.

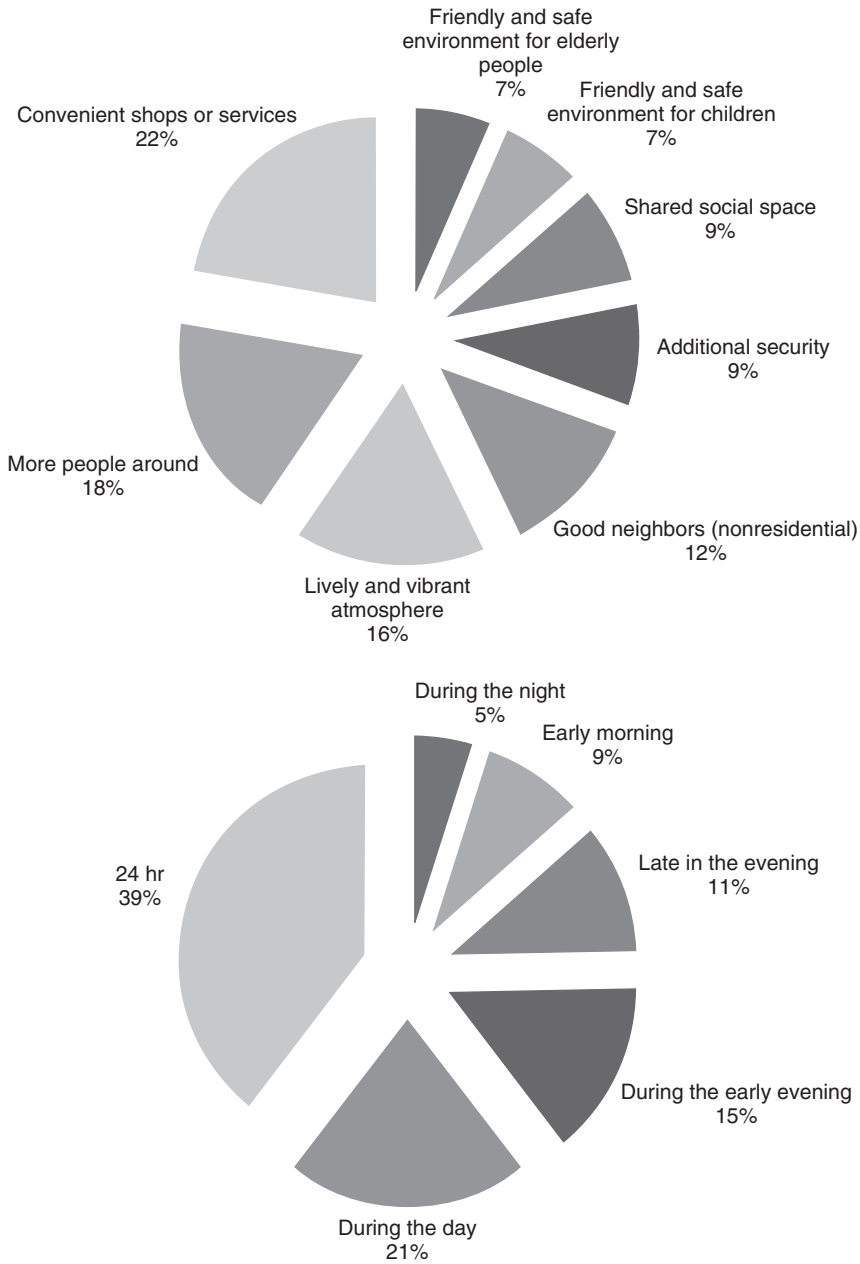


Figure 6.5. Advantages for Residents. Top: Advantages of Colocation of Nonresidential Activity; Bottom: Time of Advantages of Colocation of Nonresidential Activity.

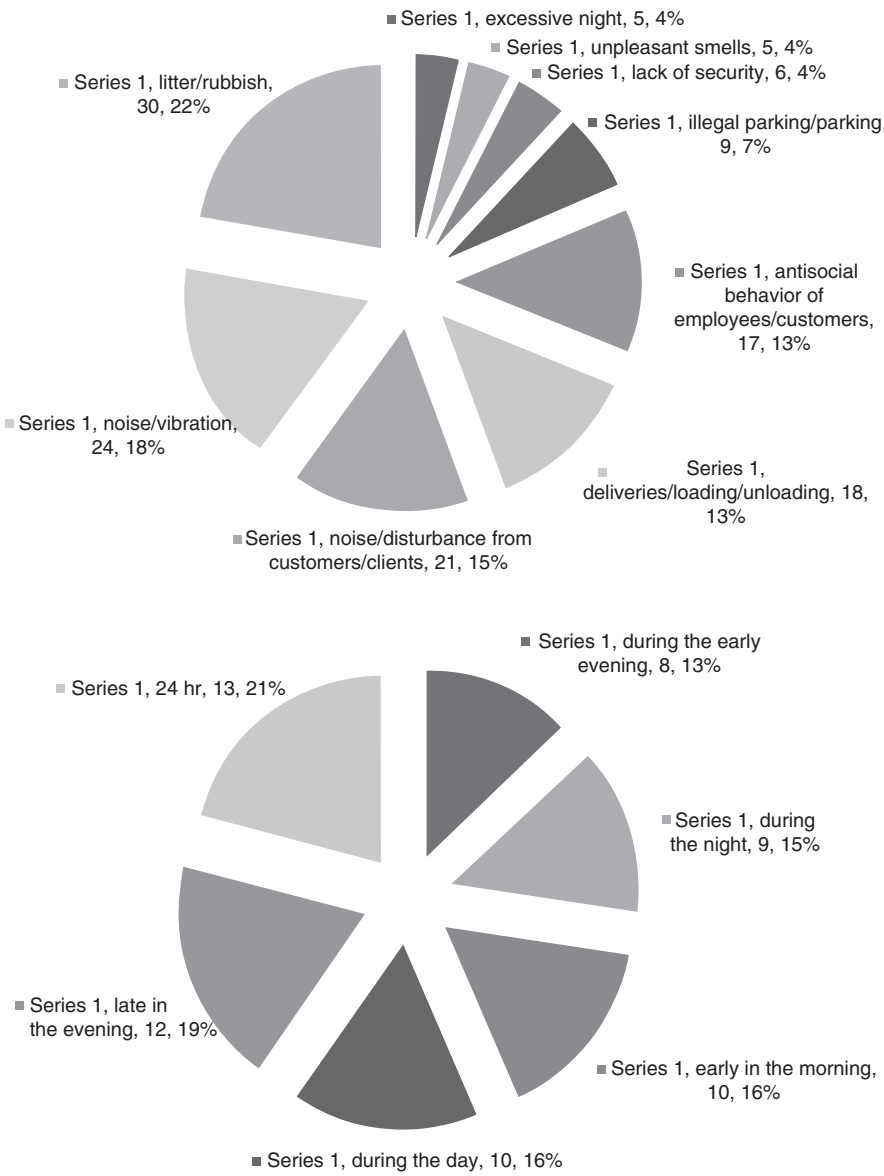


Figure 6.6. Disadvantages for Residents. Top: Disadvantages of Colocation of Nonresidential Activity; Bottom: Time of Disadvantages of Colocation of Nonresidential Activity.

> For me the problem is the litter.... It stinks. There are two problems with rubbish, there are no bins in most places so they drop things along the street. The other is the problem on the street. A lot of people put their rubbish out when they feel like it: maybe 3 days before the collection. It's not pleasant in the summer, especially when the cats get to it.
>
> In Exmouth Market they put the rubbish by the trees—you get one rubbish bag—two hours later you've got ten. Every tree has a mountain of rubbish bags.

For those residents living in mixed-use buildings litter/rubbish bothered them most but there was no particular time in the day when problems arose. Management of mixed-use buildings was identified as a particular problem, followed by the interior design, traffic noise, and poor quality of their outside space. If noise is the main downside of a living in a mixed-use area (see later in this chapter), poor management and design detract from living in a mixed-use building.

A number of attitudinal questions were used to address the overall quality of life experienced by residents. The majority (72%) felt that their environmental quality of life was fair or good with less than 10% ranking it poor or very poor. About a quarter said their quality of life was excellent. Those claiming poor or very poor qualities of life were clustered in one particular area of social housing to the southwest of the study area, squeezed between a densely mixed commercial subarea and a major thoroughfare and at a distance from community amenities and open space which are predominantly located to the north and east of the study area (Figures 6.2 and 6.7). Respondents here were also more likely to say that they did not feel safe and secure in their homes, particularly after dark. Most of these households included children under 12 or someone over 65 and some of the area's most vulnerable social groups. These respondents did not feel much benefit from living in a mixed-use environment: on the contrary they felt isolated from amenities, shops, and employment.

Community Safety

Safety and security are prime quality-of-life elements expressed by fear of crime (Figure 6.1) and other official measures of wellbeing such as Indices of Multiple Deprivation (e.g., crime and disorder). Recorded crime also provides the official data that can be matched and mapped to location (building;

(a)

(b)

Figure 6.7. Land Use in Clerkenwell: Ground Floor (a) and Second Floor and Above (b). Adapted from R. Cooper, G. Evans, and C. Boyko (Eds.) (2009). *Designing sustainable cities*. Wiley Blackwell, 2009.

e.g., burglary) and area type (e.g., street). One tenet of the compact city model is that natural surveillance, greater vibrancy, and animation at street level provide a more secure environment for residents and other users, while social cohesion is also engendered by higher-density, mixed-use living. From

our residential surveys this is not necessarily the case because sociospatial divides persist, despite close proximity and "shared space." Mixed-use development also offers particular security features such as living above ground level and reduced access for burglars and other uninvited visitors. From our case study, commercial burglary was higher where shared entrances were not controlled by a single company, unlike say a ground-floor shop, and natural surveillance did not outweigh easy access. However, for residents, street robbery (e.g., "mugging") and burglary of domestic dwellings are the two crime-based determinants of safety and security, and, therefore, wellbeing.

The vertical distribution of accommodation usage types is visualized in Figure 6.7, illustrating the distribution of land use at ground and then second floor and above levels (Penn, Perdikogianni, & Mottram, 2009). This shows the extent of residential accommodation in the darker areas between these two levels (lighter areas indicate commercial, retail, and leisure building use). This is represented by mid- and high-rise blocks, and loft-living-style apartments above ground-floor retail, cafes/restaurants, and offices.

The maps in Figure 6.8 show crime densities ("hotspots") for residential burglary and street crime ("robbery"), indicated by clouded areas. Street robbery is concentrated on the edge of the activity area, particularly large housing estates set back from wide, busy roads. It is only high in the central areas where nighttime activity (marked by dots) is located, such as in bars/clubs, cafes, and restaurants frequented by visitors, not locals (see later in this chapter).

A general conclusion is that mixed-use areas (as opposed to single mixed-use developments) suffer less crime of the type that are attributed to the wellbeing of residents; however, the mix of economic and land uses does support opportunistic crime, particularly vehicle (including bicycle) theft and vandalism. This is in contrast to areas within and on the fringes of this mixed-use area, with more mono-use residential areas which lack natural surveillance and diversity of street life, where street crime is much higher and "mixing" is less apparent.

Nighttime Economy

Whereas recorded crime provides one view, the residential quality-of-life factor most associated with mixed temporal use relates to nighttime activity, particularly pubs/bars, dance and music clubs, and related antisocial behavior on the streets as well as from neighbors. The liberalization of licensing hours and Sunday trading from the 1990s in the United Kingdom fuelled an

Figure 6.8. (a) Street Robbery (Snatch Theft) Density; (b) Domestic Dwelling Burglary Density. Criminal activity is indicated by the clouded areas. Adapted from R. Cooper, G. Evans, and C. Boyko (Eds.) (2009). *Designing sustainable cities*. Wiley Blackwell, 2009.

explosion of alcohol-based activity in city-center sites. For example, in Manchester city center the number of licensed premises increased from 225 in 1995 to 430 in 1998 and over 540 by 2002, with 166 venues holding public entertainment licences with a total capacity of over 110,000 people (Hobbs, Lister, Hadfield, Winlow, & Hall, 2002): these are predominantly nonrestaurant and nonnightclub "bars." On Friday and Saturday nights young visitors trebled from an estimated 30,000 in 1992 to 100,000 a decade later. A survey of local authorities conducted in London during 2004 highlights the factors and issues arising from this trend in late-night activity, with 100% of outer London and 91% of inner London authorities reporting a significant growth in evening/late-night activities (Roberts & Gornostaeva, 2007). Applications for liquor licences increased by 45% between 1983 and 2003, the majority of these located in pubs and bars (71%) and restaurants (19%), concentrated in central London, but also in outer London. In Westminster City Council, for example, the total capacity of premises with late licenses in their "stress areas" of the West End, Edgware, and Bayswater was 64,000 with a closing time of 1 A.M., 20,000 at 4 A.M., and 12,000 closing at 6 A.M.

Particular problems cited by local authorities include insufficient public transport at night, rubbish/litter on streets, fouling of streets/lack of public toilets, and areas becoming unsafe and noisy. The domination of one user group creating a monocultural nighttime scene has not only raised the level of street violence, antisocial behavior, and a flourishing control and security class (Hobbs et al., 2002), but has also crowded out a wider range of activities and users, particularly older people and families. This scenario is now played out in British city and town centers, from Leeds to Swansea (Thomas & Bromley, 2000). In our Clerkenwell case study area, however, while licensed clubs and drinking venues serve a late-night consumer, a wider range of eating establishments also serve a weekday office and residential market, so that one use/user group does not dominate, and the groups occupy the area at different, complementary times of the day and night. This city fringe location suffers less from the city-center nighttime crush and conflicts experienced elsewhere (including London's West End and Soho), maintaining both production and consumption activity in smaller-scale (and more upmarket) venues. Most residential accommodation is sufficiently far removed from this activity and flow of people. Where they combine, conflicts can arise, but these are often very isolated cases of street disturbances.

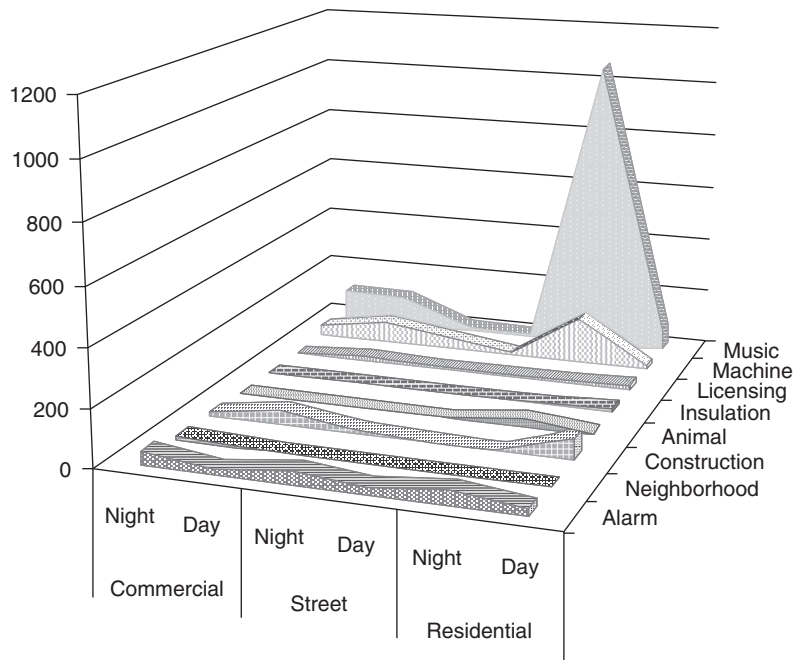


Figure 6.9. Noise Complaints by Number, Source, and Time of Day.

Data from noise complaints in Clerkenwell confirm the prime source of nuisance. Of over 2,200 complaints over a 1-year period 50% were from "music," of which 88% occurred during the nighttime (Figure 6.9).

The highest daytime noise complaints were from construction and machinery, as well as loud music. Six nightclubs with late-night music licences are located in the central area, including the first 24-hr licensed club in London. Late nights tend to run from Thursday through to Sunday, with 20,000 clubbers attending over this period. The local police maintain a close relationship with club management, mainly over drug use and parking. They "sweep" local streets to deter parking in or near residential areas to prevent noise after closing, and in fact few of the residents' complaints related to late-night club activity: several owners and staff live locally, and have a detailed knowledge of the area and the community. More problematic noise pollution emanates from smaller bars and restaurants, which are located on the ground floors of residential blocks (Figure 6.6). As already noted, environmental issues, including litter, antisocial behavior, and street crime (e.g., bicycle theft) represent the prime challenge for mixed use involving visitor

activity, while gentrification effects impact on the character and amenity for residents, and ultimately threaten the mix itself.

Loss of sleep (from external noise) was used as an indicator of the quality of urban life. Surprisingly, the majority of respondents did not report disrupted sleep patterns. In most instances the microspatial arrangement buildings minimized extreme instances of noise nuisance. Residents appear to have become accustomed to, though aware of and irritated by, the background noise during the day. However, clusters of sleep-deprivation scores were observed in subareas with intense or growing nighttime vitality and concentrated pockets of social housing where, as elsewhere, antisocial behavior is a problem.

Finally, when asked about the quality of their local community life, a third of respondents declared it poor or very poor and only 6% said it was excellent. Respondents did not tend to know many other local residents yet there were high levels of tolerance of others. There was also recognition that the area is changing and that this has social consequences:

> There's a lot of building work going on and refurbishment of old buildings that have been derelict for a long time . . . . More residential: the more expensive end. Quite different from the communities that have lived in this area and still do in some parts.
>
> Resident

Living in this mixed-use, mixed-tenure, neighborhood requires not only a certain urban sensibility but also resources (a job or income) to make it work. Most residents simply tolerated mixed use rather than actively engaged with it. Residents traded off the noise, disturbance, rubbish and litter, limited open space, inconvenient parking restrictions, and low levels of local community cohesion against the overriding benefit of Clerkenwell's location on the edge of central London, its "buzz," and its permeability. But there are groups of residents—families with children, households of elderly residents, and vulnerable new migrants—for whom the trade-off was not working and this compact mixed-use neighborhood, as currently manifest, is unsustainable. For them, proximity to and accessibility of central London is of little benefit and local services are not meeting all their needs. This group is being increasingly excluded from the public spaces of Clerkenwell and the mixed-use environment offers them no protection from social exclusion; indeed, it could be suggested that it exacerbates their isolation:

> The council wanted to have a mixed area. I don't think I'd like to live in an area where it was all one type of person. They're just over the road in council flats and houses. [But] it's like miles and miles: they never speak to each other across that void.
>
> Resident

Conclusion

Mixed-use policy emerged from a complex agenda to reclaim underused or underdeveloped urban spaces and to meet population and housing growth through higher density and compactness. Although mostly justified in terms of environmental sustainability, mixed-use policy rolls together aspirations for new forms of market investment in inner cities with ambitions for social change. Mixed use is not a modest planning initiative, as suggested by Breheny. Its muddled and idealistic objectives have deflected attention away from the everyday outcomes of its practice.

Research on existing forms of mixed use, including this case study, suggests that the range and mix of nonresidential activities required to fully support communities, including families with children and older people, is rarely established. Current developments tend to encourage a new transient population for whom compact mixed-use urban living is a temporary lifestyle choice. For existing communities, or socially excluded communities, as found in Clerkenwell, the benefits of living in mixed-use locations orientated towards high-consumption lifestyles are negligible. The nature and spatial form of this form of mixed use is rapidly eroding necessary everyday services and utilities. Moreover, whereas some urban areas have organically adapted to mixed-use from crafts to industrial, postindustrial and creative city eras, most developments, town centers, and local shopping neighborhoods have struggled to emulate them, with swathes of vacant ground-floor premises: critically the most important for street life and safety and for local economies. This has arisen due to inflexible planning guidance that has limited ground-floor use despite the fact that most of us still live in properties with front doors opening to the street. Our comparative mixed-use studies in Sheffield and Manchester also confirm the advantages and disadvantages found in London's city fringe, and similar population dynamics and divides (Evans et al., 2009).

Many living in mixed-use, mixed-tenure neighborhoods require a certain urban disposition in which the advantages are traded off against disadvantages and in which a high levels of forbearance with the behavior of others

and the uncertainty of street life are necessary prerequisites. Most residents tolerate rather than enjoy the mixed-use environment, trading off the noise, disturbance, rubbish and litter, limited open space, inconvenient parking restrictions, and low levels of local community cohesion against the overriding benefit of location and permeability. Yet this is a fine balance. When change in the spatial dominance of a land use within an area alters the level of vitality, as in areas of nighttime activity or daytime office activity, this trade-off becomes unsustainable and the "cost" is borne by the residents. Likewise, while the ability to travel out of the area makes it possible for most residents to live in this dense mixed-use environment, many who are unable to travel find themselves trapped in an area with limited resources and potentially a declining quality of life. Furthermore, high tolerance of others is only possible where households have significant economic and social resources. When wellbeing is diminished or threatened the more mobile are able to sell on and move out. In the absence of such resources Clerkenwell in this sense is not mixed enough. It is less able to support the everyday needs of those at risk of social exclusion and the less mobile. Shared understandings of daily practices such as when and where to put out the rubbish are harder to establish when social cohesion is low. A conclusion would be that mixed use also presents a mixture of wellbeing among residents, with factors such as urban management, amenities (and their "mix" and accessibility), as well as design quality all required to maintain a balanced and cohesive community, which in turn can help to maintain good levels of wellbeing in a neighborhood.

It is evident that the dynamic processes that generate diversity and mixed-use neighborhoods, including their openness, can also destabilize them. In these circumstances the trade-offs made by residents become untenable. Understanding this process and the point at which a mixed-use community changes from a state of wellbeing to one of stress, and a neighborhood changes from offering the potential for sustainability to undermining it, requires further fine-grained research. This research should have a degree of urgency, given the continued advocacy of mixed use and the compact city with an evidence base that has to date produced mixed results (Evans, 2005; Foord, 2010).

Note

1. Congres Internationaux d'Architecture Moderne. Sieverts (2003, p. 37) asserted that it was the consequence of the differentiation of land values, which led to an assortment of uses on the basis of their economic performance and of the

mutual disturbance tolerances of similar uses, that permit the establishment of areas of like commercial and industrial uses with higher tolerance levels.

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7

"We Live Here Too". . . What Makes a Child-Friendly Neighborhood?

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Introduction

Gone are the days when most children roam freely in the suburbs, play ball on the street, and populate parks after school; deserted neighborhoods are more the norm in many of today's modern westernized cities. Indeed research indicates that children are spending less time outside (Gill, 2008; Hofferth, 2009), have less independent mobility in their neighborhood (Pooley, Turnbull, & Adams, 2005), and spend more time sedentary using screens than previous generations (Rideout, Foehr, & Roberts, 2010). Changes to neighborhoods and Western culture have clearly led to some of these observed changes in children's behavior. Development of bush and other vacant land, higher-density living, and more manicured and smaller parks and gardens have led to diminishing nature contact for children (Pyle, 2007). Trends towards larger houses on smaller blocks have precipitated the demise of the once iconic suburban backyard, with dramatic repercussions for where and how children can play (Hall, 2010). Stranger-danger fears (Timperio, Crawford, Telford, & Salmon, 2004) and liability aversion (Tierney, 2011) further restrict opportunities for children to play and to be independently mobile in their neighborhood. Added to this is the spiralling 'busyness' of families; children are now timetabled into sports, homework, and structured

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activities which is reducing their free play time. The car-domination culture has led to more traffic on roads (and associated injury and safety concerns), "driving to destinations" a norm, and reduced active transport (Mullen, 2003). Design and development of residential areas have resulted in fewer public places where kids can freely "hang out" and lower tolerance has led to exclusion or discouraged presence of young people from some quasi-public places (Brody, 2007).

With such unsupportive environments it is no surprise that the physical and mental health of children and adolescents has become a concern. Overweight and obesity rates of children and young people have been increasing and are currently noted to be 25.1 and 6.8% respectively in the United States, with only slightly lower rates in many other Western countries (Janssen et al., 2005). Asthma and allergies are also a health issue for children and young people today, with international trend data indicating a rise in these diseases (Asher et al., 2006). Mental health of children and young people is also concerning, with recent figures indicating between 12 and 23% suffering mental illness in Western countries (Patel, Flisher, Hetrick, & McGorry, 2007). Emergent emphasis on the importance of environmental influences on health behaviors and physical and mental outcomes has provided impetus for communities to consider strategies to develop healthy neighborhoods for children and adolescents.

Encouragingly, the notion that neighborhoods and cities can create environments that support children and young people's health and wellbeing has gained global momentum in recent decades. Internationally this has been promulgated by the United Nations Child-Friendly Cities movement (International Secretariat for Child Friendly Cities, www.childfriendlycities.org), which promotes consultation and systems of governance to ensure cities are places where children's rights and needs are taken into account and addressed (Riggio, 2002). The concept of a child-friendly city is not based on a standard model but rather provides a framework to assist cities anywhere in the world to become more child friendly in all aspects of its environment, governance, and services (Riggio, 2002). This includes recognition of the importance of independent movement and children's access to public space (UNICEF, 2009). Fifty-four countries are currently involved in the Child-Friendly Cities movement, with participating cities including Vancouver (Canada), Porto Alegre (Brazil), London (England), Munich (Germany), and Hobson's Bay (Australia).

Clearly, formal movements such as Child-Friendly Cities play an important role in elevating the needs and rights of children in the minds of government,

urban planners, and others. However, beyond this there is a remit for all neighborhoods, communities, and cities to consider the needs and perspectives of children and adolescents in the way in which environments are planned, designed, activated, and used; and for this to move beyond just the provision of a school, a park, and a playground. Some communities appear to support children; the deserted suburb is not completely universal, drive through some neighborhoods and you can see children riding bikes or walking to school, playing in playgrounds and parks, or kicking a ball with friends. So what explains the difference between these neighborhoods and the deserted ones? It is not merely a reflection of area demographics, as empty streets and parks are observed in suburbs with high proportions of families. Is it then because some parents are fearful to let their children leave the confines of their home, while others are not, or is it something to do with the physical and social environment of the neighborhood itself? And is it also possible that parental perceptions of safety for their children are impacted by characteristics of the neighborhood?

It is most likely that a combination of factors has resulted in unequal use of streets, parks, and playgrounds by children and young people. Furthermore, a cumulative effect is expected, whereby more community members out in the streets has a positive impact upon safety perception, crime prevention, and community cohesion, thereby facilitating even more residents to get "out and about." So what constitutes a neighborhood that is a good place in which children and young people can live and play? This chapter seeks to distil the critical ingredients of the physical and psychosocial realms (see Figure 7.1) using relevant literature and findings from some recently completed research and case studies.

Walkable Neighborhoods

The notion of neighborhood walkability has gained significant currency in recent decades, not only as a principle for good urban design (Frank, Kerr, Chapman, & Sallis, 2007) but also because it brings with it environmental benefits in the form of reduced vehicle use and associated pollution (Frank et al., 2006) and public health benefits in the form of more physically active residents (Saelens, Sallis, Black, & Chen, 2003).

Young people stand to benefit from more walkable neighborhoods in many of the same ways as adults, and in additional ways relating to their developmental trajectory. Vital developmental skills can also be gained when

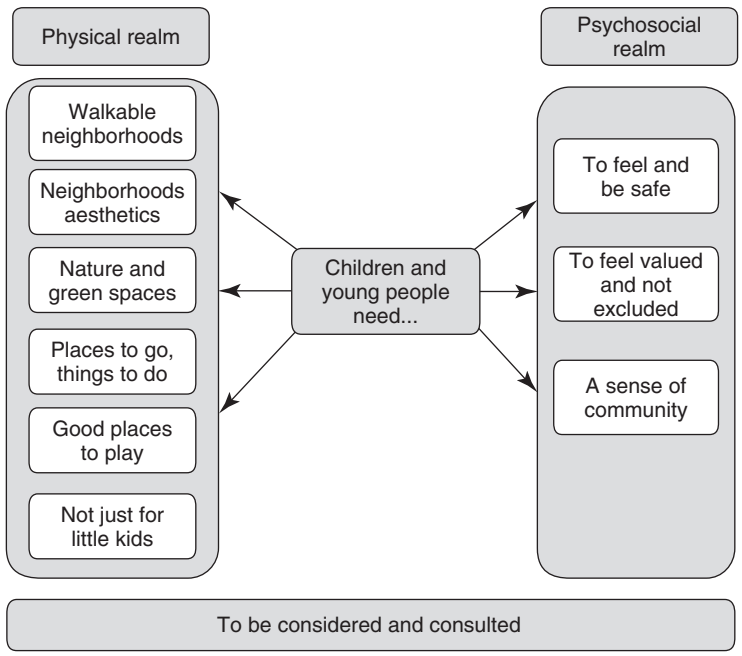

Figure 7.1. Ingredients of Good Neighborhoods for Children.

young people can move independently (e.g., walking, cycling) around their neighborhood (Cornell & Hill, 2006; Kelty, Giles-Corti, & Zubrick, 2008; Rissotto & Giuliani, 2006). Such experience can (adapted from Kelty et al., 2008)

- increase young people's spatial and local area knowledge; e.g., of where streets connect, location of shops or parks;
- develop road safety skills; e.g., through experience gained in crossing roads, watching out for traffic from a pedestrian perspective;
- enhance problem solving; e.g., through planning a destination route, working out an alternative route if obstacles encountered, remembering and retracing a route taken for the return trip; and
- develop environmental awareness; e.g., of local fauna and flora.

While the impact of walkability has more often been investigated in relation to adults, among children walkability has been associated with higher levels of walking and cycling to school (Braza, Shoemaker, & Seeley, 2004; Giles-Corti et al., 2011; Trapp et al., 2011) and higher levels of physical activity

in local neighborhoods out of school hours (Frank et al., 2007). Given high rates of childhood obesity and overweight, and the amount of time young people spend sedentary using screens, strategies to optimize neighborhood environments to encourage and support children to move actively within their neighborhoods are important.

Despite the well-documented benefits of walkable neighborhoods for children, children are far less likely to walk or cycle independently in their neighborhoods than previous generations (McMillan, 2007; Pooley et al., 2005; Salmon, Timperio, Cleland, & Venn, 2005; Tranter & Whitelegg, 1994). This decline is particularly evident in the proportion of children walking or cycling to school (McDonald, 2007). There are a myriad of factors that potentially explain the observed decline in children's movement within and around our neighborhoods. Some of these reflect broader societal trends, such as the growing proportion of households with two parents working and the associated rise of before- and after-school care (Vandell & Shumow, 1999) and a greater culture of fear and protectiveness in relation to childrearing (Collins & Kearns, 2001) resulting in reduced freedom to roam in their leisure time (Pooley et al., 2005).

So what makes a neighborhood more walkable from a child perspective? As with adults there are characteristics of the built form and neighborhood design that can deter or encourage walking and cycling. Walkable neighborhoods are generally considered those which are designed for ease of pedestrian travel, characterized by streets based on the traditional grid system. These grid systems provide high levels of connectivity between streets and offer direct routes, moderate to high urban density, and mixed land use with residential dwellings, shops, utilities, services, and parks all within walking distance (Sallis & Glanz, 2006). The research on young people appears to mirror the finding for adults, namely that the presence and proximity of destinations to which one can walk matters. Studies from numerous countries have found that the closer the park and sports center proximity to children's and adolescents' homes the more likely they are to use them, and the higher their weekly levels of physical activity (Brodersen, Steptoe, Williamson, & Wardle, 2005; Carver et al., 2005; Cohen, Ashwood, Scott, Overton, et al., 2006; De Vries, Bakker, Van Mechelen, & Hopman-Rock, 2007; Epstein et al., 2006; Evenson, Scott, Cohen, & Voorhees, 2007; Frank et al., 2007; Gordon-Larsen, Nelson, Page, & Popkin, 2006; Timperio et al., 2004). These findings are consistent for both genders, across the child–adolescent age spectrum, and for different methods of measuring physical activity.

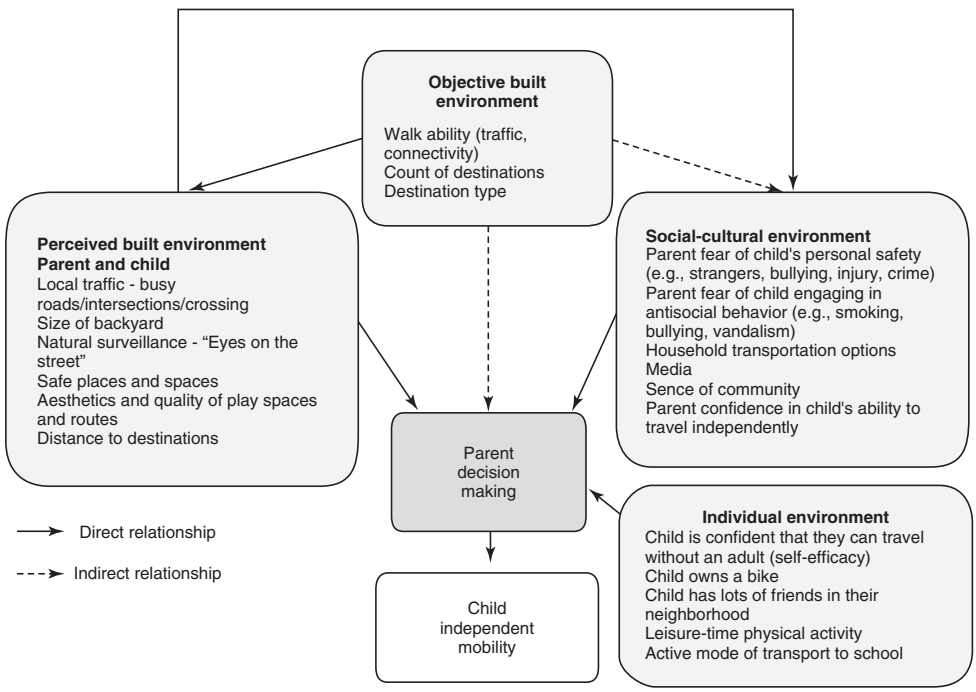

Figure 7.2. Factors Influencing Child Independent Mobility. From Villanueva (2011).

Physical elements that enhance walkability for children include the presence of footpaths en route between home and school and also home and recreational venues, which have been shown to be associated with higher levels of walking among both children and adolescents (Boarnet, Anderson, Day, McMillan, & Alfonzo, 2005; Evenson et al., 2007; Ewing, Schroeer, & Greene, 2004). Safe pedestrian crossing points are also important (Timperio et al., 2004). Exposure to traffic is a well-documented safety concern for parents (McMillan, 2007; Timperio et al., 2004), with children less likely to walk between home and school if they have to cross busy roads or are exposed to high traffic volume (Giles-Corti et al., 2011; Timperio et al., 2004; Trapp et al., 2012). In a recent study of primary school children aged 10–12 years, students were more likely to walk to school in neighborhoods with high street connectivity and low traffic, and less likely to walk if they had to cross a busy road (Trapp et al., 2012). A recent review (Villanueva et al., 2012) identified a range of built and perceived environment, sociocultural, and individual factors influencing children's independent mobility, and these are displayed in Figure 7.2.

Neighborhood Aesthetics

The aesthetics of a neighborhood is a somewhat slippery yet important concept. This has more often been researched from an adult perspective however, with numerous studies linking neighborhood aesthetics with physical activity (Humpel, Owen, & Leslie, 2002). Conversely, negative aesthetics (for example in the form of neglected gardens, litter, visible graffiti, abandoned buildings) can exacerbate fear of crime and deter people from walking within their neighborhood (Foster & Giles-Corti, 2008).

Research into neighborhood aesthetics and children is more limited and to date primarily focused on physical activity outcomes, with higher levels of physical activity consistently associated with positive aesthetics (De Vries et al., 2007; Mota, Almeida, Santos, & Ribeiro, 2005; Whitehead, Biddle, O'Donovan, & Nevill, 2006). De Vries et al. (2007), for example, undertook research with a sample of 422 primary school children and found that higher levels of physical activity were associated with the aesthetic features, namely: higher ratings of overall local neighborhood attractiveness; more green space (parks and gardens); less visible litter; less urban decay; fewer concrete-covered playgrounds. Whitehead and colleagues also found that the aesthetic qualities of local neighborhoods and sports facilities

were important to children and young people (Whitehead et al., 2006). Their study identified that the main factors associated with whether girls aged 14 and above were physically active at the weekend was whether they rated their overall neighborhood as attractive with enjoyable scenery. Similar results were found in a sample of Portuguese adolescent girls in that higher levels of physical activity were reported by the girls who rated their neighborhoods as more aesthetically pleasuring places to wander around and which offered them interesting things to look at (Mota, Delgado, Almeida, Ribeiro, & Santos, 2006).

While the association between negative neighborhood aesthetics and feelings of safety has mainly been observed in adult studies, it seems very plausible that a similar relationship between the two would exist for younger people. Moreover, children's interactions with and perceptions of their local neighborhood are inevitably shaped in part by the views and experiences of their parents. There is merit in further research into the influence of neighborhood aesthetics on children and young people, and, as part of this, probing children's understandings of what is and isn't aesthetic, and the extent to which their perceptions converge with those of adults.

Contact with Nature

Urban sprawl, increasing housing density, population growth, vehicle congestion, and shrinking backyards are among factors that have significantly reduced the presence of nature in the urban neighborhoods in which we live. Buildings increasingly take up most or all of the available land, leaving very little natural green space in which children can play (Pyle, 2007).

> The last 20 or so years have seen dramatic shifts in lifestyle trends, such as the nature of houses and gardens, urban design, the working hours of parents, the use of childcare, time pressures on families, increased uptake of electronic entertainment and increased consumerism.
>
> Planet Ark (2013), p. 6

In addition, children and adolescents tend to spend less time outside than previous generations of children, and when they are outdoors the majority of their activity occurs in setting outside of 'green space', such as on courts and paths (Wheeler, Cooper, Page, & Jago, 2010).

Nature-deficit disorder is a term that has gained considerable currency in recent years, and was coined by Richard Louv (2008) to describe the negative

consequences resulting from children's inadequate contact with nature. Correspondingly, evidence pertaining to the benefits of nature for physical, mental, social, and developmental wellbeing continues to accumulate.

> . . . few areas of life provide young people with as much opportunity as the natural world for critical thinking, creative inquiry, problem solving and intellectual development.
>
> Kellert (2002), pp. 124–125

Whereas the term nature often conjures up images of hiking in the wilderness or bush camping, a more feasible setting for providing children with greater regular contact with nature is the local neighborhood in which they live. Children want more nature in their neighborhoods. In a study spanning four countries, Lynch (1977) identified that, despite their location, children frequently commented on their desire for more trees in the city. Recognizing that children's hunger for trees was outspoken and seemingly universal, Lynch argued that landscaping in cities should be an essential part of basic infrastructure. This is further evidenced by research indicating that children classify nature as being highly important to them (Kahn & Kellert, 2002), that their preferential play spaces are outside (Moore, 1986), and that they want to be able to access forested/woodland areas (Jansson, 2009). The high value placed on nature is not unique to just younger children; adolescents have also reported widespread use of nature and that they value nature greatly (Owens & McKinnon, 2009). As noted by Louv, access to green and outdoor spaces can also foster social interaction and friendships for children and their parents (Louv, 2008).

Adults may not fully understand the natural affiliation children have with nature and the extent to which children enjoy playing in nature. In another examination of children's perspectives of play spaces (Burke, 2005), children identified that although natural materials and environments were very important to them, they perceived adults had little insight into this feature of their play. In an assessment of children's and adults' playground preferences Francis (1988) noted that children requested water and loose elements which change over time, and that they prefer challenging and fantasy elements in their play spaces, whereas parents requested more traditional play environments that were safe, neat, and fixed. The highest-ranked preferential play equipment item identified by children was open imagination areas, whereas parents identified a slide (Francis, 1988). This finding has been reiterated in our recent qualitative research in which

children identified trees, rocks, and water as their most popular play-space elements (Wood, Martin, & Carter, 2010).

The presence of nature in children's immediate vicinity has been identified as being restorative (Korpela, Kyttä, & Hartig, 2002), beneficial to their mental health (Küller & Lindsten, 1992; Milligan & Bingley, 2007), and associated with children's stress management (Wells & Evans, 2003). Contact with nature, especially during middle childhood, has also been indicated as having an important role to play in children's emotional responsiveness and receptivity (Derr, 2001; Ratanapojnard, 2001). Evidence also suggests contact with nature enhances children's learning (Lieberman & Hoody, 1998; Wells, 2000), development (Sobel, 1993), and school attitudes and behavior (Lieberman & Hoody, 1998). Time in nature has also been indicated as assisting the performance of children with attention-deficit hyperactivity disorder (Kuo & Taylor, 2004; Taylor, Kuo, & Sullivan, 2001) and those displaying delinquent behavior (Wilson-Doenges, 2000).

Natural environments can also enhance children's physical activity. For example, playing in 'greener' settings has been associated with children spending more time physically active (Coley, Sullivan, & Kuo, 1997) and in more intense physical activity (Wheeler et al., 2010). One study estimated levels of play for children in barren areas is as much as 50% less compared to play in greener settings (Taylor, Wiley, Kuo, & Sullivan, 1998). Playing in natural environments also assists with building children's motor skills (Fjørtoft, 2001, 2004), which may be attributable to increased physical activity. Of further importance, higher amounts of nature in the neighborhood has been associated with decreased risk for childhood overweight (Coley et al., 1997; Liu, Wilson, Qi, & Ying, 2007) and lower body mass index (Bell, Wilson, & Liu, 2008). Even where 'nature' is present in neighborhoods via parks, school grounds, and gardens, it is often of a landscaped or manicured variety. While this still provides contact with nature and the associated biophilic, mental health, and environmental benefits (Maller, Townsend, Brown, & St. Leger, 2002), there is evidence to suggest that children may play more actively when there is less landscaping. A study from Turkey found that that students from schools with "advanced" landscaping had higher body mass index values than students from schools with "low" landscaping (Ozdemir & Yilmaz, 2008), suggesting that the overlandscaping of children's play spaces may diminish active play options.

Encouragingly, there are a growing number of programs and initiatives around the world aimed at encouraging children to spend more time outside in nature. One of the most well known is the U.S. Children and Nature

Network (http://www.childrenandnature.org/). However, while targeted programs designed to reconnect children with nature are encouraging, developing and creating spaces to foster contact with nature in the day-to-day environments frequented by children is also vital to reverse the trend of childhood immersion in artificial environments. Developing environments that allow for children to interact with nature and enjoy the changing forms that these elements provide is important; parks, public open spaces, school grounds, and neighborhood streetscapes are all settings in which this can occur.

The last decade or so has also seen renewed interest in the use of more natural materials in play spaces designed for children. This welcome reprieve from the standard "plastic fantastic" manufactured playgrounds that have proliferated in parks, schools, and playgrounds in many countries in part reflects growing recognition of the benefits of natural play environments for children. Challenge, risk, and space as well as malleable objects, novelty, and sensory stimulation are all attributes of natural play spaces, which are increasing in popularity internationally. Children prefer and are more likely to use nature-based playgrounds than typical preformed playgrounds because they perceive them as challenging and less boring (Fjørtoft, 2001; Fjørtoft & Sageie, 2000; Lee & Christiansen, 1999). This renewed interest has led to the development of play spaces that use natural elements to promote and support play, such as streams, grassy mounds, and stick cubbies. Applying the concept of playing in nature, the Rio Tinto Naturescape play space was designed and built in a city center to reconnect children with nature. Further details of this play space are provided in Box 7.1.

Box 7.1. Reconnecting Children With Nature: Building an Iconic Natural Play Environment for City Kids.

In late 2011 an internationally unique natural play space was opened within the grounds of the Kings Park and Botanical Gardens located within the central business district of Perth, Western Australia. Rio Tinto Naturescape (Botanic Gardens and Parks Authority, http://www.bgpa.wa.gov.au/education/naturescape) covers 60,000 m^2 and has been designed as an innovative play and educational setting for children. It incorporates a series of unique zones including hidden thickets, a creek, lookouts, a cubby-building area, upside-down trees, and a wetland. These areas are connected by meandering paths, boardwalks, and bridges which offer a feeling of

immersion in the bush. The underlying rationale for the Naturescape initiative is to foster a connection to nature that is missing from many urban childhoods.

Our research team at the University of Western Australia were commissioned to examine how children played and socialized in this natural setting (Martin, Wood, Carter, & Sansom, 2011). Using a purpose-designed observation instrument 372 children were recorded playing within the space over 2 days (a family group day and a schools group day). The observations included (a) the type and frequency of children's interaction with elements within Naturescape (specifically within the different activity areas), (b) types of social interaction during play, (c) negative and positive environmental interaction by children, (d) sizes of groups playing together, (e) any safety issues observed, (f) children's perspectives of the activity areas, (g) parental perspectives of Naturescape, and (h) adult (teacher and parent) feedback. Figures 7.3

Figure 7.3. Reconnecting Children with Nature. Children building a cubby from broken branches at Rio Tinto Naturescape Kings Park, Perth. Written consent has been provided by the parents of the children in the photograph.

Figure 7.4. Reconnecting Children with Nature. Children building a dam in one of the billabongs at Rio Tinto Naturescape Kings Park, Perth. Written consent has been provided by the parents of the children in the photograph.

and 7.4 show examples of children playing within Naturescape on the study days.

The observational study identified active play, exploration, water play, construction, and imaginative play as the most popular activities. Overall children demonstrated enthusiasm for Naturescape with comments such as "It was a lot of fun and I really enjoy building cubbyhouses and making things out of leaves and other bush treasure" and "I like skimming stones and making bridges. The water was awesome. It was so much fun." Active play was the most frequently observed activity, followed by imaginative and creative play.

A feedback survey was undertaken with teachers and parents who attended the trial days with the children. Feedback from adults was positive, with comments such as "Would love to come again as the opportunity to roam freely does not happen much these days and the children were forced to explore, create and imagine on their own" (parent quote) and "The children use their own experience and

imagination to create activities. It builds cooperation skills and team building" (teacher quote).

From the synthesis of observational data and student, teacher, and parent feedback, Rio Tinto Naturescape provided a number of benefits for children playing in the area

- enabled contact and experience with nature, which is lacking in many urban childhoods;
- complimented and supports child development and learning outcomes;
- fostered problem-solving skills;
- promoted physically active play;
- fostered future ambassadors and protectors of natural environment;
- provided opportunities for creative, imaginative, non-adult-directed play.

Places to Go, Things to Do

Having appealing "places to go" and being able to "do things" within the local neighborhood is something most people desire, and proximity to a variety of destinations and amenities is often used by realtors and property developers as a marketing angle (Nathan, Wood, & Giles-Corti, 2013). For residents, however, it is more than just the notion of mixed land use as increasingly promulgated by urban planners and proponents of more walkable neighborhoods. Mixed land use can indeed provide places to go and things to do, but the term is somewhat reductionist in describing the more innate desires of many people to spend time within their community, socialize or recreate locally, or to fulfill day to day errands without having to drive for miles. This does not only apply to adults, for as noted by Kunstler (1998, p. 55):

> kids older than seven need more from their environment than a safe place to ride their bikes. They need at least the same things adults need; places to hang out, shops, eating places, libraries . . . they need a public realm worthy of respect.

It could be argued in fact that children and young people in particular need local provision of places to go and things to do, given they are less mobile, less financial, and yet have more "free time" than the typical adult. Moreover, evidence indicates that it can be "the lack of things for young people to do" that can contribute to undesirable behavior and that providing options for young people's leisure can help to prevent risky behavior, including crime and delinquency (Caldwell, Weichold, & Smith, 2006).

Parks are by far the most researched and provided neighborhood "place to go" for children and young people. Described as "an antidote to the commercialization of children's leisure" (Loukaitou-Sideris & Stieglitz, 2002, p. 468), parks provide physical space and structure for young people's socialization, imagination, and active play, as well as a destination to which children can walk or ride. Children are more likely to use parks if they are situated close to their home (Cohen, Ashwood, & Scott, 2006; Epstein et al., 2006), ideally within a 5-min walk or 400 m (Roemmich et al., 2006). In addition, parks should be situated away from high traffic density; evidence indicates that high traffic decreases the likelihood of adolescent girls traveling to the park and thus their physical activity participation (Norman et al., 2006). Zebra crossings and traffic lights can also be used where appropriate to make parks more accessible to children (Timperio et al., 2004).

Mere provision of community spaces such as parks and other amenities does not guarantee use, however, for as noted by Jacobs (1961) the quality of the public realm is also important if people are to use it. In our Child's Play study (Wood, Martin et al., 2010), inadequate or poorly maintained parks and public facilities were mentioned in focus groups by both parents and children as being detrimental to their use. This finding has been corroborated elsewhere in empirical research relating to park and playground usage (Bedimo-Rung, Mowen, & Cohen, 2005).

Growing concerns about rising rates of physical inactivity and obesity among children and adolescents has drawn greater attention to the need to provide community facilities beyond just the local park that encourage young people to be active. This includes not only facilities and public areas that cater to more traditional and formal sporting activity, but also those that provide for informal activity such as skateboarding, scootering, and bike riding (Wood, Giles-Corti, Zubrick, & Bulsara, 2011).

More formal recreational spaces and activities such as community centers, sports programs, community centers, and art and theater programs also assist with promoting and supporting children's physical activity, socialization, and development in the local neighborhood (Fauth, Roth, & Brooks-Gunn,

2007; Giles-Corti, Kelty, Zubrick, & Villanueva, 2009). The incorporation of recreational activities within a neighborhood provides an effective means of engaging young people in appropriate activity between the school and home environment, supports the development of a connection with and sense of place in their neighborhood, and also legitimizes their activities in the eyes of the public (Fauth et al., 2007). Free or low-cost recreational opportunities are particularly important for children and adolescents, who have little or no disposable income of their own, and whose families are often stretched financially. In a study by Romero (2005) of 74 adolescents in a mid-size city in southwestern United States, more than half of the young people in the sample indicated that their parents would not be willing to pay for facility fees for physical activity. It has also been shown that the greater the distance from the child's home to the recreation facility the less likely that facility will be used by the child (Estabrooks, Lee, & Gyurcsik, 2003). Access to recreational opportunities for young people must consider availability of facilities, distance, and ease of getting to the facility (public transport, active transport, or personalized mobile transport) and facilities that cater for activities that are suitable for children.

Sometimes the types of places that children and young people could, or would like to, frequent in their leisure time are however not accessible or are "off limits." The increasing trend observed in Australia towards the enclosed fencing of school ovals, playgrounds, and sports courts (e.g., basketball, netball) is a case in point. While fencing and padlocking is often used to prevent vandalism, it also reduces accessibility to children (Cohen, Ashwood, Scott, Overton, et al., 2006) and conveys a disturbing visual message that the neighborhood is not a safe and welcoming place for children (see example Figure 7.5).

Indeed, fenced off parks and schools and other visible signs of security can paradoxically make some people more fearful, as they sense that high security must mean high risk. As articulated in Minton's book on fear and happiness in the twenty-first century city (Minton, 2009), an outlook of fear and social control has increasingly been "built into architectural practice and urban planning with the guiding idea of creating 'defensible space', but contributing as result to a more withdrawn and fearful citizenry." Conversely, we have observed that where schools ovals and premises remain unfenced it is common to see their grounds being used by children and the broader community at various times of the week or on weekends. Often this use is of an informal and unstructured nature, such as children kicking a ball, shooting basketball hoops, or walking a dog. In turn, seeing children

Figure 7.5. Fenced Basketball Court.

around the neighborhood and playing "down at the local school" can be a positive symbolic marker of sense of community (Wood et al., 2011).

Places to Play

Play is recognized as being vitally important for the health and wellbeing of children and young people (McArdle, 2001). For children and young people, playing outside has further benefits in that it supports active play as well as contact with nature, both also important for normal development (Pellegrini & Smith, 1998). Increased urban density and the growing number of kids living in places with no or small backyards increases importance of being able to play within the local neighborhood. Neighborhood play spaces that are appealing and promote behaviors that support the health and wellbeing of children and young people (such as socialization and physical activity) require considerable planning and preparation. Foremost this requires consultation with the local young community using the space. However, planning

also needs to consider play-space form. Ideally outdoor play spaces (a) support interaction and socialization, (b) cater to a variety of demographics and backgrounds, (c) provide risk and challenge yet are safe and free of hazards, (d) have pleasing aesthetics, (e) stimulate children's imagination and creativity, (f) include space for active play, and (g) support interaction with nature. These characteristics are discussed in more detail below.

A good play space should encourage children to interact and engage with their environment. Prefabricated fixed structures populating many parks internationally are often limited in the scope to play creatively. In our recent Child's Play research (Wood, Martin et al., 2010) the dearth of interesting and inviting play spaces was a prominent theme in the focus groups with children and adolescents. There was a general lack of challenging, interesting, and different play spaces near their homes and local parks lacked interesting playground equipment or areas for play. Younger children reported they enjoyed playing the modern prefabricated "plastic fantastic" sometimes; however, along with older children, they indicated a general dissatisfaction with this type of equipment as the *standard* park feature. Children of all ages craved and were excited about more contemporary play equipment such as rope climbing structures, interactive and moving structures and features, and climbing equipment that was challenging. However, overall the three features described most frequently by children included trees, rocks, and water. Adolescents further commented that little existed for them, and that while children's playgrounds were available for younger children, other than skate parks adolescents felt that nothing suited their age, abilities, or interests (Wood, Martin et al., 2010). Such feedback from young people is not unique; in a U.S. study, children and teenagers likewise reported a lack of exciting and/or age-appropriate facilities, and wanted more/better playground equipment and grass, trees, and flowers (Loukaitou-Sideris & Stieglitz, 2002).

Playground equipment such as slides, swings, and monkey bars are the most common and typified play environment for children within city and suburban parks. It is important that a playground offers a certain degree of safety, firstly to avoid serious injuries and secondly because perceived safety influences the likelihood that parents will let their children play outside (Joshi, MacLean, & Carter, 1999; Miles, 2008; Play England, 2008; Valentine, 1997; Veitch, Bagley, Ball, & Salmon, 2006). However, it is necessary that playgrounds still offer a degree of risk, otherwise children perceive them as "unexciting and unchallenging" (Valentine, 1997), which decreases the likelihood they will use the park (Veitch et al., 2006). Providing

children with some degree of risk is also important as it teaches children to assess and manage risks (a skill they will use as adults) and builds resilience, adaptability, and self-confidence (Jones, 2007). "Reasonable risk" is a term now being used commonly in Australian schools as well as by groups such as Kidsafe and the Scouting Association. This term is a less emotive approach to managing risk than the frequent risk-reduction strategies applied.

The fixed structure of prefabricated playgrounds can be a deterrent to imaginative play, and there is currently a resurgence of interest in the "theory of loose parts" in the child development arena. A term coined by Simon Nicholson (1971, p. 30), the theory of loose parts, contends that:

> In any environment, both the degree of inventiveness and creativity and the possibilities of discovery are directly proportional to the number and kind of variables in it.

Sand to play in, leaves to collect, and pebbles or stones to move around are among common examples that can be readily incorporated into parks and playgrounds. Loose materials can also be introduced strategically: supplying loose materials that are always changing are likely to be more effective in encouraging children to be creative and interact and engage with their environment and each other. A Sydney study showed that an effective way of promoting creative play was to provide children with materials that had no "fixed purpose" (e.g., car tyres), thus allowing children to decide for themselves how the materials could be used (Bundy et al., 2009). An example of playgrounds that use this method are the Imagination Playgrounds in the United States (www.imaginationplayground.com). Children are provided with an assortment of loose materials and are encouraged to problem solve, cooperate and build things with one another (http://imaginationplayground.org/index.html).

Ideally playgrounds also aim to cater for different abilities by offering a wide range of activities (Christensen & Morgan, 2003). Physical barriers can be reduced through the use of ramps, suitable parking, shaded rest areas, good travel surfaces, and easy access to amenities like toilets (Meyers, Anderson, Miller, Shipp, & Hoenig, 2002; Seeland & Nicolč, 2006) and water. To reduce social barriers, activities can be provided that encourage interaction and cooperation.

While there are numerous benefits for children and adolescents when they engage in outside play and socialization, the opportunities and environments provided for outdoor play vary considerably between neighborhoods even within the same city or town. Furthermore, it seems that adult designed

spaces and playgrounds are increasingly unsuccessful in meeting children's and adolescents' needs or expectations. Incorporating features to stimulate children's imaginative and creative play are also key components of an effective playground (Malone & Tranter, 2003). Children prefer and use playgrounds with high degree of challenge, novelty, and complexity (Fjørtoft & Sageie, 2000) and a modifiable and malleable environments offer more environmental stimulus (Moore & Wong, 1997). Sensory stimulation can come from a variety of sources; touch, sight, and sound; some play spaces and playgrounds have been developed to incorporate musical sounds. Nature can also provide sensory stimulation.

Increasing evidence points to the importance of sufficient space for children (Loukaitou-Sideris & Stieglitz, 2002), particularly for supporting greater physical activity (Cradock, Melly, Allen, Morris, & Gortmaker, 2007). Specifically, grassed space is supportive of higher moderate-to-vigorous physical activity (Martin, Bremner, Salmon, Rosenberg, & Giles-Corti, 2012), and it is necessary to ensure that park and play spaces are large enough to accommodate sports and play activities. This is also particularly important in schools and sporting clubs that need to accommodate high numbers of children using the grounds. Offering facilities that cater to different age ranges is also important in developing good play spaces. For example, younger children like to walk, play ball games, and play on the equipment, whereas older children prefer to play informal or organized sport games and socialize (City of Darebin, 2005).

In decades past, neighborhood streets and sidewalks were a popular and well-used setting for play. Our own childhoods included many a cricket game "out on the road" with siblings and neighboring children, when cars came by we knew to move off the road and the cars knew to slow down. Children played in their front yards without a hovering parent, and would often ride or walk between home and the houses of nearby friends. All of this is far less seen in most modern neighborhoods; heightened fears of abduction and injury, busier traffic, and protective parenting are among the myriad of explanatory factors. At least two local governments in Western Australia do not allow play equipment, such as swings and cubbies, to be attached to verge trees out the front of homes. Of these, one council recently wrote to all residents informing them of this policy and that play equipment on verge trees would no longer be allowed: a sad indictment of a society increasingly fearful of litigation.

Encouragingly, the recent cry to "reclaim the streets" has signified the awareness of the loss of neighborhood play for children. In the late 1990s

Reclaim the Street parties were being held in the United Kingdom. Home Zones (also known as Woonerfs), whereby streets are redesigned to support children playing on or near the street, are increasing in popularity. Increases in children playing outside, reduced traffic, increased interaction between adults, and improved social cohesion are some of the benefits of these schemes (Gill, 2007). Successful redevelopments incorporating Home Zones are evident in England, Wales, and the Netherlands. While developing these zones can be obstructed by costs, other strategies such as lowering speed limits in suburban streets and installing traffic-calming devices can be used to make neighborhood streets safer for children.

"Not Just For Little Kids"

A growing need for autonomy during adolescence generally leads to adolescents spending more time outside of the home, typically with peers (Leventhal, Dupéré, & Brooks-Gunn, 2009). Providing physical space as well as the social space, adolescents have identified neighborhoods as one of the most important contexts for their time outside of home (Leventhal et al., 2009). "Social space" for young people to socialize and hang out with friends in the public realm is important. Unfortunately, the notion of young people "hanging out" is often associated with loitering or time wasting by adults and consequently adolescents are more often "designed out" than "designed for" in public places. This happens subtly, such as removal of seating in congregation areas, predominance of facilities for younger children and designing public areas to suit adults; as well as more overtly with "move on" policies in shopping centers, prohibition of skating/scootering in public areas, and fencing and locking of playgrounds and parks.

However, there is strong evidence that "hanging out" is an important and vital part of adolescent social development (Passon, Levi, & del Rio, 2008). Indeed, it has been argued that "hanging out needs to be provided for in public places" (Owens, 2002, p. 161) as part of community efforts to support the healthy development of adolescents.

> As children get older, their incidental outdoor activity . . . entails more loitering with others, sizing people up, flirting, talking, pushing, shoving and horseplay. Adolescents are always being criticized for this kind of loitering, but they can hardly grow up without it.
>
> Jacobs (1961, p. 86)

With mental health also a growing public health issue among young people, opportunities to socialize with peers and feel valued and catered for by local communities are emerging as protective factors for mental health. Furthermore, White (1996) argues that a successful urban environment is not one which is based on the principles and practices of social exclusion and that it is impossible to design a public realm that is based on the view that all users are in need of protection from each other: youth from adults, and adults from youth. There is a clear need to develop public policy focused on inclusive practices for youth (White, 1996).

In our recent research (Wood, Martin et al., 2010) older children and adolescents expressed a desire to spend time outside, to be provided with definable spaces for their age group, spaces in which they could "get away," and areas which provide some natural risk. Interestingly, while older children and adolescents described the typical playground as catering to children aged 9 or younger, there was a desire for park facilities and playground type equipment that they too could use. This age group also expressed a desire for a variety of play equipment in good condition that was challenging, an appropriate size, and provided a sense of fun and adventure. Their suggestions included adventurous playgrounds, higher flying foxes, larger "spinners," and challenging climbers. Natural elements were also desired, as was enough space and facilities such as drinking fountains and unlocked toilets. A Los Angeles study with adolescents similarly identified that teenagers wanted more natural features, age-appropriate playgrounds and spaces, and more challenging playgrounds (Loukaitou-Sideris & Stieglitz, 2002).

One of the challenges for planners and local government agencies is to develop spaces and places for adolescents to enjoy that do not cause indignation to other residents, who may hold stereotyped concerns about "what young people get up to." Some of the participants in our Child's Play focus groups reported being reluctant to socialize at parks and playgrounds for fear of being chastised, or their behavior frowned upon by adults. An example of a successful development for teenagers in a neighborhood context is the Cowley teenage space in Brixton, London (Shackell, Butler, Doyle, & Ball, 2008). Ideas for how best to develop the space emerged during a consultation project with the young people who lived on the Cowley housing estate, in which objects such as large ramps, platforms, steps, wooden crates, and a temporary shelter were used by the teens to create their own spaces. Following on from this consultation the teenage space was developed into a ramped mound for bicycles, a five-a-side football and basketball pitch, covered inactivity zone for spectators, and a loose

arrangement of large concrete blocks with both "inside" and "outside" spaces (for occupying, playing on, and flirting around). New entrance ways and signage denote it as a special place, and automatic lighting is used to enhance night-time safety. The new space has reportedly led to a new football team, improved relationships within the community, and reduced number of complaints against local teens.

To Feel and Be Safe

Safety considerations and perceptions of neighborhood safety and the social environment can also be critically impact on whether people are out and about in their neighborhood, and these issues are particularly important as determinants of children's independent mobility. Neighborhood safety is a phenomenon that is both "real" and perceived, and requires both objective and subjectively measured variables to assessing how safe people actually are, or believe they are, while being active in their neighborhood (Kelty et al., 2008). Neighborhood safety as it applies to children and young people has a number of dimensions, encompassing both the perceptions and experiences of children, and, even more significantly, those of parent/carers.

The diminished freedom of children to roam and play in their local neighborhood is one of the stark contrasts between the childhood today and that of their parents and grandparents. While some of this relates to elevated fears about "stranger danger" it is also a broader reflection of the rising prominence of an "over-protective" risk-aversive parenting style (Gill, 2007; Pyle, 2007) in much of the developed world, where children seem to be treated as more vulnerable, valuable, and needing of overt protection than past generations. *Helicopter parenting*, *cotton wool children*, or *bubble-wrapped kids* are among terms that have now entered our everyday lexicon to describe such protectionist approaches to parenting. According to Gill (2007) underpinning this style is an almost zero-tolerance approach to allowing children to experience any kind of risk, however remote or small. Although well intentioned, this can bring with it unintended consequences for children's social, emotional, and physical development. As noted by Gardner (2008) for example, the fear of children being snatched has a large impact on parent behavior, although the actual risk of abduction is infinitesimal; it is important to consider the impact of this on exercise and time outside for children.

Parental fear is a well-documented barrier to children's independence and movement in neighborhoods (Zubrick et al., 2010). Research has also shown that parental concern about safety in neighborhoods is significantly associated with children being less physically active outside of school (Timperio et al., 2004). Safety concerns relating to traffic and strangers can compound each other and lead to a vicious circle:

> A downward spiral of fear can be created in response to road safety fears in which reductions in play, cycling and walking activities among children and young people can diminish the general social activities levels of an area which can heighten fears of stranger danger.
>
> Mullen (2003), p. 352

Conversely, seeing people out and about within a neighborhood can create a "virtuous circle," helping to engender positive sense of community-type sentiments among residents and greater perceptions of safety (Wood, Giles-Corti, & Bulsara, 2012). In turn this creates more "natural surveillance" in the form of more people and "eyes on the street" (Foster, Giles-Corti, & Knuiman, 2010). Illustratively, in a study of adolescent girls, the visible presence of other walkers and joggers in the area was seen as a positive marker of neighborhood surveillance and safety (Evenson et al., 2007). Housing placement and design can also contribute to natural surveillance that is beneficial to children, with a study by McMillian (2007) reporting that younger children were more likely to walk to school if at least 50% of the homes they passed en route had windows facing the street.

There are a number of ways in which urban planning, housing design, and local government policies can increase perceptions of safety within neighborhoods that can help to alleviate parent and/or child fears and potentially increase independent mobility and young people's engagement with their local neighborhood. These include

- improving natural surveillance of parks by opening them to view of surrounding houses;
- absence or rapid removal of vandalism which can "signal" that an area is unsafe (Foster & Giles-Corti, 2008);
- eyes on the street via housing design; e.g., no or low walls, windows looking out to street, porches, and other features that bring people into their front yards (Foster et al., 2010);

- walkability of urban layout and mixed land use which in turn can foster more active travel, and eyes on the street (Foster, Giles-Corti, & Knuiman, 2011);
- upkeep of and aesthetic appearance of homes, gardens, and public areas;
- streets being well connected, yet carrying lower levels of traffic (e.g., creating avenues, boulevards, or green corridors that separate children from cars) (Villanueva et al., 2013); and
- traffic-calming measures and infrastructure that target busy roads and intersections.

Sense of Community

While there is growing research and policy interest in the nexus between neighborhood attributes and sense of community, most of the research to date has focused on an adult perspective. Indeed, as noted by Sampson, Morenoff, and Gannon-Rowley (2002) in a review of neighborhood effects on social processes, there are very few studies that have focused solely on children or adolescents as a population group. Research is needed to redress this evidence gap and to ensure that initiatives to strengthen sense of community are informed by an understanding of the influences on this for young people.

Notwithstanding this identified need for further research, children are highly likely to benefit also from living in neighborhoods and towns with good sense of community. This ripple effect has been demonstrated in relation to the mitigation of parental fear that can often deter children's freedom to roam and utilize their local neighborhoods. There is evidence to suggest that fears for children's safety can be potentially ameliorated by a strong sense of community or related concepts such as neighborhood cohesion and social capital (Zubrick et al., 2010). Several studies have found that children have greater independent mobility where their parents have more networks and social integration within their neighborhood (Hüttenmoser, 1995; Prezza, Alparone, Cristallo, & Luigi, 2005). This in part seems to reflect greater confidence that "others will look out for my child," or what has sometimes been referred to as community solidarity (Zubrick et al., 2010). Conversely, perceived declines in community perceptions of adult solidarity can render parents feeling less likely that they can trust that strangers and other people will look out for their child (Furedi, 2002). Perceptions of the physical neighborhood environment can contribute to this, with incivilities such as

graffiti, litter, or vandalism exacerbating fear of crime (Foster et al., 2010) and signaling that a neighborhood is "out of control" (Grabosky, 1995), which is detrimental to sense of community (Wood & Giles-Corti, 2008). Measures to address this therefore are important. Yet the virtuous circle is evident again, as both sense of community and neighborhood attachment have been positively associated with lower fear of crime (Brown, Perkins, & Brown, 2003; Farrell, Aubry, & Coulombe, 2004).

The built form of communities can also be proactively designed, planned, and used to enhance social capital and sense of community. For example, a more walkable environment and street network design has been found to promote neighborly interactions and the development of social capital (Leyden, 2003). Sense of community has been found to be positively associated with walking within one's neighborhood (Lund, 2003; Wood, Frank, & Giles-Corti, 2010), and with resident's perceptions of their neighborhood as safe and interesting (Lund, 2002). Conversely, perceptions of neighborhood friendliness can be adversely affected by the presence and level of vehicular traffic (Mullen, 2003).

Qualitative research has found that children give many parents a greater vested interest in their suburb and its capacity to provide "a good place to grow up" (Wood et al., 2011). Moreover, there is evidence that children can, in turn, foster a sense of community and social capital as experienced by adults (Wood et al., 2011). This can occur in a variety of ways, from children precipitating pedestrian movement within a neighborhood (such as walking a child to school) through to facilitating parent/carer involvement in schools, playgroups, sporting clubs, and a host of other community-based activities, all of which provide opportunities not just for social contact and the spawning of friendships but also opportunities for civic contribution (Wood et al., 2011).

Consulting with Children

While planning and designing cities and residential areas may include consulting the community, procedures for gathering feedback generally target adults; rarely is opportunity provided for young people to provide input. While adults and designers may perceive they know what young people want and need, without asking children and adolescents nobody can really be sure they are on track. And research tells us that advancement, design, and development may be unsuitable. Our study exploring satisfaction with the

local park and playgrounds (Wood, Martin et al., 2010) suggests that the designs are not meeting children's and adolescents' needs, and that more interesting, challenging, and age-appropriate playgrounds are required. This begs the question; in the desire to provide a large number of fun yet safe playgrounds have we "advanced" playgrounds just too much? Are children even consulted when prefabricated play equipment plans are drawn up?

Encouragingly, various not-for-profits, local government agencies, and community groups are ensuring playgrounds, play spaces, communities, and even cities are developed with the opinion of children and young people as the basis for the main design brief. A design tool called Spaceshaper (developed by the Commission for Architecture and the Built Environment) assists with enabling communities to contribute to improving places important to them. Spaceshaper 9–14 is a modified version for children, allowing them to play a role in improving their local parks, streets, playgrounds, and other spaces. Qualitative and quantitative data are collected about a space during community consultations and allow development to incorporate the perspectives of children and young people. Extending this philosophy beyond the bounds of a single destination and to the cityscape is the Children's City project (International Secretariat for Child Friendly Cities) in which children "have their say," with their needs listened to and their proposals taken into account. Dozens of cities in Italy, Spain, and Argentina have participated in this project. The Italian National Research Council (CNR) has set up a coordinating and support group for the cities which, also in collaboration with other research organizations, has launched programmes to study the changes occurring in the cities implementing the project. Other city projects have incorporated approaches whereby plans to improve infrastructure, facilities, and policies to support play for children and young people focus on existing resources in the city or local area. This is exemplified in the Redland Child and Youth Friendly City Project (Box 7.2.).

Box 7.2. Redland Child and Youth Friendly City Project: a Case Study.

A valuable case study for others to consider is the Redland City Council Child and Youth Friendly City Project (Redland City Council & Urban Research Program Griffith University, 2010). Identifying that their community wanted children and young people to be supported in

their local environments, the Council engaged a consultancy team from Griffith University to undertake a project to identify how principles, policies, and practices of Child Friendly Cities can be applied to their Council. The project included (a) investigation of principles, policies, and practices of child-friendly cities relevant to the local context and trends, (b) development of a set of child-friendly cities principles for Redland City Council, (c) testing the draft principles on two planning projects, and (d) development of a report including recommendations for future actions. The project outcomes were achieved using multiple strategies to understand the children's point of view, such as using art to visualize and effectively communicate their vision for their community. The team also walked down Redland's streets with children to better understand how children see, and are affected by, the environment around them. The project led to the development of a corporate policy, a design guide that applies to public and private development and open space/public space/park improvement strategies, and the Redlands Child and Youth Friendly City Indicators. The project deliberately sought to impact existing practices and policies, which differs to some child-friendly cities' approaches where the emphasis on achieving accreditation (through the United Nations Child-Friendly Cities initiative) is focused on stimulating a range of new activities. The tools are integrated into the practical, day-to-day workings across all of Council, and because of this, the project was recently awarded the Best Planning Ideas award by the Planning Institute of Australia.

Conclusion

A former Director of Planning in British Columbia, Canada, Larry Beasley has been quoted by the media (Koerner, 1998) as saying "If you design an environment for children, it will work for everyone." This applies not just to the walkability, safety, accessibility, and built-environment aesthetics, but also to the provision of parks and open space and recreational facilities.

Although children make up significant proportion of the population in many neighborhoods, their needs are often overlooked in decisions relating to neighborhood planning, infrastructure, and use. Neighborhoods that support the health and wellbeing of children and young people are inclusive,

provide appropriate infrastructure to support walking and cycling, have safe but challenging and interesting places to go and things to do for all ages, are aesthetically pleasing with natural play areas, and provide good sense of community. Furthermore, encouraging planners, designers, and developers as well as government organizations to consider and consult with children and young people when designing and redeveloping neighborhoods is an important strategy in the pursuit of health and wellbeing for the next generation.

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8

A Step Too Far? Designing Dementia-Friendly Neighborhoods

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Introduction

The global aging of the population has led to an increase in the numbers of people with dementia as the likelihood of developing dementia increases with age: prevalence rates increase from 1 in 25 between the ages of 70 and 79 to 1 in 6 over the age of 80, and 1 in 3 over the age of 95. Dementia generally follows a pattern of slow progressive cognitive decline accompanied by gradual and erratic physical deterioration (Goldsmith, 1996; Perrin & May, 2000). Caused by a number of illnesses, such as Alzheimer's disease and Lewy body disease, dementia can lead to cognitive, behavioral, and personality changes including spatial and temporal disorientation, short-term memory problems, agitation, and confusion. In poorly designed environments people with dementia often struggle to understand their surroundings, to recognize where they are or the route they should take, to remember where they are going, or to realize when they are lost. This is in addition to the physical challenges people can face as they grow older, such as hearing or visual impairments, poor mobility, and reduced strength and stamina.

There are currently 800,000 people with dementia in the United Kingdom; two-thirds live in the community, roughly a third have severe dementia, and about a fifth live alone. Most wish to remain at home for as long as

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possible; staying in a familiar home and neighborhood can help to maintain some autonomy and stability at a time when they are trying to cope with difficult changes in their lives (Burton & Mitchell, 2006). However, a number of people with dementia eventually choose or need to move into specialized housing or residential care.

The Importance of Dementia-Friendly Neighborhoods

As capabilities decline and frailty increases, older people with dementia often find their independence and ability to cope restricted by the built environment in which they live (Brawley, 2005; Moore, Geboy, Weisman, & Mleziva, 2001; Perkins, Hoglund, King, & Cohen, 2004). No matter how supportive their housing, health, and social care services are, their quality of life and ability to lead active, meaningful lives will be compromised if the design of their local neighborhood prevents them from getting out and about. Being able to spend time outdoors provides important opportunities for physical and mental exercise and stimulation, with positive impacts on health and wellbeing. Being able to go out to maintain independence and a sense of normality and to enjoy activities and social contact has been shown to be very important to people with dementia (Innovations in Dementia, 2012a). Yet the provision of dementia-friendly environments has been constrained by a societal view of aging as a medical problem and little understanding of the needs of people with dementia. As Vallelly, Evans, Fear, and Means (2006, p. 12) note:

> Independence is important to all older people including those with dementia. Like other older people, people with dementia are citizens and consumers, these rights do not dissipate when they have dementia, though some public policy statements still treat people with dementia as passive recipients of services.

Being unable to carry out everyday activities and meaningful roles impacts negatively on people's independence and sense of identity and can accelerate decline (Davis, Byers, Nay, & Koch, 2009; Nygard, 2006). Unsurprisingly, people with dementia enjoy similar activities to other people—such as social contact and community participation; activities of daily living, housework and gardening; the natural environment; being outside, walking, and exercise; and creative activity—but are often prevented from pursuing them due to physical and social barriers (Torrington, 2009).

As well as going out to meet daily needs, walking around familiar neighborhoods is an important means of coping for people with dementia:

> Walking off the anxiety, attempting to decrease the confusion and going down familiar streets means memories of happier times flood back, anxiety starts to decrease and they begin to feel more secure and more composed, spirits are uplifted.
>
> Wilson, Hines, Sacre, and Abbey (2007), p. 49

Research has found that physical activity significantly reduces the likelihood of becoming disabled or experiencing chronic illnesses, such as heart disease (Landi et al., 2007; Kennedy, 2007) but even just going outdoors daily can impact positively on self-rated health and functional ability (Jacobs et al., 2008). Long-term regular physical activity, especially walking, has been found to help improve and maintain cognitive function in old age. While leisurely walking is associated with better cognitive performance, those who walk regularly and/or quickly are less likely to develop dementia (Abbott et al., 2004; Larson et al., 2006; Weuve et al., 2004; Yaffe, Barnes, Nevitt, Lui, & Covinsky, 2001). Access to the natural environment helps reduce stress and agitation and aids memory and sleep patterns (Chalfont, 2005; Chapman, Hazen, & Noell-Waggoner, 2005; Cooper Marcus, 2009). Sunlight is important for the production of serotonin (a mood-enhancing hormone) and absorption of vitamin D, which is extremely important for older people at risk of osteomalacia and osteoporosis. Exposure to natural light and being able to clearly see the cycle of change between day and night and the seasons can enhance health and wellbeing and reduce the prevalence of "sundowning" (increased agitation at dusk) and sleep disorders (Cooper Marcus, 2009; Keane & Shoesmith, 2005; Torrington & Tregenza, 2007). Equally important are the psychological and social benefits of being able to access and use the local neighborhood, including increased wellbeing, satisfaction with life, self-esteem, a sense of purpose, independence and autonomy, reduced stress, and enjoyment of social contact (Calnan, Badcott, & Woolhead, 2006; Fisher & Yarwood, 2008; Sugiyama & Ward Thompson, 2007).

Moving Toward Dementia-Friendly Neighborhoods

The World Health Organization (WHO) maintains that people both need and have a right to age-friendly cities that enable older people and others disabled by poor design to be as active members of the community as

younger fit adults (WHO, 2007). WHO also acknowledges that the design of public buildings and the outside environment can impact greatly on older people's ability to age in place. The Institute for Public Policy Research (IPPR) believes that, to achieve age-friendly environments:

> design and planning should be grounded in a better understanding of ageing, behaviour and older people's relationship with their surroundings, focusing on their broader well-being as well as their physical mobility
>
> Clifton (2009), p. 25

Since the WHO launched its Global Age Friendly Cities guide many countries have developed age-friendly strategies, including making the built environment more inclusive and accessible for older people. Yet the needs of people with dementia to be able to get out and about and to access their local neighborhoods are often forgotten. However, in the United Kingdom and Europe the term "dementia-friendly communities" has begun to be used in the search for new ways to address the steady rise in numbers of people with dementia. This emerging concept builds on the recognition that people with dementia have the same rights as everyone else to be treated with dignity and respect, to lead independent, autonomous lives for as long as possible, and to continue to be active citizens whose opinions are heard and acted upon. During workshops with people with dementia to discuss what a dementia-friendly community should be, one participant described it as "an integrated society where people with dementia live in 'normal' home like situations throughout their lives with support to engage in everyday community activities" (Innovations in Dementia, 2012b, p. 3). This portrays a community that most people take for granted but from which people with physical, sensory, or cognitive impairments often become excluded through physical, social, psychological, and/or economic barriers. This is particularly the case for people with dementia, described by Innovations in Dementia (2012b, p. 3) as "among the most marginalised, socially excluded and highly stigmatised groups in society."

In recent years a number of U.K. policies have attempted to address the needs of the aging population and to strategically link health and social care with other local services such as housing, leisure, planning, transport, employment (Department for Communities and Local Government [DCLG], 2012; HM Government, 2010, 2011). The National Dementia Strategy (Department of Health [DH], 2009, 2010) aims to bring dementia "out of the shadows" with a 5-year plan to enable people with

dementia to live at home or in sheltered or extra-care housing for as long as they wish and to improve the physical and social environments of care homes. The U.K. Equality Act 2010 has required public bodies to develop age-friendly services and communities since April 2011. The Prime Minister's and Alzheimer's Society's joint challenges on dementia (Alzheimer's Society, 2012; DH, 2012) seek to improve housing, health, and care services and options and to create dementia-friendly communities, with an emphasis on providing the help people with dementia and their carers need and reducing the stigmatism, exclusion, and disempowerment they generally experience.

The public health strategy for England (HM Government, 2011a, 2011b) recognizes that people's health, wellbeing, and resilience are affected by the quality of the environments in which they live and work, including pollution, air quality, noise, the availability of green and open spaces, transport, housing, access to good-quality food, and social isolation. In particular, it notes that "Neighbourhoods and houses can be better designed, and enhance the health and wellbeing, of an ageing population." The strategy aims to empower local communities to create healthy places by giving local government control of public health resources and requiring them to develop new partnerships in areas such as housing, environment, planning, transport, and social care, and with key partners, such as the National Health Service, police, business, and voluntary organizations.

In 2008, the U.K. Government produced *Lifetime homes, lifetime neighbourhoods: A national housing strategy for an ageing population* (DCLG, 2008), described by Harding (2009, p. 5) as a "landmark publication" that "constituted a major accomplishment. It was the first cross-departmental strategy on housing, neighborhood, health and wellbeing for older people in the world." As well as setting out a housing strategy within the context of an aging society it highlighted the essential link between housing and neighborhoods in supporting healthy, active, independent lives as people age. It recognized the need to provide more housing choice rather than expecting older people to move into specialist housing and to enable people to stay in their own homes. It promoted Lifetime Homes standards: 16 design criteria to enable general housing, either from the outset or through adaptation, to meet the existing and changing needs of diverse households (Goodman, 2011) and was the first government strategy to embrace the concept of "lifetime neighborhoods," which would enable older people with and without dementia to access the local services and facilities they wished to use and to be part of the local community. The new housing strategy for England (HM Government, 2011b) also recognizes the need

to provide for an aging population and the health, social, and economic benefits of enabling older people to live in the housing of their choice and thus commits to "ensuring that housing and planning policies positively reflect the wide range of circumstances and lifestyles of older people." It also reiterates the importance of designing attractive, inclusive neighborhoods to support people's quality of life and independence as they age and promotes the Lifetime Neighbourhoods report (Bevan & Croucher, 2011) as a tool for sharing good practice to "enable local partners to create age-friendly, inclusive neighbourhoods."

The National Planning Policy Framework (DCLG, 2012) is based on a presumption in favor of sustainable development, encompassing economic, social, and environmental sustainability. It requires local governments to deliver a wide choice of high-quality homes and create sustainable, inclusive, and mixed communities, taking into account current and future demographic trends and the needs of different local community groups, including older people and people with disabilities. It also seeks to promote healthy communities in terms of safe, clean, accessible, mixed-use environments with a high quality of design and amenity. The All Party Parliamentary Group on Housing and Care for Older People (APPG, 2011, p. 5) recommends that local authorities and housing designers, providers, and managers should "embed aging in their local strategies and to develop local 'age friendly' neighbourhood criteria."

The 2008 housing strategy's commitment to Lifetime Homes standards was criticized by many developers for adding further costs to house building and the ensuing recession and spending cuts have been blamed for the low uptake of both lifetime homes and lifetime neighborhoods. But research shows that Lifetime Homes standards add very little extra cost if included early in the design and planning process. Davis (2009) believes that "too much compromise on standards will only sow problems for the future–lifetime homes should prove sound value over the longer term." Age UK (2011) agrees, arguing that designing housing and neighborhoods to enable older people to live independent lives in their own homes for longer is "value for money." A number of local authorities and organizations have developed aging strategies and age-friendly action plans which set out their visions for ensuring that their local housing and neighborhoods are age-friendly, often including lifetime homes and neighborhoods criteria. For example, the London Plan requires development proposals and plans to take account of the Plan's policies which set out the criteria required to promote inclusive, lifetime neighborhoods. But these policies, strategies, and plans

rarely, if ever, include the needs of people with dementia. An exception to this is a Dementia Friendly Community Model being set up in Sheffield through which the city council's planning and public health authorities are working together to develop dementia-friendly communities. Focusing on the neighborhood level, planners are using a checklist for designing dementia-friendly neighborhoods, developed by the author and colleagues (Burton, Mitchell, & Raman, 2004) to evaluate how dementia friendly the local area is and what needs to be changed. Addressing the needs of people with dementia is to be included in the Planning Framework for Sheffield.

Designing Dementia-Friendly Neighborhoods

It has been suggested that a lack of clear guidance on how to develop lifetime neighborhoods has been a contributory factor towards slow progress but, as the Lifetime Neighbourhood report (Bevan & Croucher, 2011, 18) says, "the 'do nothing' option is not viable"; neighborhoods that "enable and prolong an active and independent later life should reap benefits in the future with regard to reducing demand on health and social care." A recent review of the research literature identified just six projects that have addressed the dementia-friendly design of neighborhoods (Keady et al., 2012). This includes a 3-year research project conducted by the author and colleagues investigating how to design the outdoor environment to improve the quality of life of older people with dementia, funded by the Engineering and Physical Sciences Research Council. The research directly involved people with and without dementia through interviews and accompanied walks around their local neighborhoods and interviews with informal carers where relevant. The neighborhoods were also mapped, measured, and evaluated using a checklist of environmental features developed for the research. Full details of the research can be found in the following publications: Burton and Mitchell (2006), Burton et al., (2004), Mitchell and Burton (2010), Mitchell, Burton, & Raman (2004), and Sheehan, Burton, and Mitchell (2006). The research found that people with dementia, at least in the mild to moderate stages, regularly go out alone but tend to restrict themselves to their local neighborhood where it feels safe and familiar and does not require using motorized transport to get around. It was also found that the design of the environment can directly impact on people with dementia's levels of independence and ability to use and find their way around the neighborhood. Another project identified by the Keady

et al. literature review, which used interviews and virtual reality simulation, also found that their participants with dementia continued to go out alone regularly for practical, emotional, and social reasons (Blackman, Van Schaik, and Martyr, 2007; Duggan, Blackman, Martyr, & Van Schaik, 2008).

Over 70 recommendations were derived from the findings, the majority of which complement those for making neighborhoods more age friendly including the recommendations of the Inclusive Design for Getting Outdoors (I'DGO) consortium (http://www.idgo.ac.uk), Help the Aged (2008), WHO (2007), and Bevan and Croucher (2011). The recommendations would also benefit most members of society and many are similar to those found in government and urban design literature and guides. Six principles for creating dementia-friendly neighborhood environments were identified: the environments should be familiar, legible, distinctive, accessible, comfortable, and safe. These principles are interdependent and share some common characteristics and recommendations.

Familiarity

> Streets need to . . . engender a sense of belonging, a familiarity and the respect of users.
>
> Montgomery (1998), p. 109

Recommendations.

- Streets, open spaces, and buildings should be long established.
- Any change should be small scale and incremental.
- New developments should incorporate local forms, styles, colors, and materials.
- There should be a hierarchy of street types, including main and side streets, lanes, and footways.
- Places, buildings, architectural features, and street furniture should be in designs familiar to or easily understood by older people.

This research found that people with dementia avoid socially demanding settings, such as churches and libraries, for fear of doing something wrong, Similarly, De Witt, Ploeg, and Black (2009) found some participants worry about going anywhere unfamiliar in case they make a mistake resulting in them being placed in residential care. Van der Meer (2008) found participants over the age of 75 took part in increasingly fewer physically or intellectually demanding activities over time. Although restricting activity to

a small number of very familiar locations can impact adversely on general quality of life, it is a common coping strategy for people with cognitive and physical impairments. As Adkins, Smith, Barnett, and Grant (2006, p. 363) explain, they seek "a sense of normality" in safe, understandable places where they can focus on the task in hand rather than having to worry about complex and confusing stimuli. McCormack, Cerin, Leslie, Du Toit, and Owen (2007) and Madanipour (1996) both describe how people who walk regularly around the same place have a more accurate knowledge and memory of the surrounding environment; this research and Duggan et al. (2008) found that this remains the case for people with dementia.

Familiar environments are hierarchical and long established with forms, open spaces, buildings, and features in unambiguous designs familiar to older people. It is important to stress that this does not mean that designs familiar to older people are necessarily old fashioned or traditional; contemporary and modern designs can be as familiar if they give a clear image as to the function of the place, building, or feature. Familiarity is also an important element in giving people a sense of feeling at home and of ownership and belonging (Frey, 1999; Montgomery, 1998). Peace, Holland, and Kellaher (2006, p. 72) note that "familiar places . . . can support older people in a number of ways" including a sense of "entitlement" and a knowledge of local features, such as safe routes and road crossings and accessible toilets. Fleming, Crookes, and Sum (2009) agree that this is particularly important for people with dementia and recommend that people should be enabled to move into a care setting in their local area so that they are supported by familiar places and people. Lynch (1990) and Madanipour (1996) also stress the importance of familiar, meaningful environments which communicate their different identities to users visually and psychologically thereby helping them to understand a particular setting.

Long-established, familiar features.

Urban design literature recognizes that people's sense of place relies on the established use of patterns and spatial structure of a place, its historic past, and natural setting, and echoes the recommendation above that streets, open spaces, and buildings should be long established. Time-honored features, such as monuments, landmarks, buildings, streets, parks, squares, trees, hedges, and gardens are valuable, fundamental elements that give a place its own character, identity, and image (Commission for Architecture and the Built Environment [CABE], 2007; Frey, 1999; Kropf, 2001). To help protect place-identity, any change should be small scale and incremental;

Carmona, Heath, Oc, and Tiesdell (2003, p. 205) describe the adverse effects of large-scale change on local residents without frailty or impairment:

> As personal associations with our immediate environment are valued and we draw comfort from its stability, the loss of familiar surroundings can be distressing, particularly when experienced over a short period and on a large scale.

Frey (1999), Kropf (2001), and CABE (2007) agree that while change is necessary and inevitable, it should be slow and incremental. CABE (2009a) and the Department for Transport (DfT) and DCLG (2007) concur, recommending that new development should retain long-standing features and designs, follow local traditions of form, layout, and materials, maintain and produce buildings that can be adapted to new uses over time and enhance and learn from the existing environment. Butina Watson and Bentley (2007, p. 268), take this further by noting that maintaining local character should be based on protecting and learning from buildings and features that are highly valued by local people and improving or removing those that are not: "being rooted in the past but not stuck in the past."

Place-identity and local people's personal and social identity are inextricably linked due to attachments developed over time, but this appears particularly the case for older people (Butina Watson & Bentley, 2007; Day, 2008a). Madanipour (1996) believes this sociospatial view is essential in ensuring the public realm can be used by all members of society rather than just certain groups and that people tend to remember environmental features when they personally give them a descriptive name demonstrating their familiarity and attachment. This was certainly the case with our research participants on accompanied walks who used some evocative terms, including "the toothpaste tube houses," "the witch's house," and "the big, ugly house at the end." Madanipour also states people are more likely to remember places, buildings, and features that have a personal significance; our participants often used such places as their children's old school, their old work place, and GP surgery as landmarks.

Street hierarchy.

A hierarchy of streets helps people with dementia with orientation and wayfinding. DfT and DCLG (2007), Kropf (2001), and Marshall (2005) recommend following a traditional street hierarchy with different, clearly recognizable streets in terms of range, character, and building uses. Kropf (2008, p. 11) explains that these familiar hierarchies provide "one of the keys

to the legibility of urban areas–memorably structured difference." Biddulph (2007) further refers to the identifying nature of the density typology of many cities in which densities are greatest in and around the city center and on main streets and much lower in the suburbs and city edges. Density was not examined in this research but as street hierarchy is an important feature of enhancing familiarity and legibility for people with dementia it seems logical that maintaining density hierarchies could be a further useful feature.

Legibility

> Too many neighbourhoods make it hard for people to find their way around, lack character and feature spaces where ownership is ambiguous.
>
> CABE (2009a), p. 6

Key recommendations.

- There should be a hierarchy or street types.
- Blocks should be laid out on an irregular (deformed) grid based on an adapted perimeter block pattern.
- Blocks should be small and of varying lengths from around 60 to 100 m.
- Streets should be well connected.
- Streets should be gently winding with open-ended bends and corners greater than 90 degrees.
- Streets should be short and fairly narrow.
- There should be forked, staggered, and T-junctions rather than crossroads.
- Places and buildings should have clearly visible, obvious, and unambiguous functions and entrances.
- Low walls, fences, and hedges should separate private and public space.
- Signs should be minimal giving simple, essential, and unambiguous information at decision points.
- Directional signs should be on single pointers.
- Locational signs for primary services should be positioned perpendicular to the wall.
- Signs should have large, realistic graphics and symbols in clear color contrast to the background, generally with dark graphics on a light background.
- Signs should have nonglare lighting and nonreflective coverings.
- Street furniture and other latent cues should be positioned at decision points and where visual access ends.

People with dementia need streets that help them understand where they are and which way to go through a clear network of routes and junctions, simple, explicit signage, and unambiguous features. Describing legibility as "the apparent clarity" of a city, "the ease with which its parts can be recognised and can be organised into a coherent pattern," Lynch (1960, p. 2) believes legibility that works equally for everyone is crucial to a city's success. Different groups of people look for different clues depending on their familiarity with the place and reasons for being there, but certain elements are always essential: the street layout, main centers of activity, places of symbolic or historic value, and open spaces.

Street layout.

The comparative merits of uniform grid street layouts and tree- or tributary-type layouts of cul-de-sacs and looped streets are often debated. Cul-de-sacs and looped streets leading off a main distributor road provide residents with quiet living environments away from through traffic. However, as traffic is consequently heavy along the distributor road it tends to be faced by walls or fences, rather than housing, making it an unpleasant and potentially unsafe route to walk along. Tree patterns are often monotonous and disorienting, provide few route choices, and increase travel distances, thus forcing people to rely on motorized transport which further increases traffic levels on the main roads. Housing estates built on a tree street pattern are also often poorly integrated with surrounding areas in terms of street connectivity, image, and design. In contrast, the uniform grid system is generally considered to be more environmentally sustainable, legible, and accessible, spreading traffic out relatively evenly and providing direct, connected routes enabling people to get to their destination as quickly and efficiently as possible (Biddulph, 2007; CABE, 2009a; DfT & DCLG, 2007; Kropf, 2001; Marshall, 2005; Tittle, 2009).

In this research, the tree system caused orientation and wayfinding problems for participants with dementia, regardless of the length of time they had lived in the locality or whether the cul-de-sacs were linked by a footway network. Carmona et al. (2003, p. 86) explain that "to ensure permeability, all streets should lead somewhere and terminate in other streets or spaces rather than in dead ends." CABE (2008, p. 14) agrees that successful places have "a seamless network of routes and public spaces." Routes should lead to meaningful destinations rather than dead ends but although the uniform grid is perhaps the most permeable or connected street layout, rows of identical streets and crossroads can be just as

monotonous and illegible as cul-de-sacs. As Carmona et al. (2003, p. 66) observe:

> While deformed grids usually have a picturesque character as a result of their changing spatial enclosure, regular grids have often been criticized for their supposed monotony.

CABE (2009b) promotes the use of long, straight streets for providing good sight lines and helping people estimate distances but the participants, with and without dementia, perceived long, straight streets as unattractive and interminable. According to Montgomery (1998, pp. 107–108), this is the case for people of all ages, "psychologically, people are less inclined to walk down long unbroken streets with little activity or a monofunctional identity." While acknowledging the efficiency of straight streets, DfT and DCLG (2007) note that they can encourage speeding traffic and thus recommend short, gently curved and irregular streets, which also give variety, interest, and a sense of place.

The research also found that crossroads, which are often promoted for providing the most connectivity and choice, are confusing for people with dementia. While connectivity is essential, crossroads can make the vistas along straight streets seem even more unending and tedious, as described by Whyte (1988, p. 200): "most streets in our grid systems never seem to have a stopping point; they recede off to infinity." Staggered, forked, and T-junctions provide something to focus on, such as the buildings opposite, as people walk towards the junction, which helps maintain concentration and gives clues as to where they are and which way to turn. These junction types also help to produce irregular street patterns, an interesting built form, and increased road safety while still enabling connectivity (Biddulph, 2007; Marshall, 2005; DfT & DCLG, 2007).

Unambiguous places, spaces, and buildings.

The research confirmed that people with dementia need clear signals as to the uses and entrances of buildings, spaces, and places but, as already discussed, place-identity is important for everyone. CABE (2009a) and DfT and DCLG (2007) recommend that new developments follow time-honored local spatial layouts, forms, and uses to prevent ambiguities and confusion as to the purpose of new places, spaces, and features. Lynch (1990) calls this match between form and function "congruence," highlighting its role in reducing stress or conflict by giving people unambiguous signals as to where

they are welcome and the sort of behavior expected. Congruence includes a clear demarcation between private and public space, such as by front doors facing the streets and back doors facing private gardens, as traditionally found on perimeter blocks. It also requires the functions of and entrances into buildings to be obvious (Butina Watson & Bentley, 2007; Carmona et al., 2003; DfT & DCLG, 2007; Tibbalds, 2001). Describing the legibility of conventional toilets for people with dementia, Bichard, Hanson, and Greed (2005, pp. 7–8) focus on the congruence of unambiguous design:

> For people with cognitive impairments all aspects of the APC [automatic public convenience] could be considered a cognitive challenge. For people with learning disabilities or dementia many aspects of the toilet may act as a cue for appropriate behaviour. The familiarity of a door lock, the handle of a flush, the shape of a tap may all act as objects that focus the user on the use of the toilet.

Signage.

Blackman et al. (2007) substantiate this research's findings that people with dementia continue to use signs but are easily confused if they are copious, complex, or poorly designed. Day (2008b) also found that older people in general require clear, straightforward signage. Urban design guidance states that signs should not clutter or dominate streets or building façades but should be easy to see and understand (Kropf, 2001; Newton & Ormerod, 2007a). DfT and DCLG (2007) stress that correctly designed street layouts and networks should be self-explanatory so that signs need only be used when absolutely necessary to serve a clear function. Newton and Ormerod (2007a) recommend the use of large graphics with appropriate color contrast in the signage itself and between the signage and the surroundings. Kropf (2001) recommends using pictorial, iconic, or object signs to contribute to variety and vitality; however, this research and that of Blackman et al. (2007) found people with dementia tend not to understand "You are here" maps, iconic images, and three-dimensional signs. This does not mean they should not be displayed for other users; only that alternative, clearer signage is also required.

Latent wayfinding cues.

The research found that outdoor latent cues—features that work as wayfinding cues as well as their original function—are used by older people with dementia for orientation and wayfinding purposes. The beneficial role of environmental features, such as public art, street furniture, and trees, as

wayfinding cues is recognized by DfT and DCLG (2007), which suggests they can help reduce the need for signs. Butina Watson and Bentley (2007) describe the imaginative use of public seating design to enhance Ljubljana's legibility with rustic wooden seating in the rural outskirts becoming gradually more formal as routes reach the city center. Carmona et al. (2003) and Day (2008b) note that such features can also increase the quality of the environment providing they do not cause street clutter.

Distinctiveness

> Buildings, streets and spaces, hard and soft landscaping and street furniture should be considered together, to create drama and visual interest and to reinforce or enhance the sense of place.
>
> Carmona et al. (2003), p. 164

Key recommendations.

- Neighborhoods should have local character.
- Neighborhoods should have varied urban and building form.
- Neighborhoods should have small, informal, welcoming, and understandable open spaces with varied activities and features.
- There should be a variety of open spaces, such as public squares, recreation grounds, village greens, allotments, and parks,
- Streets, places, buildings, and features should be in a variety of local styles, colors, and materials.
- There should be a variety of historic, civic, and distinctive buildings and structures.
- There should be a variety of places of interest and activity.
- There should be a variety of aesthetic and practical features, such as trees and street furniture.

People with dementia need streets and neighborhoods to have a clear, distinctive image and identity. The importance of creating a sense of entitlement and ownership for people with dementia has been discussed; DfT and DCLG (2007) and CABE (2008) explain that a sense of ownership and place can be achieved by using local distinctiveness and good visual and physical quality. Biddulph (2007, p. 181) agrees:

> The juxtaposition of built and natural elements help to give a place an individual character so that a person can define their location in one part of a scheme

> relative to others . . . the balance of concern is shifted away from the rather functional notion of "way finding" to embrace a richer (and particularly visual) aesthetic response which is derived from the drama, distinction or beauty of the townscape composition.

According to Kropf (2001) character, identity, and distinctiveness are synonymous, referring to the combination of all the features that identify a place. Successful urban places combine identity (what a place is actually like) with how it is perceived. People develop an image of a place over time, based on its legibility and visual form and the sequence of features and views along its routes.

Local character and varied built form.

People with spatial orientation problems perceive bland, uniform, featureless, or ambiguous environments as uncomfortable and difficult to negotiate. Suburbs are often criticized for being monotonous and characterless and shopping centers for being indistinguishable. In contrast, the "assertive townscape" of traditional settlements provides variety within a range of common themes and groups of buildings with a "complementary variation in materials and colours, and . . . in both building and roofline" (Biddulph, 2007, p. 187). Thus, as with Lynch's "districts" in his lexicon of city image elements (Lynch, 1960), individual neighborhoods should be defined by their own distinctive, varied characteristics, features, and materials while continuing to reflect the overall character of the town or city (Biddulph, 2007; CABE 2008; DfT & DCLG, 2007; Tibbalds, 2001).

Landmarks and environmental cues.

> Your best way then is to turn sharp left by that pillar-box, and then right by the church.
>
> Du Maurier (1938), p. 413

Landmarks play an important role in depicting a place's image and giving it meaning; a street defined by a distinctive building or feature is easier to identify and remember. Our participants with dementia continue to use familiar, distinctive landmarks as wayfinding and orientation cues. Urban designers tend to use words such as "expressive, visually stimulating, monumental, memorable and symbolic" to describe the necessary requisites of major landmarks. Llewelyn-Davies (2007) notes that distinctive, civic

landmarks emphasize the location's hierarchy, further aiding place-identity. But urban designers also reflect the findings of this research that landmarks are not only large or historic buildings or structures but also unusual or functional human-scale places and spaces, such as parks and squares, and other, often smaller, environmental and architectural features, such as trees, gardens, and ornamentation (Biddulph, 2007; Carmona et al., 2003; Lynch, 1990; Montgomery, 1998). Blackman et al. (2007) also found their participants with dementia used both distinctive buildings and street furniture as landmarks. Similarly, Day (2008b) found that older people find attractive environments with natural features, such as parks and gardens, and/or interesting or historic buildings and architectural features easier to navigate and more interesting to walk along. For people with orientation problems, the positioning of wayfinding cues on street corners and at the middle or end of vistas is crucial. Kropf (2001) agrees that distinctiveness and siting are important for capturing people's attention and focus.

Accessibility

> Sensory acuity, strength and agility can decline to a point where steps, curbs and entrances . . . all represent major challenges to the older person. Moving fast enough for revolving doors or escalators or maintaining stability in moving vehicles are equally challenging. Even though most older people are not completely intimidated by these obstacles, the latter are nevertheless a source of anxiety when they try to catch a bus, drive a car, move through crowds or cross at a street light; add to these physical anxieties the fear of assault and robbery as further contributions to the immobility of the elderly.
>
> Gelwicks and Newcomer (1974), p. 43

Key recommendations.

- There should be a mix of land uses.
- Housing should be located no further than 500 m from local primary services and facilities, including a general food store, post office, bank, GP surgery/health clinic, green space (e.g. village green, green street edges), public toilets, public seating, and public transport stops.
- Housing should be located no further than 800 m from local secondary services and facilities, including open space (e.g. parks, allotments, recreation grounds, public squares), library, dentist, optician, places of worship, and community and leisure facilities.
- There should be obvious and easy ways to recognize entrances to places and buildings.

- Entrances should be at ground level wherever possible with flush thresholds.
- Public seating should be at least every 100 m.
- Streets should be well connected with clear views along them and simple junctions.
- Footways should be flat and at least 2 m wide.
- Where level changes are unavoidable there should be a choice of steps and a ramp with a maximum gradient of 1 in 20.
- Level changes should be clearly marked and well lit with guards, handrails, and nonslip, nonglare surfaces.
- There should be pedestrian crossings and public toilets at ground level.
- Telephone boxes should have flush thresholds.
- Gates and doors should require no more than 2 kg pressure to open and have levers rather than knobs.

Gelwicks and Newcomer's words are as relevant today as they were 40 years ago; WHO (2007) found that participants in many parts of the world, including the United Kingdom, thought their cities were not designed for older people. Accessibility refers to the ability of older people with dementia to walk freely and safely to and around places, services, and facilities, to spend time in the public realm without encountering barriers and obstacles, and to enter buildings and facilities without impediment. As Carmona et al. (2003) point out, the relationship and connection between places and the pedestrian network is fundamental to achieving accessibility.

Reaching local services and facilities.
Proximity to easily accessible, safe, comfortable, and welcoming local shops and services is an important issue for older people (Bevan & Croucher, 2006; Day, 2008a, 2008b; White, 2007; WHO, 2007). Bowling and Kennelly (2003, p. 21) found that participants' most frequently mentioned reasons for a good quality of life were:

> living in a home that gives pleasure and a neighbourhood that is safe, secure, neighbourly, with nice areas to walk in, and with good public transport, shops and local public services such as refuse collection, libraries and police.

Borst, Miedema, de Vries, Graham, and van Dongen (2008) note that poor design directly impacts on older people, who are more likely to regularly use their local neighborhoods if they are attractive and contain shops and services and an accessible network of paths and footways. Evans (2009) found

that older people often favor good local facilities over busy town centers for comfort and safety reasons. Yet he points out that government accessibility indicators tend to focus on access to town centers, sports facilities, GPs, and hospitals rather than food outlets or other local amenities.

The research participants with dementia were no longer able to drive or to use public transport unaccompanied so their independent outdoor activities were restricted to the local neighborhood within which they could comfortably walk. Research has found that the causes of driving cessation among older people without dementia, such as health, vision, or mobility problems, also often cause difficulties using public transport (Broome, McKenna, Fleming, & Worrall, 2009; Davey, 2007; Wendel, Stahl, Risberg, Pessah-Rasmussen, & Iwarsson, 2009). To cater for the reduced amount of walking older people with mobility problems can cope with the most important services and facilities for older people should be within a 500-m walk of residential areas. Although DfT and DCLG (2007) requires designers to consider the role good, legible design plays in meeting the needs of people with physical, sensory, or cognitive impairments, they continue to use the standard requirement that local services and facilities be within 800 m walking distance of residential areas. Llewelyn-Davies (2007) also states that local shops and services should be within 800 m, but suggests that a newsagent's should be within 400 m and a mailbox within 250 m. English Nature (2003) maintains that everyone should live within 300 m of a small local park. These shorter distances are more suitable to frail older people and others with mobility problems but any specified distance can be arbitrary if the topography and quality of the built environment are not taken into account (Day, 2008b; Tibbalds, 2001).

Alzheimer's Australia NSW (2011) recommend that footways should be wide with even surfaces. We recommend that footways should be at least 2 m wide to enable people and wheelchairs to freely pass oncomers. Biddulph (2007) and Newton and Ormerod (2007b) make the same recommendation; however, DfT and DCLG (2007) take this further by stating that footways on quieter streets should be at least 2 m wide and busier streets wider.

Entering buildings and services.

Day's (2008a, 2008b) findings on accessibility barriers to older people are very similar to those of this research, including the need for obvious entrances at ground level and easy-to-open doors. CABE (2006) and DfT and DCLG (2007) both state it is essential that direct pedestrian, wheelchair, and pushchair access is included in all buildings, spaces, and services at the

design stage, including features such as flush thresholds and highly visible entrances. However, DfT and DCLG also requires that gentle slopes are provided rather than steps. Some older people with particular mobility problems prefer steps especially for descending; hence our recommendation that, where level changes are unavoidable, steps and slopes should be provided. DfT and DCLG also recommends automatic doors, which are indispensable for wheelchair and pushchair users, people on crutches and so on, but unless they are designed to resemble conventional doors people with dementia may not recognize them.

Comfort

> Comfort is a prerequisite of successful public spaces. The length of time people stay in a public space is a function and an indicator of its comfort.
>
> Carmona et al. (2003), p. 165

Key recommendations.

- Neighborhoods should feel calm and welcoming.
- Buildings and features should be in familiar designs that older people recognize.
- There should be small, quiet, well-defined open spaces, free from motorized traffic and with seating, lighting, toilets, and shelter.
- There should be quiet side roads as alternative routes away from crowds and traffic.
- There should be some pedestrianized areas to offer protection from traffic.
- Acoustic barriers, such as planting and fencing, should be used to reduce background noise.
- Streets should be relatively short, gently winding, and well connected.
- There should be enclosed bus shelters with seating and transparent walls or large, clear windows.
- Sturdy public seating, in materials that do not conduct heat or cold and with arm and back rests, should be placed at least every 100 m.
- Public toilets should be conventional and at ground level.

People with dementia need calm, welcoming, and pedestrian-friendly environments because noisy, busy places can be confusing and disorienting. Lynch (1990, p. 90) describes how most people sometimes find the outdoor environment stressful: "too often the sensations we experience go

beyond our limits of comfort or even tolerance." However, just as people with dementia tend to prefer active rather than empty places despite their sensitivity to stimulation, Lynch believes most people prefer "a sense of quiet calm and comfort" rather than places that are noisy and crowded or silent and empty. A balance is required so that quiet calm places also offer choice and variety and are attractive and stimulating (DfT & DCLG, 2007). As Gilroy (2008, p. 16) found:

> Quality of life research with older people suggests that their needs can be best supported by enriched places where there is space and time to talk in high quality public space; by neighbourhoods and cities with distinctive architecture, decent quality shops, street markets, pocket parks and community-based activities. This is a call for more life and vitality in small places not less.

Lynch (1990) explains that people cannot cope with continuous stimulation or having to maintain constant concentration, which is certainly the case for participants with dementia who would detour down quiet side streets, rather than remaining on busy, high streets, despite increased risks of losing the way. Likewise, noise, dirt, and pollution caused some older participants in Day's research (Day, 2008a, 2008b) to become physically stressed, tired, and anxious, leading them to favor quieter streets and spaces. Therefore, a choice of lively and tranquil spaces and a balance between vitality and clamour is required.

Open space.

The importance of visual and physical contact with the natural environment and sunlight for people with dementia has been explained. Clifton (2009) and the Sustainable Development Commission (SDC, 2008) both refer to the restorative effects of exposure to natural environments including enhancing physical, psychological, and social wellbeing, life satisfaction, and life expectancy. CABE (2009c) promotes the development of open space to enable contact with the natural world but also to reinforce local identity and encourage physical and social interaction. Urban designers tend to recommend providing relatively small open spaces with a mix of vibrant activities and restful, quiet zones (Kropf, 2001; Llewelyn-Davies, 2007; Whyte, 1988). Llewelyn-Davies recommends a hierarchy of parks in terms of scale, function, and location, which would aid their legibility for people with dementia. This research found that although people with dementia may feel more comfortable in relatively small open spaces, they

enjoy the activity in mixed-use parks and squares as well as using such visually stimulating and active open spaces as landmarks. Other research has found similar preferences by older people (Borst et al., 2008; Day, 2008b; Sugiyama, Ward Thompson, & Alves, 2009). However, WHO (2007) found some carers thought older people need small, quiet open spaces with little activity, illustrating accuracy issues inherent in seeking the proxy views of others.

Street features.

People with dementia need calm, welcoming, familiar environments that include elements necessary for physical and emotional comfort including places of activity and retreat, open spaces, pedestrianization, acoustic barriers, and user-friendly accessible features. In inclusive urban design, physical comfort is generally addressed by the provision of features such as shelter, seating, and toilets, and psychological comfort by providing natural elements, such as trees, shrubs, and flowers, and other features, such as fountains, ponds, pedestrianization, and traffic calming (Carmona et al., 2003; Lynch, 1990; WHO, 2007). Kropf (2001) and DfT and DCLG (2007) point out that planting has many comforting benefits including providing visual amenity and shade and protective buffers between people and traffic, softening the street scene, and improving air quality. Borst et al., (2008) found that green buffer zones are particularly influential in the walking choices of older people. Gilroy (2006), WHO (2007), and Day (2008a, 2008b) found that clean, well-maintained, flat, uncluttered spaces and footways with seating, toilets, low traffic levels, greenery, and scenic and natural views all encourage older participants to spend time in their local neighborhood. This research recommends that public seating should have back and arm rests and should be located every 100 m; Alzheimer's Australia NSW (2011), Newton and Ormerod (2007c), and DfT and DCLG (2007) recommend the same style of seating. DfT and DCLG (2007) states that seating should be every 100 m on main pedestrian routes and even more frequent in busier places, such as squares and shopping precincts whereas Newton and Ormerod (2007c) recommend providing them at more frequent intervals in hilly neighborhoods.

Safety

> If pedestrians are skilled, it is because they very well have to be.
>
> Whyte (1988), p. 68

Key recommendations.

- There should be a mix of uses.
- Buildings, doors, and windows should face the street.
- Bicycle lanes should be separate from footways and clearly marked.
- Pedestrians should be separated from traffic by trees, grass verges, on-road parking, or bicycle lanes.
- There should be frequent signal-controlled pedestrian crossings with visual signals on both sides of the crossing and audible cues at a pitch and timing suitable for frail older people.
- Traffic-calming measures should be in clear color and textural contrast to footways and pedestrian crossings.
- Footways should be wide, well maintained, and clean.
- Paving should be plain, nonreflective, flat, smooth, and nonslip.
- Paving should be in clear color and textural contrast to walls, bicycle lanes, and traffic-calming measures.
- Level changes should be clearly marked using color and textural contrasts.
- Grates and drains should be flush with paving with openings smaller than walking-stick or shoe-heel size.
- Street trees should have narrow leaves that do not stick to paving when wet.
- Spaces and buildings should be designed and oriented to avoid areas of dark shadow or bright light.
- Street lighting should be adequate for people with visual impairments.
- Public seating, toilets, telephone boxes, and bus shelters should be well lit and in view of buildings and pedestrians.

Everyone, including older people with dementia, has a right to use the public realm without fear of tripping, falling, being run over, robbed, or attacked. As Llewelyn-Davies (2007) point out, "a safe, attractive and well cared for public realm will encourage people to walk." Environmental and social hazards that pose a threat to pedestrians can be even more perilous for people with dementia who are less likely to be aware of or cope with them. It is important to maximize natural surveillance, avoid areas of bright light and dark shadow, and provide traffic-calming measures, pedestrian-only footways with buffer zones, signal-controlled pedestrian crossings, and good street lighting. Similarly, inclusive urban design literature stresses the importance of providing natural surveillance, connected streets, and good street lighting and avoiding dark spaces and blind corners (Biddulph, 2007; DfT & DCLG, 2007; Office of the Deputy Prime Minister, 2004; SDC, 2008; WHO, 2007).

A sense of security.

Although older people are statistically less likely to experience physical attack or theft on the street, many feel very vulnerable especially after dark or when alone (Gilroy, 2006; Waters, Neale, & Mears, 2008). Borst et al. (2008), Gilroy (2006), WHO (2007), and Day (2008a, 2008b) all found that fear of crime can prevent older people in general from leading active, independent lives. Evans (2009) and Waters et al. (2008) found that fear of crime was the main determinant for older people avoiding certain streets when alone despite them being the quickest route. Yet, the Institute for Public Policy Research quotes research and U.K. Government statistics suggesting older people are more concerned with the deterioration of outside spaces and litter, pollution, noise, and traffic than with crime (Clifton, 2009). This discrepancy could be explained by research findings that the fear of attack or theft for people of all ages is influenced by the character and quality of the space, including evidence of neglect, such as poor maintenance or cleanliness, and incivilities, such as litter, dog mess, graffiti, and vandalism (Borst et al., 2008; Carmona et al., 2003; Day, 2008a, 2008b; Peace et al., 2006; SDC 2008; Waters et al., 2008). According to Waters et al. (2008) the overall visual appearance and image of a place is more important for improving older people's sense of safety and discouraging crime and antisocial behavior than CCTV and street lighting. Although this research did not directly address this connection between the quality of the environment and fear of crime, the interrelationship between the six principles means that character and environmental quality are addressed albeit for other reasons. In addition to aiding legibility, ensuring that buildings face the street also helps create an interesting street scene and a sense of safety which encourages activity, thereby further increasing interest and perceived safety (Biddulph, 2007; Borst et al., 2008; DfT & DCLG, 2007; Kropf, 2001; SDC 2008). Furthermore, meeting people's physical safety through providing wide, clean, well-maintained pedestrian-only footways with plain, flat, nonslip paving also aids people's sense of security.

Pedestrian safety.

Participants generally felt safe from motorized traffic on streets with raised pedestrian-only footways and signal-controlled pedestrian crossings. Biddulph (2007) explains that people in general find traditional streets with buildings facing the street and footways alongside the carriageway safer and easier to navigate but, while in agreement, Marshall (2005, p. 192) criticizes the continuing unfair balance between:

> those who would like to travel on urban roads safely in fast, noxious vehicles, and the needs of those who wish to safely and healthily occupy those same roads as part of their local street environment.

These "fast, noxious vehicles" often force cyclists onto the footway and some wide footways are divided into cycle and pedestrian lanes. Even when cyclists keep to their designated zone they can be extremely disconcerting for people with dementia who struggle to interpret other people's intentions and often misunderstand iconic symbols, such as bicycle images painted on cycle routes. In focus groups with people with dementia Alzheimer's Australia NSW (2011, p. 17) found that "it is dangerous for people with dementia to share walkways and footpaths with skateboarders, bicycles and scooters." DfT and DCLG (2007) and Biddulph (2007) both recommend that cycle tracks should be provided on the carriageway.

As with this research, Alzheimer's Australia NSW (2011), WHO (2007), Newton and Ormerod (2007d), Day (2008a, 2008b), Evans (2009), and Borst et al. (2008) all found older participants struggled with heavy or fast traffic and inadequate pedestrian crossings. Whyte (1988, p. 69) expressed his own anxieties about poorly timed crossings:

> You had better be off the mark the instant the light says Walk. Eighteen seconds later it will start flashing Don't Walk. They let you have a bit more time but it is nervous time.

Despite this he notes, as did this research, that people prefer to use these crossings rather than more onerous underpasses or pedestrian bridges.

Key Design Features for New Developments or Neighborhoods

From the recommendations discussed here, 17 are particularly key for new developments or neighborhoods:

1. small blocks laid out on an irregular (deformed) grid with minimal crossroads;
2. a hierarchy of familiar types of streets, including high streets and residential side streets;
3. gently winding streets;
4. varied urban form and architecture that reflects local character;

5. a mix of uses, including plenty of services, facilities, and open space;
6. permeable buffer zones, such as trees and/or grass verges, between busy roads and footways;
7. buildings and facilities designed to reflect uses;
8. obvious entrances to buildings;
9. landmarks and environmental cues;
10. special/distinctive features at junctions; e.g., street furniture, trees;
11. wide, flat, smooth, plain, nonslip footways separate from cycle lanes;
12. frequent pedestrian crossings with audible and visual cues suitable for older people;
13. level changes only when unavoidable, clearly marked with handrails;
14. clear signs throughout;
15. frequent sturdy public seating in warm materials, with arm and back rests;
16. enclosed bus shelters, with seating and transparent walls or large, clear windows;
17. ground-level public toilets.

Key Design Features for Improving Existing Neighborhoods

Where no new development is planned, the following improvements are likely to be helpful for people with dementia:

1. add landmarks, distinctive structures, open spaces, or places of activity;
2. add special features (e.g., mailboxes, telephone boxes, trees, statues) at junctions, particularly complex ones;
3. add porches, canopies, and clear signs to make entrances to public buildings obvious;
4. increase the widths of footways (e.g., by reducing the widths of roads);
5. on busy roads create a green buffer zone between pedestrians and cars;
6. move bicycle lanes from footways to roads;
7. increase the frequency of pedestrian crossings;
8. where there are steps, provide a slope or ramp (no more than 1 in 20) as well;
9. add handrails to steps or ramps if not already present;
10. fix clear signs and symbols (where existing ones are poor) to publicly accessible buildings, preferably perpendicular to walls;

11. remove all unclear and unnecessary signs;
12. replace all unclear road and directional signs with clear ones;
13. increase variety in the existing built form (e.g., by painting doors and windows different colors and adding details such as window boxes);
14. add trees and street furniture where possible;
15. make sure there are public seats, toilets, and bus shelters that are suitable for older people;
16. make sure gates and doors only require up to 2 kg of pressure to open;
17. improve audible cues at pedestrian crossings where necessary and increase crossing times;
18. replace cobbled, rough, or patterned footways with smooth, plain ones;
19. reduce street clutter (e.g. boards, adverts, signs);
20. increase the amount of street lighting where necessary.

Conclusion

There is a growing consensus that the needs of people most disabled by poor design should be the design standard rather than those of fit young adults. With the aging of the population, policy makers and practitioners are beginning to realize that this must include addressing the needs of vulnerable older people. As Bernard Isaacs, founding Director of the Birmingham Centre for Applied Gerontology, is frequently quoted as saying, "Design for the young and you exclude the old; design for the old and you include the young." Recent research showing the physical, emotional, and cognitive health benefits of getting outdoors and of active aging highlights the importance of achieving age and dementia-friendly lifetime neighborhoods. Since WHO launched its Global Age Friendly Cities guide many countries across the Western world have developed their own age-friendly strategies. In the United Kingdom and Europe there are also some innovative activities raising awareness of the needs of people with dementia among the general population, providing people with dementia and their carers with support, advice, and information and including them in research and decision making, for example through workshops, dementia cafes, and drop-in centers. However, little attention has been given to how the design of the built environment contributes to dementia-friendly communities, beyond following general guidelines for age-friendly neighborhoods.

A dementia-friendly community should provide a good choice of different types of housing, including specialized housing and general housing with home-based health and social care services, and ensure that the design of housing and neighborhoods supports and enables people with dementia. Dementia-friendly neighborhoods should be both a social and physical milieu in which life for people with dementia is a positive experience rather than a daily struggle. Their environments should be attractive, welcoming, safe, easy, and enjoyable for them to visit, access, use, and find their way around and, therefore, inclusive for all. While there are some examples of local government initiatives to develop lifetime neighborhoods, very little is specifically being done to make sure those neighborhoods are dementia friendly (City of York Council in the United Kingdom is one notable exception). The Disability Rights Commission (2003, p. 3) maintains that "'inclusive design' is not a fixed set of design criteria, but a constantly evolving philosophy." However, although it is essential for inclusive design and research to keep abreast of changing needs, practitioners often complain that policy and design guidance too often present vague principles without explaining how to achieve them. The recommendations from this research are clearly relevant to current inclusive urban design guidance and recent research relating to older people in general. Thus, dementia-friendly features can easily be incorporated into new development or regeneration and adaptation of existing neighborhoods without significantly compromising the needs of other people.

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9

Walkable Neighborhoods

Principles, Measures, and Health Impacts

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Introduction

Walking is still one of the most common ways for people to get about in their locality. Walking is positive in many ways: it promotes opportunities for social interaction between neighbors; it is a socially inclusive activity since it is free and needs no special equipment; and it provides healthy exercise. It should be possible for people to incorporate walking into their everyday routines; for example, when traveling to work or school, or in other aspects of daily life. However, as well as walking for transport—that is, to get from one place to another—people also walk as a leisure time activity and the places we live should offer plenty of opportunity for this too. Many aspects of the built environment have the capacity to either provide opportunities for, or place constraints on, walking. How close our places of work, schools, and shops are to where we live, for example, will determine whether it is practically possible to walk to them. Many other factors also come into play that influence our decision to walk or not: whether there are easy, direct routes; if sidewalks are well maintained; or if there are lots of interesting things to see on the way. Walking is a convenient and sustainable way of getting around and it is a valuable form of exercise known to have benefits for health, for example, by helping individuals to maintain healthy weight levels. This is significant, since obesity levels and their associated health problems have soared in many countries in recent years. The extent

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to which the places we live facilitate or constrain walking, both for transport and leisure, has therefore become of increasing interest. In this chapter we explore the concept of "walkable neighborhoods" and the evidence that these support more active lifestyles and better health and wellbeing for the people who live in them.

What are Walkable Neighborhoods?

An early study of the concept of walkability outlined what it termed the "3Ds" as key influences: population *density*, pedestrian-friendly *design*, and *diversity* of destinations (Cerevero & Kochelman, 1997). These elements were reconfigured in later work by Frank et al. as *transportation systems*, *land-use patterns*, and *urban design characteristics* (Frank, Engelke, & Schmid, 2003), although the scope of investigation was largely similar. Since then, a body of evidence, originally from the United States and Australia, has correlated walking with neighborhoods that exhibit high residential density, mixed land uses, well-connected street networks, and good access to public transportation (Humpel, Owen, & Leslie, 2002; Owen et al., 2007; Saelens, Sallis, & Frank, 2003; Sallis et al., 2009; Wendel-Vos, Droomers, Kremers, Brug, & van Lenthe, 2007); similar studies have taken place more recently in Europe (Sundquist et al., 2011; Van Dyck et al., 2010). These studies have identified a number of factors which encourage walking, including a safe, comfortable, and high-quality pedestrian realm, pleasing views, high-quality landscaping, and access to open recreational spaces. Aspects of the built environment that may influence walkability are therefore thought to operate at range of scales in the urban continuum. In simple terms, however, a walkable neighborhood might be defined as one where it is easy and enjoyable to walk and where the day-to-day requirements of life are accessible within a comfortable walking distance.

Older neighborhoods that evolved prior to mass car ownership were designed for pedestrians. Residences were built near workplaces, shops, and services in neighborhoods as soon as they became viable. Early suburbs accessed by public transport would often have a good range of neighborhood facilities. Figure 9.1 shows a plan of West Jesmond, Newcastle, United Kingdom, a late nineteenth-century inner suburb, originally served by the railway (now part of the Tyne and Wear Metro system). The area contains a mix of terraces, "Tyneside flats" (high-density housing with the appearance of a traditional terrace, but divided into flats one above the other), larger

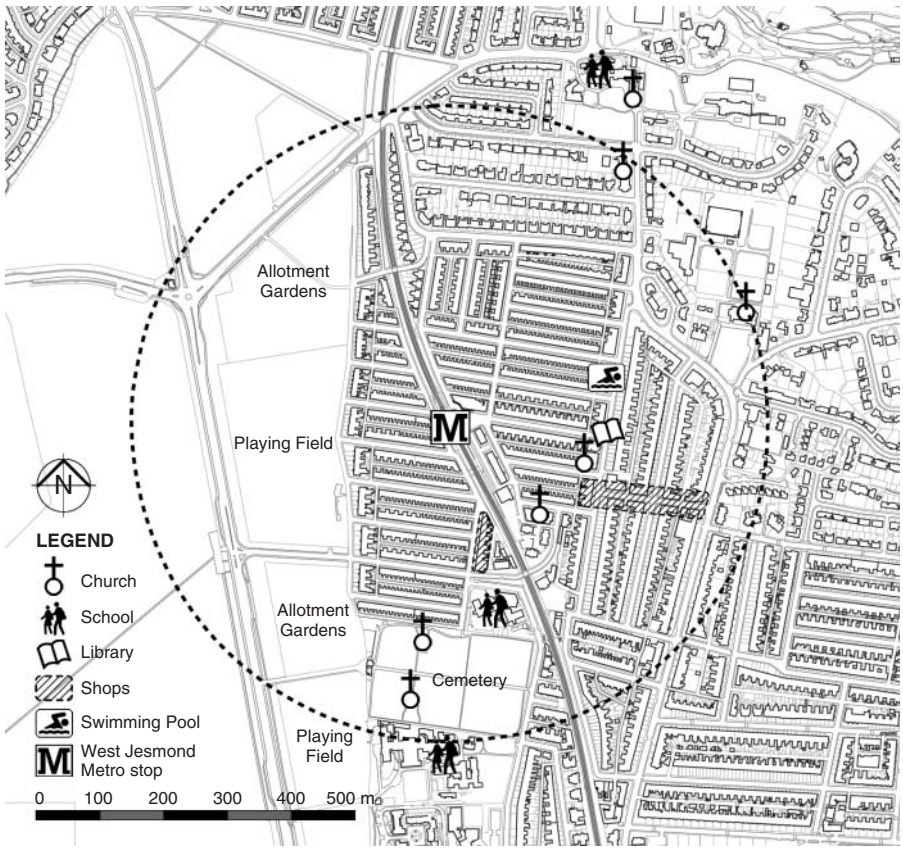

Figure 9.1. Plan of West Jesmond, Newcastle, United Kingdom, Showing the Variety of Land Uses within a 500 m (5–10 min) Walk.

detached homes, local shops, schools, and other amenities (see Figure 9.2). It is a highly walkable area and today is popular with families and students.

As the twentieth century progressed, however, urban areas were increasingly designed around the private car. Planning regimes encouraged city authorities to effectively zone urban areas into tracts of residential, commercial, and industrial land use. Urban areas became increasingly segregated and disconnected and by the closing decades of the twentieth century this monofunctional urban growth was the dominant development model for most developed countries. However, a number of crises increased the awareness of the problems this type of development created. For example, the economic problems associated with the oil crisis in the early 1970s not only greatly increased traveling costs, but brought an end to much "clean-sweep" urban renewal. Furthermore, in the closing decades of the century increasing

Figure 9.2. Acorn Road, Jesmond, Provides Local Shops and Amenities for a Range of Users.

traffic congestion and pollution, and acknowledgment of the depletion of fossil fuels, greenhouse gas emissions, and climate change, fundamentally challenged the sustainability of car-orientated lifestyles.

In the face of much criticism planners revised their approach to development patterns and mixed-use communities. A series of alternative models of development, for example, New Urbanism, Transit Orientated Development, Smart Growth, Urban Villages, and Eco-Towns, were proposed as ways to reduce urban sprawl and reliance on private car use. The idea of "walkable communities" evidently fits into these broader models and debates. However, more than other concepts it has been specifically linked to possibilities of improved health outcomes for local populations.

At its simplest level the argument for walkable communities seems logical. In the developed world most people (adults and children) do not reach recommended levels of physical activity. Undertaking physical activity is important to personal health in many ways, not least in maintaining healthy weight levels. Intuitively people who live in more walkable neighborhoods should walk more, show lower incidence of being overweight

or obese, and fewer associated health problems than those who rely on private car transportation. Proof of the existence of such relationships would have considerable significance. For even if at the individual level the influence is modest, measured over entire populations and given that the built environment lasts many generations, the potential impact on public health could be substantial. However, thus far, establishing these relationships has proved extremely difficult.

There are of course many complexities and uncertainties in trying to establish causal pathways between the built environment and our propensity to walk for travel, or leisure. Urban designers have long since abandoned notions of environmental determinism; that is, that the physicality of place dictates human behavior. Individuals react to places in different ways and with differing intensity. Moreover, our towns and cities are incredibly complex, so extracting exactly those elements, or combinations of elements, that are most conducive to encouraging (or discouraging) walking is problematic and natural experiments are almost impossible to carry out. On the health side there are vast complexities too: for example, the physiological response to exercise varies from individual to individual; that is, some will benefit more from day-to-day exercise such as walking than others, which is just one of the reasons that obesity is a complicated condition to address (Foresight, 2007). Finally there are more prosaic issues; for example, even if it is established that people who live in walkable communities walk more and enjoy better health, it may be that already healthy individuals, interested in walking, seek out such places to live, so-called *self-selection*; this issue is discussed in detail towards the end of the chapter. It is not that surprising, therefore, that despite a relatively large number of studies, reviews of studies and even reviews of reviews (Saelens & Handy, 2008), there are many disparities in findings and there are still large gaps in the existing knowledge.

The following section explores some of the ways in which researchers have tried to understand the components of walkability and then measure aspects of walkable environments to explore correlation and/or causality between factors and health outcomes.

Components of Walkability and Increased Walking

The basic components of walkability deserve some detailed exploration. As stated in the Introduction these characteristics have been grouped together in slightly different ways by different researchers; however, for the sake of

simplicity it has been decided to return to Cerevero and Kochelman's 3Ds: *density, diversity*, and *pedestrian-friendly design* (Cerevero & Kochelman, 1997).

Density

Residential density is basically a measure of how many people live in the specified area of land. It can be measured using residential population, although net housing density (i.e., excluding roads, open spaces, and nonresidential land uses) is often used as a proxy. Density is thought to be important to walkability in a number of ways: firstly it provides a critical mass of individuals to support local shops and services (with multiple destinations also thought to be influential). It provides the opportunity for walking to be seen as a "norm;" that is, people are more likely to walk when they see others doing it too. Related to this, the presence of others provides natural surveillance; in other words, people feel safer walking when there are others around. In densely built-up areas this surveillance can be created by "others" physically present on the street and also perceived surveillance from the windows of adjacent buildings. Finally, in very dense areas, such as the centers of major cities, where walking is common competition for land use means that car ownership is inconvenient, because parking tends to be scarce and expensive. However, it should also be noted that it is likely that density levels have different influences on different groups in the population: for example, young adults might specifically benefit from high-density apartment living when there are lots of walkable facilities within easy reach; however, this scenario might be less beneficial for children, who may suffer from a lack of available play space.

Several studies have linked density with increased walking, although the findings, as with much research in this field, have been inconsistent (Robertson-Wilson & Giles-Corti, 2010). Moreover, there is no definitive measure of what level of density is required to induce the beneficial effects of walking. Work in the United States, for example, has defined less-walkable neighborhoods as having fewer than 10 residential units per hectare and more-walkable areas as having more than 18 units per hectare. However, this higher measurement is still low compared to European standards, where a level of over 30 units per hectare is more common, even in suburban areas. Moreover, in many European urban centers 40–60 units per hectare (levels needed to support a tram or light railway) are found. As a result much European urban development is undoubtedly already within levels which in

theory should facilitate walking. In contrast in the United States, walkable developments would need to be at much higher densities than the average of most cities (Townshend, 2009).

Diversity: Land-Use Mix

Greater land-use mix is also associated with greater active travel; in particular, bringing a diversity of land uses together in one neighborhood has been associated with increased walking for transport. There are, however, different ways in which land-use diversity can be measured and analysed. Some studies have simply measured ratios of nonresidential buildings, or commercial buildings, to residential land use. A metareview of the built-environment correlates of walking found that whereas three reviews established an association between mixed land use and higher levels of walking, five reviews correlated the latter with aspects of "accessibility" to different destinations (Saelens & Handy, 2008). Accessibility is a broader measure than mere physical availability and can take into account issues such as affordability and even psychological access; that is, whether people perceive they have the *right* to access a facility. As such it is a more satisfactory and sophisticated measure of land use; however, much more research needs to be undertaken to develop reliable measures.

There are other issues relating to land-use mix, not least that some combinations of land use are likely to generate more walking for transportation and/or leisure than others. Land uses which generate frequent/regular trips—for example, local shops, or a school—might well increase overall walking in a neighborhood more than an office development. Somewhat counterintuitively, space given over to public transportation can also increase walking (Rundle et al., 2007). Some land-use diversity, such as including a drive-through restaurant near residential units, might actually discourage walking. Such issues have yet to be fully explored.

Green space.

A specific element of mixed land use which needs consideration is access to green space. Living in greener neighborhoods is associated with greater wellbeing and lower risks of some chronic conditions (Mitchell & Popham, 2008); however, the causal pathways between green space and health are not necessarily straightforward. One suggested mechanism is that access to parks and other green spaces encourages more walking and other physical activity for leisure (Giles-Corti et al., 2005). Some greener neighborhoods

have also been associated with higher levels of walking for travel (Tilt, Unfried, & Roca, 2007). Overall, however, findings have been equivocal. One study, for example, found that people in greener neighborhoods actually spent less time walking and cycling, although they still enjoyed better perceived health (Maas, Verheij, Spreeuwenberg, & Groenewegen, 2008). A recent review of green space and obesity concluded that while the majority of studies found a positive relationship between green space and health indicators, overall findings were inconsistent (Lachowycz & Jones, 2010). While this contradictory evidence sounds less than encouraging, it may be a reflection of the complexity of the issue. Green space may be private, shared, or public. It comes in many forms: parks, (semi)natural areas, recreation grounds, garden allotments, and community gardens and even facilities like cemeteries provide substantial open spaces. Some types of green space may encourage different behaviors to others and moreover different combinations of types and uses may be more beneficial than others. There are also trade-offs between how much land can be given over to open space of different types and how much should be deployed for competing land uses which might also encourage walking. Finally there is a tension between providing adequate open space and increasing housing density. All of these issues require much further research.

It is also likely that any influence green space has in promoting activity will be greater for some groups within communities than others. Children, adolescents, and those out of work and/or above retirement age may have considerable amounts leisure time to fill, so providing appropriate spaces to encourage them to be physically active is particularly important for these groups. Research in the Netherlands, for example, has suggested that in areas where there was a least 75 m^2 of public green space per dwelling within 500 m of the postcode area children spent more time outdoors and were generally healthier, although the link to weight status was less clear (de Vries, 2010). Research has also shown a positive relationship between green space and walking among older persons, although health outcomes were not measured (Li, Fisher, Brownson, & Bosworth, 2004).

Before leaving the topic of green space it is also worth noting that contact with green space has been associated with a range of health benefits that are not necessarily associated with physical activity. There has been much encouraging research that links green space, mental health, and wellbeing. So whether or not the presence of green space encourages walking, the benefits of its provision are well established.

Pedestrian-Friendly Design

The final aspect of urban form that is thought to have a potential impact on walking for leisure and/or active transportation is that of pedestrian-friendly design. This is turn can be divided into two elements: physical connectivity and quality of the pedestrian experience.

Connectivity.

Connectivity has been the focus of a number of studies. It is argued that street networks that are more connected—that is, have shorter distances between intersections and fewer dead ends—are more conducive to walking since they make getting from one place to another quicker and simpler, as routes are easy to follow.

Historically towns were designed around the needs of the pedestrian (with access to public transport as it became available) since only the relatively wealthy could afford personal transport. Street networks were therefore highly connected and permeable, whether based on early organic patterns or the more geometric (gridiron) patterns that generally superseded them. From the twentieth century, however, road networks were increasingly designed around the need to accommodate the private car. While people wanted car access to their individual property, they were often less keen to live on busy roads. The "cul-de-sac" designs of clustering a number of properties around dead ends seemed to address these requirements. Moreover, the design proved popular with developers because it reduces the total space taken up by the carriageway, thereby lowering development costs and increasing space for housing.

Cul-de-sac designs, however, are among the least "walkable" of environments: while individual clusters may seem homely and intimate, replicated over an entire neighborhood they create a bland experience for the pedestrian. Furthermore, as there are usually few direct routes traversing them can create confusion and disorientation. The rear of many properties also necessarily face toward interconnecting roadways and sidewalks, where they exist, are bounded by high boundary fences, walls, and/or uninspiring, low-maintenance landscaping. This adds to the level of "blandscape" created. Cul-de-sac designs still maintain a level of popularity, however. Supporters often suggest their layout provides a safe space for children's play, through shared central spaces that can be informally observed from surrounding residences. However, while these spaces can be beneficial to small children, the overall design where clusters of culs-de-sac are linked together by relatively

busy and high-speed distributor roads can feel unsafe and unpleasant once a child becomes more adventurous and wishes to explore further from home. In the United States and Australia, where these developments are often on a relatively large scale and pedestrian facilities (sidewalks and crossings) are often completely absent, this can be particularly problematic.

Connectivity can be measured in several different ways and studies have used measures such as block size, density of intersections, and percentage presence of four-way intersections. Unfortunately studies have rarely used consistent measures and thus results are often not directly comparable. Moreover, while many studies have shown a positive correlation between connectivity and walking, the correlation is often statistically weak (for further exploration of this topic see Oakes, Forsyth, & Schmitz, 2007; Rodriguez, Aytur, Forsyth, Oakes, & Clifton, 2008; Wendel-Vos et al., 2007). Overall research suggests that connectivity alone is not necessarily a good predictor of walkability.

Quality of the pedestrian realm.

The quality of the pedestrian realm is undoubtedly more important than straightforward connectivity in encouraging/discouraging people to use pedestrian routes. For example, an alleyway which connects a residential street with neighboring shops will not be used if people think that it is unattractive or unsafe. Factors such as appearing narrow and dark and cutting through blank gable ends of buildings, having a poorly maintained surface, or the presence of litter and graffiti might all combine to discourage pedestrians. There are a myriad of factors which contribute to whether people will consider pedestrian routes as suitable and these change according to the perspective of the user; for example, their level of confidence in getting about outdoors, whether they have sight or mobility problems, and whether or not they are familiar with an area. Research has suggested that older people and women, for example, may be more sensitive to fears about crime and safety and reduce walking as a result, while men are more ambivalent (Foster and Giles-Corti, 2008; Li et al., 2004; Loukaitou-Sideris & Eck, 2007).

Space prevents detailed coverage of this issue, but drawing on Burton and Mitchell's work on inclusive street design it is worth covering a few key issues that facilitate and encourage pedestrian usage (Burton & Mitchell, 2006)

- *legibility*: hierarchical street patterns, unambiguous signage, clear divisions between public and private space;

- *distinctiveness*: local character, variety of distinctive form and features;
- *accessibility*: wide flat surfaces, gentle gradients, ample crossings;
- *comfort*: quiet routes away from traffic noise, seats and shelters at appropriate distances;
- *safety*: well-maintained pedestrian surfaces, buildings facing the street to offer natural surveillance;
- *familiarity*: older people and particularly those suffering from dementia may be helped by retaining familiar and distinctive visual clues (signs, street furniture, etc.) and street layouts.

No research has attempted to measure *all* of these issues in relation to walkability concurrently. However, studies have shown that neighborhoods that are perceived to be pleasant and have a good-quality public realm support a higher level of walking and physical activity than those where the public realm is of poor quality and/or badly maintained (Borst, Miedema, de Vries, Graham, & van Dongen, 2008; Carnegie et al., 2002; Ellaway, Macintyre, & Bonnefoy, 2005; Foster, Giles-Corti, & Knuiman, 2011; King et al., 2003; Sugiyama, Leslie, Giles-Corti, & Owen, 2009). However, even here, as with most aspects of walkability, there is a question over *correlation* and *causality*. For example, it may be that people who walk more spend more time outdoors, engage with their local community and neighborhood more, and therefore have a more positive perception of where they live; that is, familiarity of the neighborhood breeding content rather contempt. At present the evidence is somewhat equivocal.

Capturing and Measuring Walkable Neighborhoods

An issue that researchers have grappled with and which remains largely unresolved is the best way to measure built-environment attributes that have been associated with increased walkability. Early studies tended to concentrate on issues of *perception*; that is, how people's opinion of their neighborhood influences their decision to walk. More recently studies have attempted increasingly sophisticated *objective* measures of the built environment. However, as stated any influence that the physical nature of the built environment has over walking is also mediated by perceptions of that environment.

The *perceived* walkability of neighborhoods is generally measured through the self-report of residents. There have been a number of different tools for analysis developed (see Table 9.1). The Neighborhood Environment Walkability Scale (NEWS) survey is a good example of a self-reported

Table 9.1. Summary of Environmental Assessment Tools.

Type*	Tool name	Country	Research goal	Assessment technique
CCE	Analytical Audit and Checklist Audit Tool	U.S.	Determine relationship between street-scale and physical activity	Two audit tools used: analytical tool to be used by researchers and the checklist tool for use of community members
CA	DIY Community Street Audits	U.K.	Developed to audit the quality and walkability of local environments	Tool is designed to be used by community. Auditors walk in groups, making objective comments/ observations and suggested improvements
CCE	Environmental Supports for Physical Activity Questionnaire	U.S.	Determine perceptions of physical activity in the built and social environment	Telephone questionnaire; results validated by GIS, walking behavior was analysed using univariate and multivariate tests
EA	Irvine–Minnesota Inventory	U.S.	Expanding on existing audits to include more built environmental features	Observers conduct independent surveys by walking through each area. There are 178 questions, assessed on a scoring scale
CA	Neighbourhood Environment Walkability Scale (NEWS); also see adapted for youth NEWS-Y	U.S.	To determine perceptions of design features related to physical activity	98 questions designed to gauge subjective measurements by residents; answers then subject to scoring and analysis

EA	PARA, Physical Activity Resource Assessment	U.S.	Assessment of physical activity resources	Check-box instrument which rates facilities as poor, mediocre, or good
EA	PEDS, Pedestrian Environment Data Scan Tool	U.S.	Address pedestrian concerns over walkability and safety	Street segments are assessed by trained surveyors, who assess feature in situ
EA	SOPLAY, System for Observing Play and Leisure Activity in Youth	U.S.	Provides objective data on physical activity during leisure opportunities	Scans of play/leisure facilities are conducted. Separate scans made for males and females. In each area the predominant type of activity is recorded
CA	SPACE, Spatial Planning and Children's Exercise study	Netherlands	To examine association between built environment and children's physical activity	Tool predominantly based upon NEWS tool. The SPACE tool was modified to reflect Dutch environment and factors relevant to children
EA	SPACES, Systematic Pedestrian and Cycling Environmental Scan	Australia	Measures environmental factors that may influence walking and cycling	Street segments are assessed by observers with a checklist for field data entry
EA	St. Louis Environment and Physical Activity Instrument	U.S.	Measures environmental influences on physical activity	Data is collected via a 104-question survey conducted by telephone

(*continued overleaf*)

Table 9.1. (*Continued*)

Type*	Tool name	Country	Research goal	Assessment technique
EA	SWAT, Scottish Walkability Assessment Tool	U.K.	Measures environmental influences related to walking	Developed from SPACES audit; included 112 specifically related to the Glasgow environment
CA	Twin Cities Walking Survey	U.S.	Examine perceptions of the built environment relation to physical activity	Audits are conducted by local residents; tool has a questionnaire style format which allows for subjective measures to be assessed
EA	Urban Design Qualities Related to Walkability	U.S.	Assessment of urban design qualities related to walkability	Statistically derived equations are used to define and link objectively measured urban design features of the environment to ratings of urban design quality.

*EA, trained "expert" audit; SCA, community audit; CCE, combined community and expert audit. Adapted from Townshend and Lake (2011).

subjective survey (Saelens, Sallis, Black, & Chen, 2003); it includes 98 questions designed to explore types of residence, proximity of facilities, perceived accessibility, and street characteristics. It was originally used on two nonadjacent (one highly walkable and one not very walkable) neighborhoods in California (based on criteria of density, land-use mix, and street connectivity). The study by Saelens et al. stated that the residents in the highly walkable neighborhood reported higher residential density, land-use mix, street connectivity, aesthetics, and safety; they also reported more physical activity and lower obesity prevalence. One issue that particularly stood out in this study was that walking for errands was much higher in the neighborhood perceived as highly walkable. This suggested that walking for transportation is particularly influenced by perceptions (Saelens, Sallis, Black, et al., 2003). This tool has subsequently been used and adapted by many other studies (see for example de Vries, Bakker, van Mechelen, & Hopman-Rock, 2007; Rosenberg et al., 2009).

Objective measures are usually collected from field studies using audit tools or land-use databases. Both techniques may be mapped using Geographical Information Systems (GIS). Studies have employed a variety of objective measurements, collected at varying distances, generally referred to as "buffers" around individual's homes. An example is Frank et al.'s Walkability Index (WI) used in the Strategies for Metropolitan Atlanta's Regional Transportation and Air Quality (SMARTRAQ) study (Frank, Schmid, Sallis, Chapman, & Saelens, 2005). This uses three measures: net residential density, street connectivity, and land-use mix. A 1 km road-based buffer was drawn around each participant's home for subsequent analysis. The buffer was based on actual access from the resident's home; that is, the size of the buffer varied by household. In more connected areas, households had larger buffers as it was physically possible to cover more ground; see Figure 9.3. A formula for land-use mix was used based on the area of commercial-, residential-, and office-use buildings. It was allocated a value from 0–1, with the highest score representing the most evenly distributed land-use mix in the participant's buffer zone. Finally the road intersections per kilometre were measured. This study concluded that their Walkability Index was significantly related to objectively measured walking in adults (Frank et al., 2005).

Other studies have taken similarly objective approaches, although measurements have varied from 0.1- to 1-km buffers around participants' homes. This causes great difficulty when trying to compare results between different studies; it also highlights another issue with this approach. Figure 9.3

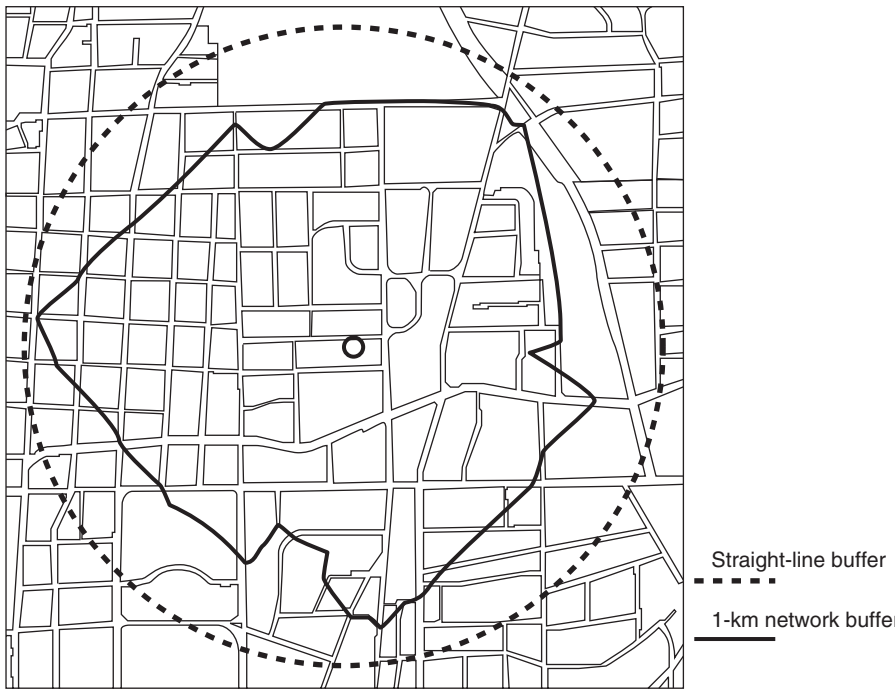

Figure 9.3. The Impact of Street Connectedness on Pedestrian Buffers. Redrawn from Frank et al. (2005).

demonstrates that in the modeling of "neighborhood" in this type of study, it assumed that people consider their neighborhood to radiate out in all directions from their home. This may be the only reasonable proxy measure possible, but it rarely reflects reality. People living on a single street often have very skewed notions of their neighborhood, particularly if they routinely head off from home in one particular direction, such as in the direction of school, work, or to catch public transport. Their idea of neighborhood can differ completely from that of neighbors living in the same street if they regularly interact with different adjacent areas. Furthermore, individuals also have very different views on how far their neighborhood stretches. This can depend on mobility, nearby networks of friends or family, or the regular use of a facility at some distance from their own home.

Research that has attempted to capture both perceived and objective measures of walkability in the same study has reported varying results. Some found high levels of agreement between perceived and actual measures of residential density land-use mix and street connectivity (Leslie et al., 2005). Others have found low levels of agreement between such measures

(Ball et al., 2008; Gebel, Bauman, & Owen, 2009; McCormack, Cerin, Leslie, DuToit, & Owen, 2008; Montemurro et al., 2011; Prins, Oenema, van der Horst, & Brug, 2009). It has not been fully explained why this should be so; however, sociodemographic influences may be confounding factors. For example, a study found adults in lower socioeconomic-status (SES) groups with children, or who were overweight, were less likely to accurately perceive their neighborhood as having walkable attributes (Gebel et al., 2009). This is important, because another study reported that those who did not perceive areas rated as highly walkable to be so increased their body mass index (BMI)[1] over a 4-year period much more than those who had concordant views (Gebel, Bauman, Sugiyama, & Owen, 2011).

This later study by Gebel also raises a further important issue. To date most studies have been cross-sectional (i.e., measured at just one point in time). This creates a number of problems, not least that causality is particularly hard to establish, as any influence of the built environment on behavior is likely to occur over long periods of time. Moreover, the influence of moderate physical activity (walking) on issues such as weight gain is also only measurable over long periods. There is, therefore, a need for more longitudinal studies. Unfortunately these are relatively difficult to set up and any interventions to modify the built environment for research purposes are likely to be prohibitively expensive. Longitudinal studies are most likely to come from studies of new, or redeveloped neighborhoods, or as an evaluation of relevant policy or legislation. One such opportunity is the RESIDential Environment study (RESIDE) in Perth, Western Australia. Launched in 2003 to evaluate the state government's Liveable Neighbourhood guidelines on walking, cycling, and public transport use, occupants of 73 new housing developments were surveyed three times (before moving and at 12 and 36 months post-occupancy). This work is currently being evaluated (University of Western Australia, 2012).

Evidence of Health Benefits of Walkable Communities

Overall, there are many questions relating to walkable neighborhoods and their possible health benefits. For example, if walkable neighborhoods promote higher levels of walking, does this result in total higher physical activity among neighborhood residents? If walkable neighborhoods do lead to higher activity levels, does this result in enough additional physical activity to confer health benefits? Furthermore, if there are benefits, how

are these distributed across populations? Do the already healthy merely remain healthy, with those with weight and related problems failing to benefit? Alternatively, taking a completely different tack, if the amount of physical exercise generated does not confer health benefits, might there be alternative benefits for individual and group wellbeing derived from going out and walking more and interacting with other members of the community?

Physical Activity and Weight

The most consistently investigated issue in relation to health and walkable neighborhoods has been in relation to physical activity levels and weight status; being overweight and/or obese, often measured by BMI. Being overweight and obese are known risk factors for a range of health problems, including hypertension, type 2 diabetes, several types of cancer, and mental health disorders, including depression; all of these issues have been increasing in developed countries in the last few decades (Foresight, 2007). A number of studies have linked walkable neighborhoods with higher levels of walking and total physical activity and/or found that residents in highly walkable neighborhoods have lower BMI and/or are less likely to be overweight or obese (Papas et al., 2007; Rundle et al., 2007), although it should be noted that the differences are often modest.

A number of studies have also broken walkability into its objectively measured constituent parts to try to assess whether some elements are more associated with weight gain and obesity than others; generally, however, the evidence is very mixed. Several studies have linked higher-density neighborhoods to lower BMI (Lopez-Zetina, Lee, & Friis, 2006; Ross et al., 2007; Rundle et al., 2007; Smith et al., 2008; Stafford et al., 2007); increased land-use mix/walkable destinations to lower weight (Brown, Yamada, Smith, Zick, Kowaleski-Jones, & Fan, 2009; Rundle et al., 2007; Smith et al., 2008; Stafford et al., 2007; Tilt et al., 2007); higher street connectivity with lower weight/BMI (Frank, Kerr, Sallis, Miles, & Chapman, 2008; Smith et al., 2008); as well as a higher-quality public realm with fewer weight problems (Boehmer, Hoehner, Deshpande, Brennan Ramirez, & Brownson, 2007; Giles-Corti, Macintyre, Clarkson, Pikora, & Donovan, 2003). However, overall findings are inconsistent, particularly across different measures (i.e., BMI, overweight, and/or obesity) and other studies have reported no relationship or even an inverse relationships (Robertson-Wilson & Giles-Corti, 2010); thus overall research findings remain equivocal.

Children and adolescents.

Children and adolescents are a particularly important group in relation to health outcomes since, as stated, they are likely to be much more limited in their spatial autonomy than adults and therefore any influence from their immediate neighborhood is likely to be more pronounced. In relation to children, research examining active travel to school (including walking and cycling) in particular has linked population density (Kerr et al., 2006; McDonald, 2007; Nelson, Foley, O'Gorman, Moyna, & Woods, 2008), land-use mix (Kerr et al., 2006; McMillan, 2007), and good-quality sidewalks and pedestrian crossings with children's active travel (Ewing, Schroeer, & Greene, 2004; Timperio et al., 2006). Other work has suggested links to SES. In Australia links between high income, walkability, and walking or cycling to school have been established (but not in low-income walkable neighborhoods) (Kerr et al., 2006); in Belgium the opposite relationship was established with walkability and increased vigorous physical activity only found in low-SES neighborhoods (De Meester et al., 2012); this suggests that broader national/local sociocultural factors are important. Research has also suggested that children in highly walkable neighborhoods *are* more likely to walk to school but this is mediated by traffic volumes; that is, where traffic volumes were high, walking to school was reduced (Giles-Corti et al., 2011). However, it should be also noted that proximity (i.e., <1.6 km) has been the most consistent factor associated with walking to school in studies over the last decade (Black, Collins, & Snell, 2001; Bricker, Kanny, Mellinger-Birdsong, Powell, & Shilsler, 2002; Ewing et al., 2004; Giles-Corti et al., 2011; Nelson et al., 2008). Similar relationships have been found for adolescents, and in particular the density of facilities for that age group (public or quasipublic provision) has been associated with increased walking (Cradock, Melly, Allen, Morris, & Gortmaker, 2009).

In terms of health outcomes, one Australian study suggested that children living in more walkable communities were less likely to be overweight (Grafova, 2008). There has only been one comprehensive review to examine the potential health benefits of walkability and health-related fitness in children/youth (Lubans, Boreham, Kelly, & Foster, 2011). This review included 27 studies and concluded that while there was evidence to suggest active travel to school might be linked to superior cardiorespiratory fitness, it did not establish evidence of a link between active travel to school and body weight. However, the authors of the review highlighted a number of shortcomings with the available research, not least that studies needed to look at a young person's movement around their neighborhood more

generally rather than focusing only on trips to school; findings also needed to be more closely related to those factors known to influence active travel to school in children, as already outlined in this chapter (Lubans et al., 2011).

Older people.

There are fewer studies that have explored neighborhood walkability, older people, and health outcomes. This is a key gap in knowledge, since broader research suggests environmental determinants of health may be of increasing significance for older people due to a possible combination of reduced mobility (both active travel and driving), declining cognitive and physical resources, reduction in social networks, and a time when increasing numbers of older people live alone (Glass & Balfour, 2003).

Studies exploring physical activity and neighborhood environment have shown various results. The most consistent evidence suggests that the availability of local shops and services supports the highest levels of walking among older people (Yen, Michael, & Perdue, 2009). Studies that have tracked through to health consequences are even fewer and again, the findings are inconsistent. One study looking at over 65s in the United States, while linking walkable neighborhoods with more walking by older people, found no link to lower obesity levels (Berke, Koepsell, Moudon, Hoskins, & Larson, 2007). However, more recent work has suggested that older adults living in walkable neighborhoods undertook more moderate to vigorous physical activity and had lower BMI values than those living in less-walkable neighborhoods (King et al., 2011). Further work using a walkability index also suggested that increased walkability was related to more walking, less time spent traveling in a car, and less likelihood of being overweight in over 65s (Frank, Kerr, Rosenberg, & King, 2010). As with other aspects of walkability, more focused research is needed. Certain aspects of walkability may become more crucial to this age group than others, depending on individual circumstances, particularly when health problems arise. Accessibility and proximity of facilities may be more important to encourage walking for those with limited mobility, for example, whereas "navigability" might be crucial for those beginning to suffer memory loss.

Walkability, Wellbeing, and Sociability

An area related to wellbeing is whether walkable neighborhoods encourage more social interaction between neighbors. Walking should increase the opportunity for chance encounters on the street and, therefore, more

chances to interact with other members of the community. Sharing knowledge and experiences between neighbors decreases the fear of others and increases social capital within communities. However, there is mixed evidence about whether walkable communities engender more sociability. Some research has suggested a positive relationship between walkable neighborhoods, social interaction, and an increased sense of community (Forsyth, Oakes, Schmitz, & Hearst, 2007; Lund, 2002). However, other research has suggested that the relationship is not necessarily straightforward and that, for example, greater land-use mix may actually inhibit social interaction among neighborhood residents, unless environments are sensitively designed to accommodate the needs of the pedestrian (Wood, Frank, & Giles-Corti, 2010). Research looking at broader measures of social capital has also been contradictory, with some finding positive links (Wood & Giles-Corti, 2008) and others finding an absence of links. A recent study in Japan, for example, suggested that historical and geographical factors were more important (Hanibuchi et al., 2012), which again may suggest broader social/cultural factors are influential and need further investigation.

Whereas research thus far has been equivocal it is likely that some components of walkability are more associated with sociability than others. So, for example, the existence of attractive public spaces and parks where people walk for leisure and are more likely to stay and chat to neighbors, or simply feel reassured by the presence of others, might be more important in this respect than encouraging walking for travel (e.g., by providing direct routes, access to public transport networks, etc.) when people may be less inclined to linger.

Self-Selection and the Acceptability of Walkable Neighborhoods

Some researchers have suggested that any correlation established between neighborhood characteristics and healthier, more active lifestyles is most likely due to individuals who desire an active lifestyle seeking out walkable neighborhoods in their residential choice; so-called self-selection (Boone-Heinonen, Gordon-Larsen, Guilkey, Jacobs, & Popkin, 2011). In other words, the higher the amounts of walking present in walkable neighborhoods result from personal lifestyle preferences among residents, rather than any influence of the built environment.

There is some evidence that a measure of self-selection probably does exist, and a number studies have attempted to control for self-selection in their analyses. Those who like walking live in walkable neighborhoods where possible; and those who prefer sedentary lifestyles choose neighborhoods that facilitate their lifestyle choice. Most studies that have attempted to control for self-selection, however, also suggest higher physical activity in higher walkable neighborhoods after taking self-selection into account (Frank, Saelens, Powell, & Chapman, 2007; Owen et al., 2007; Sallis et al., 2009; Van Dyck, Cardon, Deforche, Owen, & De Bourdeaudhuij, 2011). When it comes to impact on weight status, the picture is less clear. Some research has suggested that only those who already have lower BMI values (Plantinga & Bernell, 2007) or who are interested in walking (Berry et al., 2010) actually benefit from living in walkable communities. Other U.S. work, comparing 17–20-year-olds (who had less control over residential location) to adult 27–30-year-olds (who had more residential choice) suggests when BMI is the dependent variable there is considerable evidence for residential selection (Smith et al., 2011). These studies suggest that for people who are not interested in walking, living in a walkable neighborhood will not necessarily make a difference to physical activity levels and/or weight status.

This therefore lends some support to researchers who suggest that self-selection is a limiting factor to walkability research, although whether it is the *major* issue—as argued by some researchers—is open to debate. The concept itself is not without its own problems. Self-selection assumes a large amount of freedom over where individuals choose to live. This many hold true in some situations, but for substantial parts of the population in many countries it will be at best a partial representation. Those in social housing or entering a housing market at the lower end, for example, will probably have very limited choice. Even established home owners when faced with housing location make compromises between location, type of property, and what they can afford. External factors can be important drivers; being near to good schools, relatives, and other social networks may all be important.

At the very least self-selection assumes that individuals are able to make rational and well-informed choices about where they want to live and that the preferences of different individuals within the same household will coincide; both assumptions are far from proven. As discussed in this chapter perceptions and objective measures of neighborhoods rarely concur and this is for residents who have often lived in an area for a number of years, so

those making decisions about where to live may have much more limited knowledge on which to base decisions.

A related issue, however, addresses the market demand for walkable neighborhoods. Housing developers in the United States, Australia, and the United Kingdom (albeit in a denser form), as discussed, have favored suburban, monofunctional residential developments in the post-war period. While relatively dense, mixed-use, historic areas are often some of the most expensive urban areas, doubts have been raised about the marketability of new walkable neighborhoods. Robust research on this subject is somewhat lacking. However, a recent study based around Seattle, for example, found higher property prices in more dense single-family-home developments, contradicting most market-orientated wisdom (Sohn, Moudon, & Lee, 2012).

In the final analysis it is likely that there is a complex interplay between neighborhood preference (i.e., self-selection) and neighborhood characteristics in terms of actual walking generated and any health benefits derived. Walkable neighborhoods will not meet everyone's lifestyle aspirations and for those who prefer a sedentary lifestyle living in a walkable neighborhood may have little impact on their activity levels or health in relation to weight gain. This does not provide sufficient argument against walkable neighborhoods being the aspiration for built-environment professionals. As is the case for all complex health issues, it demonstrates that multiple approaches are necessary. Furthermore it also does not alter the fact that walkable environments appear to benefit that part of the community whose activity levels and health might be adversely affected if they were unable to live in this type of environment.

Conclusion

This chapter has provided an overview of the ways in which researchers are trying to understand how the built environment influences people's propensity to walk as part as everyday travel and/or leisure, and the consequent health and wellbeing outcomes. Despite over a decade of research there are still significant gaps in knowledge and a frustratingly contradictory body of evidence. Partly this is to do with issues pertaining to the research; for example, many different approaches have been taken to measuring walkability, meaning that results are often not directly comparable. Whereas there have been numerous cross-sectional studies investigating correlations, more longitudinal studies are needed and greater exploration of causal

relationships. In part, however, the lack of definitive evidence is due to the multifarious nature of the relationships under examination and it may be some time before enough evidence can be gathered to address this level of complexity.

Note

1. BMI is calculated as mass (kg)/height $(m)^2$ and is used as a proxy for body fat percentage. A score of 18.5–24.9 kg/m^2 is considered acceptable, whereas over 24.9 kg/m^2 may be overweight and over is 30 kg/m^2 defined as obese.

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10

Quality of Urban Spaces and Wellbeing

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Introduction

What constitutes quality in an urban context is rather subjective, although years of effort have been given to understanding particular aspects of it. Much research and policy has focused on establishing baseline levels of pollution, noise, and air quality, establishing standards and determining whether specific urban areas meet these criteria. As a result many urban areas have improved air quality, meet national and World Health Organization pollution guidelines, and, from this empirical perspective, may be considered a quality urban environment.

However, an overview of literature on indicators of urban environmental quality identifies numerous different measures, including air-quality measurements such as concentrations of sulfur oxide (SOx) and nitrogen oxide (NOx) emissions, carbon monoxide levels, and low-level ozone exposure, plus other measures such as urban traffic density and noise levels. It is clear that with so many indicators there is no one measure that can successfully, holistically, convey the notion of quality.

These measurable criteria were developed and used for specific policy purposes and as a result the more experiential aspects of living and working in the urban environment have often been neglected when evaluating the quality of those spaces. The distribution of this measurable environmental quality is of itself an area of interest and much research in the area of

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environmental justice has focused on that spread from a socioeconomic, political, and ethnic community perspective.

Studies have highlighted the conflict or misalignment between expert measures of local environmental quality and local knowledge of the quality of local spaces (Wynne, 1989; Yearley, Cinderby, Forrester, Bailey, & Rosen, 2003). As well as this expert knowledge and repositories of data, local people are aware of the microlevel differences in pollution levels or noise levels in one neighborhood or street compared to another; they may not have the measurements but they have the local knowledge. Therefore it is essential to consider this link between subjective and objective understanding of urban environmental quality if we are to better understand what it means for wellbeing.

This chapter turns its gaze on the experiential aspects of urban spaces, the perceived quality of such spaces, both objective and subjective, and the relationship between the *physical*, the *experienced*, and *wellbeing*.

Quality and Urban Spaces

Let me begin by looking at some definitions of quality which have been applied to the urban environment (see van Kamp, Leidelmeijer, Marsman, & de Hollander, 2003). Lansing and Marans (1969) stated that "an environment of high quality conveys a sense of wellbeing and satisfaction to its population through characteristics that may be physical, social or symbolic" and Porteous (1971) defined environmental quality as "a complex issue involving subjective perceptions, attitudes and values which vary among groups and individuals." More recently, Pacione (2003) states "in contrast to the objective definition of urban environmental quality urban liveability is a relative rather than absolute term whose precise meaning depends on the place, time and purpose of the assessment, and on the value system of the assessor" (see also Pacione 1990, 1993). His contention is that "quality is not an attribute inherent in the environment but is a behaviour-related function of the interaction of environmental characteristics and person characteristics. . . . we must consider both the city on the ground and the city in the mind."

Urban planners have long thought about issues of urban environmental quality, from Le Corbusier (1935; cited in Montavon, Steemers, Cheng, & Compagnon, 2006) and Jacobs (1961) to Lynch (1981), each bringing their own conceptual perspectives to the subject. These sentiments about quality

can be very context-dependent, in both space and time (van Kamp et al., 2003, p. 9). Smith, Nelischer, and Perkins (1997, p. 233) reviewed the urban planning literature to develop a table of quality and need principles that an urban environment should fulfil; these consist of liveability, character, connection, mobility, personal freedom, and diversity. van Kamp et al. (2003) reviewed the literature on liveability and urban planning and revealed that no generally accepted conceptual framework had been developed in relation to wellbeing. They found that terms such as urban environmental quality, liveability, quality of life, and sustainability are popular lexicon in policy documents and with the public, but that there is no uniformity in how they are used in practice in the literature (van Kamp et al., 2003, p. 6). They are often used as if they are synonymous, but occasionally are contrasted, leaving the reader with only a vague understanding of their meaning and application. Pacione (2003, p. 19) indicates that quality of life generally refers to the condition of the environment in which people live and/or some attribute of people themselves, such as their health or educational achievement.

To this end objective research has focused on understanding such things as social indicators of poverty and the geographical distribution of housing types (particularly the demographics of substandard housing). However, following Pacione's (2003) more context-dependent interpretation, it is necessary to assess the quality of urban spaces and their relationship to wellbeing by considering a more holistic picture. To do this I discuss taking a sensory urbanism approach.

Sensory Urbanism

The field of sensory urbanism developed to challenge the ocular-centric focus of much research and practice in urban planning and design. Extending an interest in the sensory experience in cities to include the full range of sensory experience as mediated through hearing, smell, touch, and taste as well as sight has allowed an interrogation of everyday life that incorporates a meeting of the mind, body, and environment (see Adams & Guy, 2007).

Lucas and Romice (2008) have identified that the bias toward the visual misrepresents experience as it neglects the emotional experience of the nonvisual senses. Naming the three components of environmental experience as perception, cognition, and emotion, they claim this deficit oversimplifies experience for the sake of expediency (p. 83). Following a sensory approach

permits a new focus on the experiential and allows for the emergence of the more context-dependent interpretation called for by Pacione.

The last decade or so has seen a burgeoning literature in the area of sensory cities, although many of the studies have focused on historical cities or on specific groups' sensory engagements with particular cities (Corbin, 1999; Law, 2001; Picker, 2003). Such commentators have illustrated how the sensory mix of urban culture is politically and socially influenced (Drobnick, 2006; Howes, 2005; Landry, 2006; Picker, 2003). Not many have looked at the affordances such a multimodal approach provides for understanding the quality of urban spaces, nor have they related this to wellbeing.

In this chapter I attempt to make this link. I look at how people's wellbeing is influenced by the urban spaces around them. By identifying the aspects of urban spaces influencing people's perception of their own wellbeing some key design constructs/features can be outlined. The supposition is that people have a multimodal engagement with the urban environment that, if recognized, can lead to better design for wellbeing.

Drawing on two projects, Vivacity 2020,[1] which looked at urban sustainability for the 24-h city, and the Positive Soundscapes Project,[2] which looked at the relationship between the built environment and its soundscape, this chapter acknowledges the multimodal affordances of urban spaces. Experience of an urban square, for example, is influenced by the visual aesthetic of its design, the appropriateness of its soundscape, the tactility of its fabric, and the feel and smell of the air, and is ultimately determined by the person experiencing it. In this chapter I emphasize how people receive different types of sensory information when evaluating the total sensory experience of a space; the interaction of sensory information then influences people's final experience of that space, ultimately affecting wellbeing. In this way it is possible to connect subjective concepts of quality of urban spaces with sensorial aspects of experience, ultimately providing an idea of ways in which quality of urban spaces link to wellbeing.

Wellbeing and the Urban Environment

The relationship between a well-designed urban environment and the health of people living in and using those urban spaces has been documented by the Commission for Architecture and the Built Environment (CABE), which states there is an urgent need for a sustainable planning approach

that takes into account the influence of environments on health: "Evidence increasingly suggests that the wider environment can reduce stress, encourage exercise and promote good health" (CABE, 2009, p. 4). There is an obvious relationship between health and wellbeing, with the World Health Organzation defining health as "a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity" (World Health Organization, 2006). However, definitions of wellbeing lack conformity and range from academic scientific interpretations as a reified entity that can be studied—that is, an object of research—to a more critical interpretation as a social and cultural construction; that is, accepting there are no uncontested biological, spiritual, social, economic, or any other kind of markers for wellbeing (Ereaut & Whiting, 2008).

It is the latter understanding of wellbeing that is drawn on in this chapter; by considering the multiple encounters of different users of urban spaces, their expectations as well as actual experiences, a picture can be built of the complexity of the relationship between the quality of urban spaces and wellbeing. Using a sensory urbanism approach facilities this endeavour.

Researching Sensory Relationships

This chapter draws heavily on research carried out under the auspices of two U.K. Engineering and Physical Sciences Research Council (EPSRC) research projects: Vivacity 2020,[1] urban sustainability for the 24-h city, and the Positive Soundscapes Project,[2] the reevaluation of environmental sound.

The aim of Vivacity 2020 was to develop an in-depth understanding of human behavior in urban environments and to create new practical resources to support urban design professionals with sustainable decision making. One aspect of this was to understand the relationship between environmental quality and city-center living; by focusing on user perceptions and experiences of life within city centers we identified what influences quality of life and what effects urban spaces have on that quality of life. Using a sensory urbanism approach city-center residents were taken on sensory walks in three cities: London, Manchester, and Sheffield. Following these walks and supplemented by a participant-led photo survey each participant was interviewed in depth about their sensory experiences of living in the city center (see Adams et al., 2007, and Moore et al., 2008, for methodological details).

The Positive Soundscapes Project followed Vivacity and focused on one aspect of urban experience: the auditory. Its aims were to move away from a focus on negative noise to identify a means whereby the concept of positive soundscapes could effectively be incorporated into planning, and to evaluate the relationship between the auditory environment and the responses and behavioral characteristics of people living in it. Using a sensory urbanism approach urban design professionals and city-center residents were taken on soundwalks in two cities: London and Manchester. These walks included in-depth, in situ interviews about experience of the auditory and physical environment and the relationship between sound and urban design (see Adams & Bruce, 2008, for methodological details). Additionally, a number of focus groups were held to explore in more detail different users' experiences of the auditory urban environment.

By looking at the data gathered across both these projects, and analysing it jointly from a new perspective to specifically consider wellbeing, a rich picture emerges of how urban spaces influence people's sense of wellbeing.

People's Experience of Urban Spaces, Quality of Life, and Wellbeing

By examining sensory experiences of urban spaces it is possible to identify two realms in which quality of life is affected: the physical realm and the emotional realm. The physical realm is perhaps the simpler of the two to consider as it deals with tangible, corporeal, material aspects of the built environment; dimensions with substance that are mutable and can be touched, altered, and shaped.

On the other hand the emotional realm deals with less tangible, more ethereal aspects of urban spaces that nonetheless demand attention due to the impact they have on the physical realm. It deals with people and their relationships to each other, their rapport with places, their senses of community, and the differences experienced by different people at different times.

Ultimately the two are entwined and it is with this interconnection between the physical and emotional realms that urban design must work to create urban spaces that contribute to a positive quality of life and wellbeing.

The remainder of this section looks at the quality of urban spaces in relation to five contextualizing factors: proximity to traffic, provision of green infrastructure, access to open space, local character and distinctiveness,

and belonging, community, and neighborhood. Personal narratives provide clear evidence of the irrefutable bond between the physical and emotional as experienced by city residents and users, and their accounts demonstrate their awareness of the connections with their own wellbeing.

Quality of Urban Spaces: Proximity and Traffic

The layout of cities and the proximity of urban spaces to main thoroughfares can have a notable impact on the evaluation of a location and the effect on stress levels. For example, in London, moving from Oxford Street to Soho Square presents a contrast in the soundscape from "just really loud . . . the screeching of brakes and stuff" to being able to hear people talking:

> As soon as you came walking down the street probably only really five metres down the road you really felt the low frequency sort of drop off and suddenly felt a lot more relaxing aware, and not being quite so stressed perhaps.
>
> L9, London, Positive Soundscapes Project (PSP)

Heights of buildings and their orientation both contribute to the soundscape in a particular location, and ultimately to the quality of the urban space itself. Sound can be channelled along corridors between tall buildings so that sidewalk cafés or city squares located in close proximity to main roads can be quite noisy and unattractive. The traffic interfering with a conversation might make the location undesirable as a place to linger. For example, in Manchester, Deansgate is a very busy road: "I find it very noisy actually; I don't really like it very much . . . it's very noisy, it's stressful. [I wouldn't sit at this café] I'd prefer somewhere a bit quieter . . . even when you were talking to somebody, you wouldn't necessarily be able to always hear what they were saying, I mean you would in the gaps of the traffic, but no, as I say where we were before was quite peaceful and you'd want to sit there to get away from all the noise, it was much quieter" (M3, Manchester, PSP). This location was St. John's Gardens, removed from the main road, although close to the railway line. It was described as a relaxing location, a place people might sit and relax in their lunch hour.

Similarly, city-center residents experience the contrast between the quietness of side streets and the main thoroughfares: " . . . the other thing on noise is that there are very quiet areas. I mean when we walked up Cowcross Street I always think it's amazing how quiet that is, and it feels really sort of really lovely. . . . But then you sort of, it almost makes it worse when

you kind of emerge from those lovely quiet areas and go onto the main, big two big main roads, Clerkenwell Road and Farringdon Road, and then it's sort of—oh God—and there's all these lorries and buses. . . . I mean that's an overriding factor in quality of life as you walk around" (L17, London, Vivacity 2020). People can readily identify a positive soundscape in their locality, and link that to the physical environment (traffic), their own sensation ("amazing"), and wellbeing ("feels really lovely").

In terms of liveability this points to the importance of the scale at which mixed use is created. If proximity to, or distance from, main roads is a contributing factor to the quality of life experienced by urban residents and users then this needs to be taken into consideration when determining the locations of residences and services.

Quality of Urban Spaces: Provision of Green Infrastructure

Green infrastructure is another feature of urban spaces that can be seen to have a bearing on wellbeing. It refers to "the combined structure, position, connectivity and types of green spaces which together enable delivery of multiple benefits as goods and services" (Forest Research, 2010). Forest Research (2010) describe three categories of potential health and wellbeing effects of green infrastructure: increased life expectancy and reduced health inequality; improvements in levels of physical activity and health; and promotion of psychological health and mental wellbeing. They explicitly state that "The benefits of green space are greatest for people from lower socio-economic groups" (p. 13).

Talking to an urban design professional in Manchester with a broad interest in social regeneration led to a discussion about the role of green infrastructure at multiple scales. On the role green infrastructure plays in creating positive soundscapes, our respondent said that "there is academic evidence that a visual green barrier makes people less aware of the noise that otherwise they would be experiencing. . . . Ecotec established nine different dimensions under which economic benefit can be secured from an investment in [green infrastructure] and one of those was this psychological impact on sound" (see Ecotec, 2008). " . . . To get a real scientific impact, the barriers would normally need to be a lot broader and thicker than is normal in an urban area and often banking helps as well, but even a thin tree screen through which you can demonstrate scientifically the noise permeates just as if that barrier wasn't there. Nevertheless it's shown to have a psychological impact on people, and feel good about it. There's certainly a

relationship between wellbeing and stress levels and green infrastructure, it has its health and wellbeing benefits, that are now well documented" (M5, Manchester, PSP project).

City green spaces such as Soho Square provide respite for people from the hustle and bustle of city life.

> I think green spaces are important in cities, this is tiny but it provides relief for people, that's why people come here because you know what it's like in the summer, it's always full of people. . . .
>
> L10, London, PSP

Simply the presence of green space, the ability to be near it, to see it, to walk past it, is appreciated by city users and has a positive effect:

> I walk around that bit of it on my way to work every morning so I walk past the trees and I walk back again, I like walking past green space.
>
> L12, London, PSP

> It's calming, it's somewhere I can sit down, there's plenty of benches and you can see, visually, you're looking at some greenery.
>
> L15, London, PSP

> I think it's an inviting, comfortable space. It's bringing some green space into the city, it's bringing some wildlife into the city and that's always I think very calming for anyone.
>
> M2, Manchester, PSP

> This is my favourite green space by the way anyway, I come down here nearly every weekend in the summer when I can. . . . [It makes me feel] peaceful, rested, it's just respite from the sort of the hustle and bustle of the city, it calms you down.
>
> M6, Manchester, PSP

> Number nineteen's just a nice shot of the, the local green space, which is you know round the church. . . . I short cut through it you know but that's all really, you know like probably if I was going, going home.
>
> L24, London, Vivacity

As one regeneration professional told us green infrastructure softens the city and makes it more desirable to be outdoors:

> . . . obviously in a built-up urban environment with things like canyon effects and a lot of reflection of hard surfaces it can be overpowering at times. I mean I lived in Hong Kong for 18 months and at times you had to retreat indoors because it became so intrusive it's just. . . . So it's really loud and really in your face. It takes a while to get used to that, and so softer parts of the city, particularly green spaces and open spaces, trees and things like that are essential really to take that harshness out in an urban acoustic environment.
>
> F16, Focus group, PSP

For some people their local green space is the only outdoor space available to them and it provides them with a connection to nature and their community:

> For some people it's their only green space, and maybe their lives don't really allow them to kind of go off on holiday and experience space in that way or whatever. And they come and it's very important for them and also it's public.
>
> L18, London, Vivacity

In focus groups people were very supportive of the presence of green space, attributing both acoustic absorption to it and beauty and tranquillity:

> But then in terms of the soundscape, it is about putting the trees and the verge, it creates sort of a natural noise while sort of absorbing some of the urban noise I suppose.
>
> F5, Focus group, PSP

> And people want to live where there's trees mostly. People will say oh where you live is nice because there's loads of trees on your road . . . . The sound that's coming from the tree connects you to your environment because you can hear what's actually there rather than hearing something that's somewhere else getting pumped in.
>
> F3, Focus group, PSP

Not only can the green infrastructure provide dual physical functions such as positive sounds and noise absorption, but it also provides the emotional impact of a pleasant liveable environment where people want to live.

One question to consider is how small can urban green spaces be and still afford the benefits generally associated with large places like Hyde Park in London or Heaton Park in Manchester. It appears that green infrastructure of all sizes, from a single tree to a large urban park, all afford psychological benefits to those who experience them. Designing green infrastructure into

urban spaces so that people from all backgrounds have access to them for exercise, relaxation, meeting friends, and contemplation is essential for wellbeing in an increasingly high-density urbanized world.

Quality of Urban Spaces: Access to Open Space

Parallel to the discussion of the affordances of green infrastructure is the availability of public and private green spaces themselves. Not everyone has access to private spaces like gardens, rooftops, or balconies, and therefore the provision of green space in the public realm is necessary to compensate for this.

Some residents take the lead themselves: one London resident talked about doing up the roof garden at the top of their building. It was a bit of a mess on moving in because it had been vandalized but the garden seats that had been provided by the council were still there. The new resident stripped them and renovated them, manually took the soil up three flights of stairs, and over the past 7 years planted about 50 shrubs and flowers in pots:

> [I did it] not only for me, I think it's important for people who live in central London to have somewhere to sit and have a bit of fresh air. . . . It's somewhere relaxing. If you've had a stressful day or you want somewhere to go away from people and you want to read a book it's quiet. You can still hear the traffic in the background, but it's reasonably quiet. . . . There's not many places in London that have got gardens and all you know. Some of these Victorian houses have, but not many, no flats have. . . . You see these multistory blocks, none of them have got gardens, only got a little tiny balcony, put a couple of pots on it and that's it. But up there you could have a party.
>
> L4, London, Vivacity

By doing up the rooftop garden all residents reap the benefits; a space is created to relax, to interact, to get away from the noise at ground level. It provides a quality urban space in a busy urban environment promoting wellbeing for the residents.

In contrast to this, in Manchester, one resident talked about the lack of private outdoor space being the key reason for seeing living in Manchester as a temporary arrangement:

> It's got a sell-by date for me. . . . At this moment in time it suits me to live here. I will want a garden, more space, eventually because the space I've got within the apartment is small. . . . Also it's not tranquil and at night if you have

> a stressful job, which most people do these days and of course I'm putting myself in there, you go home and you can't just sit in your garden and have a you know like bottle of Stella or a glass of chardonnay and just chill. I can sit out on the balcony and I do my best endeavors there but it's busy, there's no peace, there's no park. So I think 2 years will probably do it for me then I'll be looking for something else. But it's fun living here, it is fun living in Manchester.
>
> M15, Manchester, Vivacity

In Manchester in particular, public green space in the city is very scarce. Whereas residents in other cities enjoy access to their local parks and public gardens, Manchester city center has a dearth of such spaces. Given that so much is known about the relationship between access to green space and health, quality of life, and wellbeing, Manchester city center residents may be missing opportunities; a transitory city-center population who see their city-center life as being temporary have little incentive to invest in creating public or shared spaces that would enhance their wellbeing.

London has more green spaces than Manchester but many residents still have access only to balconies rather than gardens or public parks:

> For me a key thing has always been having a bit of an outdoor space, having a balcony that's all, I love the space of the balcony. . . . And at the moment having a garden is, still for me the ideal thing would be to have an apartment, but opposite a park, rather than a house with a garden, cause it'd be me who'd maintain the garden.
>
> L27, London, Vivacity

Another Manchester resident feels that all open spaces should be in the public realm, or if privately owned should be available for the general public to use:

> And I think if everything was completely developed and there was no open space like that, it doesn't necessarily have to be a green space with grass, 'cause some of the squares and things they've developed, you know round sort of Marks and Spencer's and the space at the back there, it's a nice open space that, it's a very nice contrast with everything else that's around it, all the tall buildings that are around it. . . . I wouldn't favor any sort of large open areas being private space, I think they should all be public really in a city center, it's a great public area, it's a great public place, so. If an office building had lots of private gardens I don't think that's quite on. They should put a public café in there and, and stuff like, I mean some of the stuff they're doing at Spinningfield

> it seems to be going that way which is good, sort of down towards the Irwell and that whole new development down there.
>
> M10, Manchester, Vivacity

It is important to recognize the variety of open spaces that might contribute to the needs demonstrated in the above examples. Local residents are seeking spaces in which to relax, meet, and interact. It is not only green spaces that might offer these functions; many urban spaces are "hard" and functional but still offer the facility for recreation and enjoyment. Well-designed public spaces foster social inclusion and add to the character of places where people want to live, work, and visit.

Quality of Urban Spaces: Character and Distinctiveness

> The nice thing is that I like walking through Myddleton Square because it is this old Georgian 200-year-old square, still pretty much as it might have looked you know 200 years ago and it's still there. . . . I like walking around here, it's kind of a bit of old London, . . . I like a place with kind of bit of character to it.
>
> L10, London, Vivacity

People often talk about the character of places as contributing to the quality of the urban spaces they visit and experience. This is often linked to conservation and the historic built environment. In the United Kingdom areas within cities may be designated as Conservation Areas and these relate to the space around and between buildings as much as to the buildings themselves. Indeed the buildings themselves may be protected by listed building legislation; the Conservation Area protects the character of the area.

> Well anything of this sort of age, Victorian and, and with any historical significance surely shouldn't be demolished. This is conservation area thankfully now so everything you see should stay as it is. Unfortunately other pockets of the city center they've just cleared stuff, I think to the detriment of areas because they cease to be old historic areas with character and just become a grid pattern of new buildings that just don't have any identity, they're very bland. . . .
>
> M10, Manchester, Vivacity

But character is not exclusive to areas that have warranted, or yet received, such legal protection and the importance given to the character of an area

is as much a function of personal experience and emotional connection as to the age, heritage, and designation of the place. The historic environment enriches people's understanding of the diversity and changing nature of their community and through this contributes to people's quality of life (English Heritage, 2005).

One Sheffield resident felt that heritage wasn't as big a part of the regeneration decisions for Sheffield city center as they might have been and that there is a danger of that link with the past being lost:

> . . . it would be very nice if there was more to do with the history of this area. . . . just over the Green there's some little industrial units and certainly as you go further round into Sheffield the little Mester-type steel, old steel units and warehouses, very traditional industries and traditional buildings. It's part of the character that contributes to Sheffield and it'd be really nice I think if we pulled that out a little bit more and less focused on trying to be trendy and 24-hour city living and looking at modern flats. It'd be good to link that back to the heritage.
>
> S32, Sheffield, Vivacity

Places matter to people and a focus on the character of a place supports the idea that there are strong links between people's emotional experience of their environment and the physical environment itself. Quality of life is directly affected by the quality of the urban environment.

Quality of Urban Spaces: Belonging, Community, and Neighborhood

The preceding section dealt with the physical character of urban spaces and highlighted the relationship between the historic environment and people's affinity with a particular place. This section expands on this notion of affinity with a place to look at people's sense of belonging as relating to the other people within a community or neighborhood.

There is evidence that new residents need local social networks and shared community experiences in order to build a sense of belonging and identity in new places (Crowther, Cummings, Dyson, & Millward, 2003). CABE (2009) have shown how the quality of social infrastructure, which includes attributes that support the formation, development, and maintenance of social relationships in a community, directly affects residents. In particular, children's happiness, health, development, and life chances are affected by the quality of social infrastructure which influences whether children can play

outside and walk to school safely. By providing safe spaces for communities to engage with and get to know each other, for children to play, and by providing sustainable transport networks urban design can support and promote strong community engagement.

One London resident described the effect of moving to a new place where they didn't already have a social network:

> I used to live out in suburbia all my life until I moved to the city 6 years ago. When I first moved into the city I was actually quite stressed for a couple of years or so until I managed to get use to the hustle and the bustle. . . . It was quite a culture shock and I wasn't expecting this. . . . The lack of green space. The constant worry about getting the car parked safely with the traffic wardens everywhere. And trying to build up friendships and acquaintances in the immediate area. We didn't know anyone when we moved in 6 years ago.
>
> L7, London, Vivacity

Supporting CABE's notion of social infrastructure influencing a sense of wellbeing this resident went on to say:

> . . . All the neighbors in the square started getting together about a year or two after we moved in, and that then provided a natural focus to bring people together, so my wife and I got into that and we got friendly with people. And with there being that social relationship with people around the square you began to ease your way into a sociable communicative lifestyle. Then you get used to the noise, you get used to the hustle and the bustle, and you learn to be very careful with a car.
>
> L7, London, Vivacity

Once these residents felt that they had made friends with neighbors and could socialize with people the other stresses associated with the physical environment, such as lack of green space and noise, reduced.

Another resident described how they tried hard to fit in when they first arrived in a new part of London and their feeling that they'd perhaps got it wrong:

> . . . The first night we moved in, we decided to go out for a meal. And we kind of got dressed up; we sort of ironed our shirts and things and went out for a meal out. And we felt like foreign visitors in, you know in another city. It was really odd. Cause we were wandering round trying to work out where we were going to go to eat, so we were kind of reading the menus outside, and we really felt like strangers to an area, and sort of were we going to fit in

> and, and maybe this area's a bit trendy for us 'cause neither of us is particularly bothered about fashion. And, so we felt a bit kind of out of place. . . .
>
> L17, London, Vivacity

The architecture of urban spaces themselves can facilitate neighborliness by bringing people face to face:

> . . . The architecture here is what makes it really 'cause you have to talk, you know you, as you saw, everybody you know is on this kind of central stairwell. There are ten stairwells . . . and you're facing your neighbor so you tend to know them at least by face, and going up and down the stairs you tend to see people . . . but there's like enough privacy . . . because there's sort of private outdoor space as well you know [a balcony].
>
> L9, London, Vivacity

And the design of such residences can mean that the physical infrastructure that's necessary to facilitate social interaction can simultaneously provide for privacy.

Holistic Experience

From the previous sections on different aspects of the quality of urban spaces we can see that people experience urban spaces holistically, both physically and emotionally in a multisensory way; it is not easy to separate the factors that influence their overall sense of wellbeing in such a way as to identify causality. It is possible, however, to identify some contributory factors that constitute that state of wellbeing.

Research shows that the activities that people are performing and wishing to perform have a considerable bearing on their resultant evaluation of an urban space itself (Adams et al., 2007). Talking about urban soundscapes one participant identified that individualistic behaviors can also be the cause of conflict:

> People think they have a right to soundscapes and acoustic environments, whereas other people think that they have a right to do what they want. And this is where you find the conflicts in inner city areas, particularly later on in the evening about playing music, or using their cars in certain ways and all the rest.
>
> F16, Focus group, PSP

People's expectations of what they can or might do in an urban space therefore has an effect on their own experience of that space, as well as others' experience.

Urban design needs to acknowledge and work with this discrepancy to produce quality environments that meet the needs of multiple, diverse, users. In a focus group made up of urban design professionals one participant said "I don't think it's completely ever going to be resolvable for 100% of the people 100% of the time. . . . What the planners decide looks right in a certain place or meets a certain set of criteria is never going to please everybody, but . . . I think we need to start thinking about how we can please most of the people, even if we accept we can't please all the people (Focus group, PSP). The challenge then becomes identifying the factors that might please most of the people and doing it in a way that enhances wellbeing.

Designing Urban Spaces for Wellbeing

Emerging from this examination of the lives and experiences of people living and working in cities are some central features that are important in terms of delivering a sense of wellbeing through the provision of urban spaces.

We need to recognize that all urban spaces impact on quality of life and wellbeing; it is the use and functionality of these spaces that is relevant, not just the design and provision. All urban spaces, from the concrete square to the green urban park, from the residential street to the arterial thoroughfare, play their role and make their impact. These are the spaces that glue the city together; they enable flow through the city and deliver amenity value.

Access to urban spaces of different types and for varying purposes has been shown to be of great importance for wellbeing. Feelings of safety, security, and belonging are essential criteria in delivering wellbeing. But how is access negotiated and enabled? Who enjoys the access they desire and therefore whose wellbeing is supported or denied by different models of access? To consider this we need to consider what delineates public and private space in the urban context.

In the United Kingdom this delineation is somewhat breaking down with an increasing "privatization" of public spaces, such as shopping centers and arcades in the high street. Generally, we think about urban space as a collective good: something that can be consumed by right, without appeal to others. However, it is often the case that usage of public space is contested

and there are conflicts to resolve between expectations of citizenship and management of public spaces. Government, local authorities, and other agencies are all involved in managing our public spaces and this, in recent times, has led to the quasiprivate status of some public spaces. In turn this can lead to barriers to access for certain individuals or social groups, as city center management companies, for example, put controls on who may and may not enter parts of the city center. Ultimately, this can lead to a controlled social mix and alienation of people who are deemed to "not fit."

One way of looking at public urban spaces and wellbeing is to focus on the social interaction that occurs within such spaces, as many of the participants in the research referred to have done. Narratives of different people meeting and interacting creates a harmonious picture of social unity but the reality is more complicated. Because control of access to some urban spaces is managed we must consider the ways in which these trends towards privatization of public spaces might affect certain individuals' wellbeing. What effects does exclusion of some citizens have on these individuals and on social life in cities more broadly? While social segregation by exclusion possibly enhances some people's quality of life, there is a detrimental effect for others.

Recognition of the shared usage of space and the different expectations and requirements of different users can lead to the provision of urban spaces that provide multiple functions. Many city-center residents expressed their satisfaction with spaces that were designed for many people; the cheek-by-jowl interaction of different social groups provides a sense of community and awareness of society that segregation or social management doesn't allow.

Creating the right sensory environment is also vital for enhancing wellbeing. For example, the soundscape of an urban space can have a direct impact on quality of life. Tranquil spaces allow for thinking, contemplation, and learning while noisy spaces detract from those activities. On the other hand, people enjoy the hubbub of busy places where they can see and interact with others, deriving pleasure from those interactions.

Consideration needs to be given to the interpretation of individual and emotive responses to sound. People's taste is certainly a factor: what we like and dislike about a soundscape varies. In music, individuals can make stark choices between Bach and Beethoven, between the Beatles and the Sex Pistols; in society we have to sometimes accept what we don't like, such as a car alarm, siren, or people making "noise."

Yet again it is the activities of people that matter most and there are ways in which spaces can be physically enhanced to allow for desired sensory

experience, meeting the needs of various activities. For example, in the auditory realm, absorbent cladding can be used on new buildings to dampen road noise. Building envelopes can be formed in such ways that unwanted sound is reduced. Transport routes might be determined so that transport noise is minimized in residential areas. Water features might be incorporated so that calm acoustic spaces are created. However, it's not necessarily that people want places to be quiet, they want them to be private: people want to engage with their own activities without disturbing or being disturbed by others. The acoustic environment is very important in this respect.

The effects of the acoustic environment on wellbeing are well recognized, on health, productivity, and amenity. Environmental noise impacts on health include an increasing risk of diseases such as heart attacks and hypertension, hearing impairment, and mental illness. Effects on productivity are brought about through sleep disturbance and daytime distractions which worsen performance in the workplace and school. In amenity terms annoyance is caused in people exposed to noise and calm is induced in people experiencing tranquillity. Getting the acoustic environment right can improve wellbeing in all these realms and this requires the urban planning agendas to engage with soundscapes at the forefront of the design process.

Current pressures to squeeze residential developments into higher-density areas, frequently near noisy sites such as railways and main arterial roads, mean that the detrimental effects on wellbeing discussed here will be increased unless the sensory dimensions of urban living are adequately addressed. This doesn't necessitate reducing density; rather rethinking density from a sensory perspective that acknowledges the links between physical urban spaces, emotional responses, and wellbeing.

Notes

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Part 2
Wellbeing and Buildings

11

Children and the Physical Environment

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Introduction

Although the topic of environments and child development is not a new one to researchers, the scholarship on the physical environment and child development is relatively recent. The role of the physical environment is implied in two major theories of child development. Piaget (1969) emphasized physical attributes of the home environment for the child's motor, cognitive, and intellectual development during the sensorimotor stage. Bronfenbrenner's theory of nested environments encouraged researchers to examine children's lives in all of their complexity (Bronfenbrenner, 1979). According to this bioecological model, child development is regarded not only as a product of the child's biology and his or her home but a more complex relationship between biology, the social and physical environment of the home, and other settings in the "microsystem," the larger community such as a parent's place of employment (exosystem), and intangibles such as culture and social class (macrosystem). A microsystem, as defined by Bronfenbrenner (1979), is a place where enduring personal relationships are established and children spend the majority of their time. The child's world consists of several microsystems including home, child care outside of the home, school, and the immediate neighborhood. Children's everyday experiences typically take place in a mesosystem which is a combination of two or more microsystems. Microsystems play a central role in child development.

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The home as a microsystem is the subject of this chapter. It is important to consider the home as a system and not a static place. The child's experience in the home is a product of the child's abilities and personality, the opportunities to engage in meaningful interactions with objects and people in the home, and the physical characteristics of the home. It is this system of interactions that guide child development. The home environment is related to a number of health and wellbeing outcomes. For the purposes of this chapter we will not examine physical health outcomes, such as asthma, but instead concentrate on outcomes related to cognitive and socioemotional development. Environmental attributes related to these outcomes are crowding, privacy, noise, and housing quality.

Crowding

Although much of the research on crowding is related to adults, children's responses to crowding have received some attention. A limited amount of research has been done in acute laboratory settings but crowding in the home is more likely to be on a long-term, or chronic, basis and therefore potentially more damaging. In general residential crowding has negative consequences for children's development and wellbeing. Research findings fall into two categories: cognitive development which includes academic achievement in school/child-care settings, and socioemotional development including behavior. For the purposes of this review we examine in-home residential crowding irrespective of housing type. Neighborhood density conditions are not part of this discussion. Residential crowding is usually defined as spatial density: the number of people per room.

Cognitive Development

Children, especially boys, as young as 24 months living in high-density homes exhibit cognitive delays (Wachs, 1978, 1979; Wachs & Gruen, 1982). Residential crowding has negative consequences for preschool-aged children's cognitive development as well (Heft, 1979, 1985; Maxwell, 1996). Residential chaos of which crowding was a major contributor is related to poor response to academic challenges among Head Start children (Brown & Low, 2008).[1] Interestingly, lack of sleep was a partial mediator between chaos and academic performance. Children living in more chaotic homes (including ones with high density) were less likely to have a regular

sleep schedule or sufficient amount of sleep. The lack of sleep contributed to a sense of helplessness when confronted with academic challenges. Household density also predicted Haitian American infants' psychomotor development at 12 months (Widmayer et al., 1990). Psychomotor development involves both mental and muscular activity. As the child gains in large and small motor abilities, he or she begins to use those skills in concert with cognitive skills for problem-solving purposes (e.g. building a tower with blocks). Young children in crowded homes may lack sufficient space to fully explore their motor skills. For school-aged children household crowding is linked to poor academic performance, especially reading skills (Evans, Lepore, Shejwal, & Palsane, 1998; Evans & Saegert, 2000; Leventhal & Newman, 2010; Maxwell, 2003a; Michelson, 1968; Mitchell, 1971; Murray, 1974; Saegert, 1982).

Most of the above research looked at household density at one point in time and did not measure household density over time to determine the length of time the family and child lived in specific density conditions. A longitudinal study using both national and Los Angeles County data found significant negative effects of long-term household crowding on adolescents' academic performance (Solari & Mare, 2012). Household crowding (persons per room) was measured periodically over a 4-year period and averaged for that time period. In the national sample for every unit increase in household crowding (usually the addition of one person) there was a corresponding decrease in mathematics standardized test scores of 4.3 points and 6.8 points for reading scores. In the Los Angeles County sample (which had a wider range of household crowding and was more likely to have a higher percentage of crowded households) for each additional person in the household there was a decrease of 2.1 and 2.0 percentiles respectively on the mathematics and reading standardized test scores.

Except for the study done by Evans et al. (1998), which was conducted in India, all of the studies cited above were conducted in North America, primarily the United States. A study conducted in France examined household density and academic achievement in a slightly different way. Researchers determined that in French society the ideal number of bedrooms in the family home is determined by the gender composition of the children. When families consist of two children of the same sex, parents are more likely to have a third child in anticipation of having a mixed-gender family. If the two youngest children are of different genders then the parents often seek an additional bedroom. However, due to a variety of factors not all families who desire additional space can move. Goux and Maurin (2005)

used a national sample of 19,000 children, 15 years old, living with two parents in a household with at least two children. Controlling for family size and income 59% of the adolescents living in crowded households (density greater than one person per room) were not performing at the level deemed adequate for their year in school. Only 29% of adolescents living in low-density households had been left back at least 1 year. The researchers concluded that the probability of being held back in school increased with the number of children sharing a bedroom independent of family size and socioeconomic status.

A study conducted with black South Africa children in three residential areas (homeland, settlement areas, and white-owned farms) found that high residential crowding predicted lower verbal and quantitative scores among 5–6-year-olds (Goduka, Poole, & Aotaki-Phenice, 1992). Household crowding in this study was also negatively associated with height, weight, and head circumference. All of this work provides credible evidence that household crowding has serious negative consequences for children's cognitive and intellectual development beginning as early as infancy.

Socioemotional Development

Direct effects of household density in relation to socioemotional development center on behavioral outcomes as reported by parents, teachers, or children's peers. Several researchers report on behavioral misconduct. Elementary-school-aged children living in crowded households received higher scores on a teacher-rated scale of behavioral disturbance than their peers from less crowded homes (Saegert, 1982). The effects were most prominent for boys. The subscales anxiety and hyperactive distractibility were especially sensitive to crowded homes. Murray (1974) found that children from crowded homes were rated as more aggressive by their elementary school peers. Behavioral adjustment problems in school were noted for 10–12-year-old children living in crowded homes in India (Evans et al., 1998). Preschool-aged children from crowded homes displayed more aggressive behavior in a Head Start setting than peers from less crowded homes (Maxwell, 1996).

Behavioral outcomes in the form of increased aggression are also noted in the home itself. Solari and Mare (2012) report in the Los Angeles County sample that for every additional person in the household aggressive behavior in adolescents living in the home increased by 4.4%. Saegert (1982) found that children living in high-density households reported feeling angry and

fighting more often than peers in low-density households. Both studies controlled for socioeconomic status. Saegert notes that children in the more crowded homes also reported more people in their homes being angry. This pattern of family interaction could have consequences for children's socioemotional development. Evans et al. (1998) also noted more parent–child conflicts in the home. As we discuss later in the section Underlying Mechanisms, some of the impacts of residential conditions on children may happen indirectly because of alterations in parenting.

External behaviors such as aggression and fighting are not the only form of socioemotional development affected by living in crowded households. Some children respond to high residential density with internaling behaviors such as social withdrawal. Such behavior may be a response to too much stimulation from others. Solari and Mare (2012) report 2.6% increased withdrawal and sadness symptoms for adolescents in Los Angeles County with every increase of one person in the home. Preschool-aged children from crowded homes were more likely to be unoccupied and display onlooking behavior in a new child-care situation than children from less crowded homes (Liddell & Kruger, 1987, 1989).

Evans, Saegert, and Harris (2001) measured children's psychological health using a standardized instrument with items measuring behavioral conduct disorders as well as anxiety and depression. They sampled 8–10-year-olds from low-income urban and rural communities. More symptoms of poor psychological health were found for children living in high-density homes in both types of community. Parents rated children on the measure. Maxwell (2003a) examined children in the same age range as Evans, Saegert, and Harris (2001) and found that those living in high-density urban households scored higher on a child self-report measure of psychological stress. Children in the crowded households reported feeling bad more often than peers in less crowded homes controlling for household income and mother's educational level.

Another measure of psychological wellbeing is the sense of freedom of choice, that one has control over specific outcomes. Children living in crowded homes exhibit symptoms of learned helplessness when confronted with situations involving choice (Rodin, 1976). It is hypothesized that living in a crowded home reduces children's ability to control social interactions and other aspects of their environment. Children then generalize their lack of control to situations that, although controllable, are perceived to be outside of their control (Evans et al., 1998; Evans, Saegert, and Harris, 2001; Sherrod, 1974).

Moderators

Residential crowding effects in children vary by gender and age. In other words, the strength of the relationship between crowding and children is sometimes moderated by the child's gender or age. When gender effects are found boys are typically more negatively affected than girls. Effects include increased aggression or behavior problems (Murray, 1974; Saegert, 1982), higher blood-pressure levels (Evans et al., 1998), and lower cognitive development (Wachs, 1979). However, Booth and Jonson (1975) report small adverse effects for girls of household crowding on school performance. Incidences of helplessness in relation to household crowding were found for girls and not boys (Evans et al., 1998). Wachs (1978) found that among infants household environmental effects, including crowding, on cognitive development were seen earlier in girls than boys.

Children's age is also a moderator. While researchers have found indicators of psychological and behavioral adjustment problems related to household density in elementary-school-age children (Booth & Johnson, 1975; Evans et al. 1998; Evans, Saegert, & Harris, 2001; Murray, 1974; Saegert, 1982; Sherrod, 1974), Goduka and colleagues (1992) found no crowding effects on self-concept for 5- and 6-year-old South African children. Mental development was found lagging for 18- and 24-month-olds living in crowded homes but was not evident at 12 months of age (Gottfried & Gottfried, 1984). These effects do not disappear with maturation given these same researchers found deficits in relation to household density for verbal, perceptual, and quantitative performance at 30, 36, and 42 months and for language development in 39-month-old children. Wachs (1978) notes a positive relation between lack of crowding in the home and infants' cognitive performance at 12–14, 15–17, and again at 21–23 months.

Physiological Health

Although little work has been done related to physiological effects of residential crowding on children there is evidence of negative consequences. Evans et al. (1998) report a positive relation between density and high systolic blood pressure but only for boys. In a study of a low-income neighborhood in New York City girls and boys from crowded homes had increased levels of stress hormones especially in families that also experienced high levels of turmoil (Evans & Saegert, 2000). These findings suggest that children from crowded households are at risk for stress-induced health issues.

Privacy

Privacy is a highly valued concept in the United States and many Western cultures because of its association with individualism, autonomy, and independence (Weigel-Garrey, Cook, & Brotherson, 1998). Children's opportunity for privacy is considered necessary for their socioemotional development; namely, self-regulation, self-identity, and self-esteem (Weigel-Garrey et al., 1998). Therefore it is necessary that children be able to obtain privacy, especially in their homes. The state of privacy has two attributes; physical separation from others and the ability to control social interaction (Altman, 1976) and the control over access to information or psychological privacy (Wolfe, 1978). For the purposes of this chapter we are primarily concerned with physical privacy.

The ability to control social interactions is rooted in physical attributes of the home. Having a private space that is respected by other family members facilitates a sense of independence in the child and fosters the development of self (David & Weinstein, 1987). Sebba and Churchman (1983) point out that the home should be a place where children can claim a space of their own and control its use, including who has access to the space. The ability to control the use of a space allows the child to achieve a desired level of privacy. In high-density homes physical privacy may be difficult to achieve. For example, elementary-school-aged children living in high-density homes are more likely to report that they do not have enough space in the home especially when they share a bedroom with another family member, or sometimes with another function such as the living room (Saegert, 1982). Children sharing a bedroom also state that they cannot be alone when they want to and they do not have a place to be alone (Maxwell, 2003a).

When children do not have a bedroom to themselves they may use other spaces in the home to achieve a desired level of privacy. Elementary-school-aged children from a low–middle-income community in Queens, New York, were interviewed about their home, school, and neighborhood. Those who shared a bedroom with another family member, usually a sibling, were likely to use a closet or their bed as a private space, a space where they could control access (Maxwell, 2003b). One child reported that when she wanted to be alone she played with her dolls in the closet because "no one bothers me there" (Maxwell, 2003b).

The ability of children to achieve bathroom privacy is dependent on the number of bathrooms in the home and household density. In crowded

homes, regardless of the number of bathrooms, children are more likely to restrict access (closed and locked door, family members required to knock). Parke (1979) suggests that this is an attempt to not only control the space (physical privacy) but also to achieve psychological privacy.

Parents of preschool children seem to recognize that even a child as young as 3 or 4 needs some time alone, yet many are not willing to tolerate locked bathroom or bedroom doors for children of this age (McKinney, 1998). McKinney notes that while some parents allow young children to close the bathroom door, others in her study were reluctant to do so. Parents' willingness to allow for spatial privacy can be even more restrictive for children with disabilities. Weigel-Garrey et al. (1998) found that parents of children with disabilities had difficulty balancing the value of privacy and independence for their child with the desire to protect the child from potentially hazardous situations in the home. For these families the physical environment of the home inhibited children's ability to be independent. For example, Weigel-Garrey and colleagues (1998) report that some parents do not allow their mobility-impaired child to use a wheelchair in the home because it damages the furniture and walls. Therefore the child has to be carried around the house, thereby losing independent mobility. In other situations parents allow the child to be in his or her bedroom alone but, for example, the light fixture and the child's toys and belongings are stored out of reach of the child so he or she needs assistance to do anything except sit. These examples point to ways in which the home's physical environment precludes opportunities for a child with disabilities to gain meaningful privacy.

The ability to control social interactions is a critical element of privacy. Regulating social interactions usually means that the individual has control over the use of a physical space and can determine when and how the space is used by others. If someone does not have the ability to regulate how a space is used that individual needs to use other mechanisms to control social interactions. Psychological privacy may be an option for regulating social interaction when physical privacy is not possible (Laufer & Wolfe, 1977). The parent of a child with a disability reported that her daughter needed constant supervision. The mother stated that the child would sometimes sit in the living room and stare out the window. Weigel-Garrey et al. (1998) indicate that the child used psychological privacy to distance herself from others in the room. Children in high-density homes who do not have a disability but have little opportunity for physical privacy or a space that they can control may also resort to mentally distancing themselves from others in the home.

Children may not need a permanent place of their own in the home to achieve privacy and to gain the benefits of having a private space. Michelson (1968) identifies the role of "functional" privacy in the academic success of school-aged children. Functional privacy in the home is achieved with a space that can be solely devoted to the child's particular needs at a given time, such as homework, but has other functions at different times. This could be a desk in the living room, a kitchen table, or a specific time in a shared bedroom when the child is not to be interrupted. Michelson (1968) found that functional privacy was a positive predictor of children's achievement on a standardized test and teacher ratings of academic performance, creativity and behavioral adjustment. Wachs notes that infants and toddlers also benefit from temporary private space. He defines this type of space as a "stimulus shelter" (Wachs, 1979). Infants and toddlers who had a stimulus shelter in their home providing a respite from other people and noise in the home performed better on cognitive measures than children without such a space. Having a functional private space may be important for other reasons too. Hong Kong adolescents living in high-rise housing who had access to a functional private space in their home (their own desk in a shared bedroom) were rated by their teachers as having fewer behavior problems in school than peers without such a space (Li, 2011). Household density was not a significant factor in predicting behavioral conduct in this very dense city where the majority of residents live in high-rise housing and most children share a bedroom with a family member.

Moderators

Age and gender also act as moderators related to privacy. Children's privacy needs and expectations change with age. Parke (1979) reports children's stated desires for privacy are a function of physical maturity. Controlling access to the child's bedroom and the bathroom as the child becomes more aware of his or her body is a function of age and activity. Children between the ages of 2 and 5 place few if any restrictions on access to bedroom or bathroom. From about 6 years of age through adolescence children increasingly restrict access to the bathroom when performing personal hygiene activities. Opposite-sex siblings are excluded first, followed by parents (Parke, 1979). Girls restrict their fathers at an earlier age (10–13 years old) than boys (14–17 years old) restrict their mothers but eventually both genders restrict fathers and mothers (Parke, 1979).

Noise

The primary focus of research on residential noise and children has been transportation-related impacts, principally vehicular and aircraft sources. Therefore, based upon what we currently know, the location of the home as well as the sound-attenuation properties of the residence are likely the most critical design elements of homes in terms of noise impacts on children. Secondarily, the location of children's bedrooms with respect to the street and whether or not windows need to be opened during warm weather are potentially important as well (Babisch, Neuhauser, Thamm, & Seiwert, 2009). Intraresidential noise sources in most cases are unlikely to be sufficiently loud to compromise children's health or wellbeing, although, as we describe below, the distracting properties of background speech can have consequences for cognitive processes. The principal dimension of noise studied to date has been intensity, usually measured in decibels: either peak or average levels over some time period (often 24 h). Laboratory work also suggests the synchronicity as well as the degree of control over noise exposure is also important. Some noise-exposure metrics weigh nighttime exposure more heavily than daytime exposure, but there is little data outside of adult studies of annoyance to validate the use of weighted indices.

Academic Achievement and Cognitive Processes

The largest and strongest body of research on noise and children is about reading acquisition. Children exposed to elevated community noise levels, particularly from aircraft, have delays in reading acquisition (Evans, 2006; Evans & Hygge, 2007). In addition to numerous cross-sectional studies, evidence for a community-noise–reading link also emanates from longitudinal studies, including at least one prospective study (Hygge, Evans, & Bullinger, 2002), studies with dose–response functions (Green, Pasternack, & Shore, 1982; Lukas, DuPree, & Swing, 1981; Stansfeld et al., 2005), as well as sound-attenuation evaluations (Bronzaft, 1981; Cohen, Evans, Stokols, & Krantz, 1986; Federal Interagency Committee on Aircraft Noise, 2004). The longer the duration of exposure the worse the impact, plus there is some evidence that the combination of high noise exposure at home and at school has detrimental symbiotic effects (Cohen et al., 1986; Evans, 2006).

In addition to reading acquisition there is evidence that long-term memory and the ability to focus attention are adversely impacted by chronic noise

exposure, particularly when the cognitive tasks are difficult (Evans, 2006; Evans & Hygge, 2007; van Kempen et al., 2010). Both acute and chronic noise, even at relatively low intensities, can alter cortical processing of speech as well as attention allocation (Kujala & Brattico, 2009).

Other properties of noise other than high intensity may be salient, particularly to children's cognitive development. Acoustic stimuli with speech-like properties can be especially distracting and interfere with cognitive processing by adults (Jones & Morris, 1992) and these adverse effects appear to be stronger for children (Elliott, 2002; Klatte, Meis, Sukowski, & Schick, 2007). Activities such as reading or doing homework might be compromised by exposure to even low-intensity levels of speech that children cannot block out. In a laboratory study with toddlers, Dixon, Salley, and Clements (2006) showed that auditory distraction (reading aloud by a stranger) interfered with word learning as well as nonword-based learning. Of interest in thinking about mechanisms to explain these effects, the adverse effects of auditory distraction were accentuated among toddlers with poor attentional focusing ability relative to those with relatively high attentional focusing abilities. Another property of noise, reverberation time ("echo"; the amount of time for sounds to dissipate) also appears to be distracting to children and interfere with cognitive performance, including aspects of speech perception fundamental to learning acquisition (Klatte, Hellbruck, Seidel, & Leistner, 2010; Maxwell & Evans, 2000). If any of these properties related to noise are found in the home it is reasonable to expect that children's cognitive development and academic achievement will be negatively affected.

Psychological Health

Most children, at least in economically developed countries, are not exposed to sufficiently loud noise levels on a regular basis sufficient to produce hearing damage. Nonetheless, at intensity levels far below those necessary to produce hearing deficits chronic noise is capable of adverse health effects. For example, chronic noise exposure for many individuals is a source of stress, creating irritation and annoyance, and capable of inducing feelings of helplessness or loss of control. Higher ambient noise exposure elevates blood pressure as well as stress hormones such as cortisol, epinephrine (adrenaline), and norepinephrine (noradrenaline) (Evans, 2006; Ising & Kruppa, 2007; Paunovic, Stansfeld, Clark, & Belojevic, 2011). Modest but relatively consistent elevations in children's blood pressure have been noted in many studies and include data from both longitudinal as well

as sound-attenuation interventions. Although there is not sufficient data to draw definitive conclusions, work suggests that children may become more psychologically distressed, in particular manifesting hyperactive symptoms, when chronically exposed to noise (Haines et al., 2001; Lercher, Evans, Meis, & Kofler, 2002; Stansfeld et al., 2004). Noisy home environments may put children at risk for these health effects related to stress.

One aspect of children's psychological wellbeing that has received more scrutiny in the noise literature is helplessness. People chronically exposed to uncontrollable stimuli, including noise, become vulnerable to helplessness, the belief that their actions have little or no consequences on the environment; in other words that environmental conditions are not contingent upon the behaviors of the individual. Residential and school noise levels are positively associated with helplessness among children (Cohen, 1980; Evans & Stecker, 2004). Typically learned helplessness in children is measured by giving them difficult or unsolvable puzzles with persistence as the primary index. Children living or attending schools in nosier areas are also more likely to believe what happens to them is attributable to external forces and conditions rather than to their own ability or efforts (Cohen et al., 1986; Evans & Stecker, 2004). The relation of noise to learned helplessness parallels findings of chronic exposure to residential crowding.

Housing

Most work on housing and children has focused on physical health, particularly upper respiratory problems related to cold, dampness, and allergens (Braubach, Jacobs, & Ormandy, 2011; Shaw, 2004). But even these aspects of housing quality can have psychological consequences. Shenassa, Daskalakis, Liebhaber, Braubach, and Brown (2007), in a large, cross-national study of housing quality in eight European cities, showed that adults residing in substandard housing that was damp and moldy were more likely to suffer from depression. Moreover, their depression was largely attributable to the perceptions, by persons living in damp and moldy homes, of the lack of ability to control one's own physical surroundings and their impact on health.

Given the central role of housing as the primary microsetting for young children, qualities of residential spaces that make them less predictable and

harder to regulate could be a key ingredient in linking residential experience to children's socioemotional and cognitive development. In addition to possibly providing an essential setting for the development of a sense of competency in children, housing also functions for many of us as a refuge that provides some escape from the bustle and demands of daily life. Poor-quality housing can add to daily burdens, precluding adequate restoration or recovery for children and parents alike (Hartig, Johansson, & Kylin, 2003). Psychological research on children and housing has emphasized psychological distress and academic performance. The majority of research on housing and psychological wellbeing in children has examined building height, housing quality—defined primarily in terms of structural and maintenance problems—and chaotic living conditions.

Building Height

Younger children in high-rise compared to low-rise buildings manifest more behavioral problems (Evans, Wells, & Moch, 2003; Gifford & Lacombe, 2006). This is believed to occur because of more restrictions on children's out-of-the-unit play behavior necessitated by residence on upper floors coupled with concordant interpersonal tensions among families cooped up inside. Parental concerns can also be engendered by high-rise living given the greater difficulty to control and monitor one's children, particularly as they transition into adolescence. In one of the few true experimental research designs on housing wherein families were randomly assigned to housing, Fanning (1967) found that mothers of young children on higher floors of multifamily dwellings suffered greater symptoms of stress. Gillis (1997) uncovered similar trends for women in a correlational study. Another possibility is that residing in a multifamily dwelling leads to more crowding, created by too much unwanted and uncontrollable social interaction. The adverse mental health consequences of crowded living among children are exacerbated if they reside on upper floor levels (Hassan, 1977; Mitchell, 1971) or in larger, multifamily dwellings (Evans, Lercher, & Kofler, 2002).

More mixed results exist for high-rise housing and academic performance (Evans, 2006; Evans et al., 2003). One possible reason for these less consistent results could be gender differences, with some evidence indicating boys but not girls having more academic difficulty as a function of high-rise dwellings (Saegert, 1982). Because families typically choose their residence, it is difficult to disentangle the effects of housing height or quality from personal characteristics of adult family members. Some of the studies examining

linkages between building height and children's wellbeing partially address self-selection bias by relying on statistical controls for socioeconomic status. There is stronger evidence of adverse impacts of housing quality relative to building height on children's wellbeing. Several studies of housing quality used longitudinal study designs examining children who had or had not moved, and, in one case, a true experiment with random assignment was possible.

Housing Quality

Both children and adolescents suffer more psychological distress if they live in substandard housing with statistical controls for socioeconomic status (Evans et al., 2003). The strength of this association increases with longer duration of residence as well (Marsh, Gordon, Pantazis, & Heslop, 1999). Obasanjo (1998) found multimethodological indicators of poorer psychological wellbeing among low-income African American and Hispanic adolescents whose families were essentially randomly assigned to public housing units. Eight- to ten-year-olds, independent of income levels, living in poorer-quality housing are more susceptible to learned helplessness (Evans, Saltzman, & Cooperman, 2001) and when public housing residents were randomly relocated to middle-class, suburban neighborhoods they reported marked increases in feelings of self efficacy compared to their counterparts remaining in public housing (Rosenbaum, Reynolds, & Deluca, 2002). Not surprisingly home ownership as well as duration of occupancy are positively associated with feelings of mastery (Fried, 1972; Hiscock, Macintyre, Kearns, & Ellaway, 2003; Smith, 1990). Many studies have uncovered negative correlations between housing quality and academic performance (Evans, 2006) and include at least one investigation with random assignment to improved housing (Wilner, Walkley, Pinkerton, & Tayback, 1962). Moreover, nearly all cross-sectional studies on housing quality and academic performance incorporate good statistical controls for family characteristics.

Lower-quality housing may be stressful but very little is directly known about this. A few studies indicate an inverse association between housing quality and perceived stress. In two U.K. studies housing quality was correlated with anxiety among middle-aged adults (Hiscock et al., 2003; Payne, 1997). Taking advantage of a naturally occurring experiment, Carp (1975) showed improvements in overall happiness and life satisfaction among older residents who moved to better-quality housing than those who

remained in their original housing. Immediately before and after the move these two groups did not differ in outcomes. Moreover, both groups were from very similar backgrounds. Therefore it is likely that enhancements in positive affect were due to improved housing quality per se. As far as we know similar work has not been done related to children.

An important weakness in these initial studies on housing and stress is reliance upon self-reporting. We are aware of only two studies on housing quality and physiological stress among children. Blair and colleagues (2011) showed greater elevations in basal cortisol levels over a 4-year period from infancy to 4 years of age as a function of housing quality. These investigators controlled statistically for family income. Evans and Marcynyszyn (2004) showed that low-income children with a combination of suboptimal housing, high noise levels, and high residential density had elevated overnight stress hormones. Interestingly this relation did not hold for middle-income elementary school children, perhaps because they were much less likely to contend with cumulative environmental stressors.

Chaotic Living Conditions

Developmental psychologists have become increasingly interested in the implications of chaotic living conditions on children. Lack of daily structure and routines, paucity of household rituals, and high levels of clutter, noise, and crowding are common elements of chaotic households. Various composite indicators of chaotic residential and school settings are associated with children's and adolescents' academic and psychological functioning (Ackerman & Brown, 2010; Brooks-Gunn, Johnson, & Leventhal, 2010; Fiese & Winter, 2010; Maxwell, 2009). Chaotic living can also exacerbate other stressors; for example, interfering with children's ability to cope with family divorce and remarriage (Guidubaldi, Cleminshaw, Perry, Nastasi, & Lightel, 1986; Henry & Lovelace, 1995).

Chaos often covaries with housing quality and is another factor that could also contribute to the development of helplessness in young children. Both Brown (2009) and Evans, Gonnella, Marcynyszyn, Gentile, and Salpekar (2005) demonstrated that chaotic household conditions in children ranging from preschool age to 17 are positively associated with learned helplessness, independent of socioeconomic status. Chaotic homes are a perfect example of how social and physical attributes of the home together create environments that are untenable for healthy child development.

Underlying Mechanisms

The findings reviewed here on crowding, privacy, noise, and housing quality in relation to children's psychological wellbeing beg the question of what explains linkages between residential living conditions and childhood outcomes. Better understanding of underlying mediating processes that help account for residential environment effects on children is important for several reasons. First, a plausible underlying pathway from environment to health, development, or wellbeing strengthens the evidence for environmental impacts on children. Second, insight into why and how the environment influences children's health and behavior yields potentially valuable information about potential leverage points for interventions to improve children's lives, even when it may be impossible or unlikely that one can alter the fundamental environmental condition producing the problem in the first place. Although it may not be politically or economically feasible to eliminate high-rise housing for young families, if part of the ill effects of high-rise buildings on young children and their mothers is related to difficulties associated with a dearth of proximate play spaces for children it would suggest some alternative points of intervention that might buffer some of the problems found in high-rise buildings for young families. Third, as suggested by this example of a possible leverage point to relieve family stress and tension in high-rise buildings, knowledge of underlying pathways linking the residential environment to child development can also offer designers ideas and principles they can incorporate into their work as a problem-solving tool (Danko, 2010). In this section we offer some preliminary thoughts about underlying mechanisms that may illuminate why and how the residential environment can affect children.

Parenting

When children live in settings that are suboptimal, usually their parents are contending with some of the same environmental demands. Given the well-documented role of parenting on children's development, one pathway worth thinking about is how environmental conditions in the home might influence parents; this, in turn, could contribute to children's wellbeing.

Note, this is not to argue that the residential environment cannot have direct impacts on children. Rather, our point is simply that physical

settings can influence children directly as well as indirectly via their parents (Bartlett, 1997).

One critical dimension of parenting is responsiveness or sensitivity (Bornstein, 1989). More responsive or sensitive parents respond to their children's emotional and instrumental needs (e.g., help with homework). Responsive parenting appears to be essential to healthy development, among other things being a key component of the development of secure attachment relationships (Collin, 1996). Residential crowding (Bradley & Caldwell, 1987; Evans, Maxwell, & Hart, 1999), noise (Wachs, 1979; Wachs & Camli, 1991), and high-rise buildings (Saegert, 1982) have been associated with reduced parental responsiveness toward children. Chaotic living conditions also appear to lead to reduced parental responsiveness (Matheny, Wachs, Ludwig, & Phillips, 1995). We also know that family members withdraw from one another under more crowded conditions (Evans, 2003). Noise can interfere with communication which might have important consequences, particularly for things like family meal-time interactions or reading aloud to children. Several studies in schools have observed less instructional time during noisier periods (Evans & Hygge, 2007).

Noise is an irritant which, in combination with modeling or provocation, elevates interpersonal conflict (Cohen & Spacapan, 1984). Teachers in noisy schools also report less patience as well as greater fatigue (Evans & Hygge, 2007). Parents in more crowded homes report greater conflict and strain with their children (Evans, 2006), and at least two studies have demonstrated that more conflictual family relationships mediate some of the ill effects of high residential density on children's socioemotional, cognitive, and physiological stress reactions (Evans & Saegert, 2000; Evans et al., 1998). Parents in multifamily residences report greater conflict and familial strains compared to their counterparts living in smaller housing units (Edwards, Booth, & Edwards, 1982; Moore, 1975). Not surprisingly, chaotic living conditions are also linked to family conflict (Jensen, James, Boyce, & Hartnett, 1983). The links discussed here between noise, crowding, housing, and chaos with conflict and interpersonal strains occur independently of socioeconomic status.

Control

Helplessness can occur when it is difficult or impossible to control or regulate the physical environment. As noted, noise, crowding, and poor housing quality have all been linked to elevated helplessness. We have noted

as well that certain types of housing conditions can lead to restrictions on children's behavioral options. For example, it can be very difficult to monitor children in high-rise buildings, leading parents to restrict their outdoor play (Evans et al., 2003), which in turn can exacerbate tension among family members. Home ownership and longevity of occupancy both contribute to elevated mastery (Evans et al., 2003). Not surprisingly, frequent relocations are difficult for children, disrupting social networks and possibly engendering anxiety (Ackerman & Brown, 2010; Fiese & Winter, 2010). We also know that when children can control their exposure to adverse environmental conditions their negative impacts are significantly attenuated (Cohen et al., 1986; Evans & Stecker, 2004).

One of the important ways children learn to be competent is by experiencing environmental contingencies. This may be one reason why chaotic living conditions are inimical to children's development. Without structure and patterns of predictable environmental experience children have difficulty learning that their own actions can influence outcomes of their choices. Mastery or competence in manipulating one's surroundings in order to serve one's own needs is also a necessary prerequisite for the development of self-regulatory skills. It is hard to see how a child growing up in chaotic living conditions would come to appreciate the value of controlling strong emotions, deferring immediate gratification, and taking the time to reflect on the best course of action. It is also worth thinking about the potential impacts of chaotic early childhoods on the development of planning skills and comprehension that present actions and choices can lead to future outcomes of importance. Brody and Flor (1997) noted that 6–9-year-olds growing up in more chaotic households, independent of income levels, had more difficulty self-regulating, which in turn accounted for much of the covariation between chaos and psychological wellbeing and academic achievement. Adolescents from less cohesive, more chaotic households engage in riskier behaviors as young adults (Fisher & Feldman, 1998).

Summary of Consequences

Children's healthy cognitive, socioemotional, and physiological development is closely tied to their residential environment. Effects of living in crowded, noisy, chaotic, and poor-quality housing include impaired cognitive development, delayed reading acquisition and poor academic

performance, behavioral problems, and psychological symptoms of stress including loss of control and helplessness. The literature reports direct effects of negative residential experiences on children of all ages from infancy to adolescence. The family's economic status may contribute to the impact of some, but not all, environmental attributes since families with low incomes may have housing situations with more than one negative environmental attribute.

Although chronic exposure to crowded, noisy, and/or chaotic homes can result in poor outcomes for children, understanding more about the pathways, or mechanisms, by which children are affected may help in understanding ways to reduce the negative effects. Two such mechanisms are parenting and control. As reported above, adults suffer negative effects of exposure to residential crowding, noise, chaos, and poor housing quality. Therefore parents' ability to be responsive to their children is reduced when they are negatively affected by crowding or noisy homes or poor-quality housing. In addition, parents' inability to achieve a desired level of privacy in the home may result in them becoming less responsive to their children. Crowding in the home means that children and parents have difficulty controlling social interaction. This means that parents as well as children lack privacy. When parents of preschool children were questioned about privacy issues in the home, many responded they lacked privacy and did not mention that their children also need privacy (McKinney, 1998). This lack of privacy may account for some of the reduced parent responsiveness. When physical privacy is not available, children and adults may resort to psychological privacy resulting in reduced social interaction.

Some of the negative effects of residential crowding, noise, and chaos on children may also be attributable to control issues. The inability to achieve desired levels of privacy and social interaction or to control noise sources can result in a sense of helplessness. As reported elsewhere in this chapter, children may generalize their lack of control over environmental circumstances to personal failings. A sense of helplessness or hopelessness is not a good foundation upon which to build positive psychological development and academic achievement potential. Children who do not experience environmental contingency in the home are at a greater risk of poor development in these areas. The centrality of this microsystem setting in children's lives makes the home's physical environment critical to all aspects of children's health, wellbeing, and development.

Future Issues and Research

There are several issues related to children's health and development that remain to be addressed. First, to better understand the ways in which the physical environment as represented by noise, crowding, chaos, and housing affects children's development, more longitudinal work is needed. Investigators have included children across the age spectrum from infancy to adolescence in research on home environments. However, most of these studies are cross-sectional so long-term effects can only be implied. Longitudinal studies help us better understand possible cumulative effects of exposure and critical periods in children's lives when permanent or near-permanent damage might be done. Second, although families with a range of socioeconomic statuses are represented in the literature, less attention has been paid to cultural differences. This is not be confused with any implication that some culture groups can better tolerate crowding or noise. Rather, how might differences in culturally based parenting styles or expectations for children's privacy or competency be related to developmental outcomes? Nearly all of the research reported in this chapter with the exception of three studies has been conducted in Western developed countries. Exceptions include studies in India (Evans et al., 1998), Hong Kong (Li, 2011), and South Africa (Goduka et al., 1992). Very little work has been done in urban or rural communities of, for example, sub-Saharan Africa or Latin America. The bioecological model of child development emphasizes the interrelatedness of the child's biology, the context (social and physical environment), and time in producing development. Cultural differences are part of the context and therefore should be part of research initiatives. Such research efforts will also provide a more global view of child development issues and the role of housing in children's health and wellbeing. Furthermore, basing conclusions about residential setting impacts on predominantly economically developed samples can lead to truncated exposure with regard to physical factors. In economically underdeveloped countries there is often a much wider range, particularly at the low end of physical quality.

Third, to develop interventions that improve the lives of families and children we must be confident that all relevant variables are included in future studies. Some variables are related to housing policy, some are important to designers, and still others might be directed at parent education/educators. The studies described in this chapter primarily relate to changes in housing policy. Although housing is usually an issue of choice, the range of choices

or the ability to choose is not equally distributed across all income groups. Housing policy can affect choices and these choices can have lasting effects on children. For example, Goux and Maurin (2005) assert that in France housing policy related to blue-collar workers could contribute to children's success in school. They regard this as a national concern. Public funds spent on providing better housing choices for such families will ultimately benefit society because the children of these families will have a better chance of good academic achievement. More research that has policy implications is certainly desirable.

Research is needed that informs the design of future housing and informs parents of how to better use existing space. If design professionals are to assist in providing better housing choices they need more information related to variables that they can manipulate. Light and color are two such variables. The amount and type of artificial and natural light in the home may affect health and wellbeing, thereby affecting psychological and possibly cognitive development. Color choices in the home may be related to environmental complexity and could contribute to overall stimulation levels. Designers might also be able to provide parents with information about materials to use in the home that might reduce exposure to outside noise sources. Researchers, however, must first include such variables in their studies to test the effectiveness of potential interventions.

Finally, although this chapter has concentrated on the residential environment, the bioecological model of development requires researchers to examine children in the entire context of their lives. Even the very youngest child spends time outside of the home and these experiences combined with their home environment affect health and development. Therefore we need to ask questions that can help us better understand the relative contribution of the home environment. Studies examining children's mesosystem (more than one microsystem) are vehicles for asking these questions. For example, a study done in Hong Kong multifamily housing found no effects of home ownership (rental public housing vs. owner-occupied housing) for children's teacher-rated conduct behavior in school (Li, 2011). All of the families lived in high-rise multifamily apartments, which is common in Hong Kong. Other societal factors such as housing expectations and provision of public and private services in the neighborhood may compensate for negative effects of high-rise living for children found in less dense cities in the United States. There is also evidence that the degree of stochastic relationships as children move across settings is a potentially important aspect of healthy environments for children (Dunn, Schaefer-McDaniel, & Ramsay, 2010).

Such symbiotic relationships between and across chaotic physical settings and interpersonal sources of stress are reminiscent of findings reviewed above showing that exposure to substandard housing quality, noise, and crowding in combination led to elevated stress hormones among elementary-age school children.

Research with mesosystems requires methodologies that ensure appropriate data collection. Maxwell (1996) included a range of home and child-care density settings to examine the effects of crowding on preschool children. Crowded daycare classrooms aggravated negative outcomes for children from crowded homes. Answers to such questions may not yield universal truths but may be more nuanced. Nevertheless, such research is needed to help ensure healthy development for as many children as possible.

Note

1. The Head Start program is a federally funded preschool program for children aged 3–5 years. The program is designed to give children from families who meet certain income guidelines a "head start" in preparing them for successful school experiences.

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12

Wellbeing and the School Environment

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Introduction

It is noteworthy that when children and adolescents are considered the measurement of wellbeing has traditionally been constructed using a deficit-based approach that focuses on an individual's problems and associated environmental disamenities (Long, Huebner, Wedell, & Hills, 2012), yet it is increasingly recognized that wellbeing in children is both driven and measurable by similar attributes to that of adults (McCullough, Huebner, & Laughlin, 2000). Nevertheless, the specific environments that influence the wellbeing of young people are rather different to those observed for adults, largely as a result of variations in the settings within which children and adolescents spend their time. A key difference from adults is that young people spend a substantial percentage of their time in school settings. Their experiences in school have been found to drive not only their academic performance but also to influence their socioemotional and physical health development, both positively and negatively (Saab & Klinger, 2010).

Schools have an important influence on children's learning and development, both by acting as a connection to the wider environment and by providing a locality within which they spent a large amount of their day (Elovainio et al., 2011). Indeed, a large body of literature has shown that the school climate, as defined by the social, psychological, and academic atmosphere of a school (Anderson, 1982), is associated with scholastic

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performance and, more broadly, reported wellbeing (Aveyard, Markham, & Cheng, 2004; Hill & Tyson, 2009). For example, health behaviors exhibited by children as well as their self-perceptions have been repeatedly associated with characteristics of their time spent at school (Anderman, Maehr, & Midgley, 1999), while in addition to the direct teaching of academic skills schools provide opportunities for pupils to develop rationally, emotionally, and behaviorally in ways that can have lasting impact on their lives (Willms, 2004). Given the important impacts of schools, Saab and Klinger (2010) have argued that it is unsurprising that they reflect the values and expectations of society as a whole.

Simons-Morton, Crump, Haynie, and Saylor (1999) illustrated that the presence of a positive atmosphere or climate in a school has the potential to enhance the ability of pupils to develop key social bonds, and this in turn predicts later academic achievements. Satisfaction with school can be considered a construct that contributes to overall life satisfaction in pupils, and is indicated by expressed happiness, enjoyment of school, a sense of wellbeing while attending school, and a high quality of life among young people (de Róiste, Kelly, Molcho, Gavin, & Gabhainn, 2012). Further, good academic achievement has itself been associated with high levels of school satisfaction, which has subsequently been found to contribute to motivation and continued good academic performance (Samdal, Nutbeam, Wold, & Kannas, 1998). There is also evidence that the benefits of achieving a high level of wellbeing at school continue much later in life, as a rapidly growing literature suggests that there is a strong association between early cognitive ability developed in the school environment and later health (Batty et al., 2008). For example, a recent analysis of a cohort of Swedish boys born in 1928 found that measured intelligence at the age of 20 years acted as a predictor of mortality in late adulthood, and that measured intelligence was associated in part with the schooling that members of the cohort had received (Lager, Modin, de Stavola, & Vågerö, 2012). The authors of that study concluded that school-induced changes in IQ scores have the ability to bring about lasting changes in both adult intelligence and adult health.

The environment of the school undoubtedly has the potential to influence the wellbeing of the student population in a negative manner. Yet a good school environment may promote wellbeing by providing a platform on which children can develop a positive mental outlook, perform well academically, and gain both the social and cognitive skills required to meet their goals in life. Indeed, the concept of "health-promoting schools" has been in use for over three decades, having emerged in the early 1980s, and

it was further elaborated in the World Health Organization Health Promoting Schools Symposium held in Scotland in 1986 (Simovska, 2012). In accordance with the broader field of health promotion, a health-promoting school is defined as an educational setting that attempts to constantly develop its capacity for healthy learning, working, and living (World Health Organization, 1998).

Enshrined within the concept of health-promoting schools is the view that the whole school environment provides an important arena for action if a school is to effectively promote good health and wellbeing. Indeed, research in the field of health-promoting schools places particular attention on challenging traditional discourses of school health promotion whereby the focus is a narrow one that concerns pupils' knowledge, skills, and behavior. Instead the work attempts to critically explore socio-cultural and other contextual determinants, such as the physical characteristics of the school environment that determine pupils' broader health and wellbeing (Simovska, 2012). Indeed the aim is seen as being to achieve an environment which improves not only education through health, but also health through education.

In this chapter we adopt this broad view of the relationship between the school environment and the wellbeing of its pupils. We consider wellbeing as encompassing more traditionally utilized measures such as subjectively reported wellbeing and mental health, as well as the more objective indicators of health that include the risks of accidental injury and pupils' dietary and physical activity behaviors. In line with this, schools are being increasingly recognized as an important component of socioecological models of health that reflect the broad vision of wellbeing that encompasses multiple outcomes at both organizational and community levels (Saab & Klinger, 2010). Indeed, a notion that is inherent in socioecological models is that the functioning of the school will at least in part be dependent upon the characteristics of the social and physical environments within which it is situated. Accordingly, a notable number of recent studies have begun to examine the role of the wider neighborhood within which the school is situated as a determinant of associations with health and wellbeing in the school (Harrison, Jones, van Sluijs, et al., 2011).

We begin the chapter with a brief consideration of issues associated with the measurement of wellbeing in the school environment before moving on to consider the impact of bullying at school on children's mental health. We then consider the rather limited research evidence regarding the risk of accidents in the school environment before turning our attention

to a relatively new field of research, that of diet and physical activity. Whereas schools have been identified as important vehicles for health promotion due to the significant role they play in most children's lives, their role in determining the weight status of the children that attend them is not well understood. Therefore we conclude our evidence review by focusing on the role of the school environment as a potential determinant of children's weight before moving on more generally to consider how school environments of the future may be better placed to improve the wellbeing of their pupils.

Measurement of Wellbeing at School

The traditional measure of the "success" of a school lies in the academic achievements of the pupils who attend it, and indeed this is reflected by the myriad of school league tables that are published each year to allow both parents and policy makers to compare the relative merits of one school over another. However, whereas the viewpoint of achieving excellence in academic outcomes being the important facet of a well-performing school is long-standing (Rutter, 1979), there is increasing recognition that academic metrics are not the only ones that matter (Saab & Klinger, 2010). Indeed, in their analysis of data from Longitudinal Survey of Young People in England, Gibbons and Silva (2011) have shown how test-score-based measures of school quality tend to dominate parental satisfaction with the learning environment but are not strongly associated with pupil-reported happiness and wellbeing at school. In line with such findings there has recently been a call for efforts around school reforms to combine academic metrics with those that are of a more affective (psychological and emotional) nature when considering school performance (Fitz-Gibbon, 2006).

A key construct in most descriptions of positive psychology, the study of positive emotions, character, and institutions, is that of subjective wellbeing (Long et al., 2012). Subjective wellbeing considers how people evaluate the experiential quality of their lives in terms of emotional responses and judgments of life satisfaction (Diener, Suh, Lucas, & Smith, 1999). An important component of subjective wellbeing in children and adolescents is school satisfaction, which represents a cognitive evaluation of pupils' overall satisfaction with their school experience (Huebner, 1994). Studies have shown school satisfaction to be associated with academic performance, school absences, and behavioral problems (Baker & Maupin, 2009). Although the role of

features of the school as a determinant of school satisfaction is not well understood, improved subjective wellbeing has been associated with the presence of personal goal setting, structured mentoring and life coaching, good interpersonal relationships, the promotion of gratitude, and the presence of extracurricular activities, suggesting these are all areas that may form an appropriate focus for school-based interventions (Bird & Markle, 2012).

Alternative subjective measures of wellbeing focusing on the school environment that have been employed in research include direct measures of self-rated health and perceived academic performance, and reported opportunities for participation and engagement in the development of school rules and policies (de Róiste et al., 2012). These contrast with the more objective indicators commonly employed in the public health literature that include measures of mental health status, participation in risky behaviors and associated injury rates, and physical activity and dietary behaviors. Although subjective and objective indicators may not necessarily be associated with each other there is good evidence that achieving high levels of subjective wellbeing may be associated with improved objective outcomes. For example, using data from the Scandinavian HBSC Study, Samdal, Wold, Klepf, and Kannas (2000) reported low-level autonomy to be the most important school environment predictor of pupils' smoking and alcohol use, and Murphey, Lamonda, Carney, and Duncan (2004) found that better involvement in school decision making was associated with increased odds of engaging in safety behaviors among a sample of Vermont high-school students.

A methodological issue that all studies face when attempting to identify the role of the school as a determinant of pupils' wellbeing, however it is defined, is that it is difficult to disentangle the effect of the influence of the school itself from that of the context within which it operates. Numerous studies, often employing multilevel modeling statistical methodologies, have found that school attended is a statistically significant predictor of unexplained variation in a range of subjective, physical, and mental-health-related outcomes (Hill & Rowe, 1996). A simple explanation for this observation is that certain unmeasured features of the organizational or physical structure of the school are acting as either positive or detrimental drivers of these outcomes. Yet one of the mechanisms that has been suggested to drive observed school-level effects is the "contagion theory" (Jencks & Mayer, 1990). Under this, the socioeconomic composition of a school neighborhood will determine the kind of behavioral norms that are transmitted at school through peer influence. Accordingly, the school

neighborhood will influence the social composition of the school and thus determine the key educational orientations and ethos of the school (Saab & Klinger, 2010). For example, Le Blanc, Swisher, Vitaro, and Tremblay (2008) showed how students with behavioral problems tended to reinforce each other's behaviors when they were located in the same school, leading the authors to conclude that the level of problem behaviors in a school may in fact be more influenced by the composition of the student body than the nature of the school environment itself.

Despite the difficulties in determining the causality of observed differences in wellbeing outcomes between schools, schools are in no way a unique environment in the means by which their composition is influenced by external and largely uncontrollable factors. By better understanding the components of the school environment that influence wellbeing, schools will be more empowered to modify, at least in part, those parts of their context that are most amenable to change, and subsequently the potential for successful interventions in the school environment will be maximized.

The School Environment, Bullying, and Mental Health

Since the early work of Olweus (1978), school bullying has been identified as one of the most serious acute problems that school-aged children face. Bullying may be defined in general terms as the systematic abuse of power (Rigby, 2011). It presupposes an imbalance in power in which the perpetrator(s) repeatedly engage in aggressive behavior intended to hurt or threaten a targeted person or persons. Surveys have shown that the proportion of school-aged children who report being bullied more than once or twice in a term is particularly consistent across countries, ranging from 19% in England to 14% in Norway (Ng & Tsang, 2008). Yet there is now considerable evidence to suggest that bullying is linked to both social and psychological difficulties among pupils, some of which can be long-lasting and persist into adulthood (Bibou-Nakou, Tsiantis, Assimopoulos, Chatzilambou, & Giannakopoulou, 2012).

Much research has been undertaken to identify the characteristics of individuals that predispose them to either being bullies or being bullied. Using an ecological system analysis to better understand factors associated with bullying and victimization, Hong and Espelage (2012) show that important individual factors include age, gender, race/ethnicity, and sexual orientation. Their work also identifies a number of contextual components

of the school environment as being potential determinants of the prevalence of bullying. In terms of the social environment of the school, youths expressing lower levels of connectedness with the school have been found to be significantly more likely to be involved in bullying (Glew, Fan, Katon, Rivara, & Kernic, 2005). Kuperminc, Leadbeater, Emmons, and Blatt (1997) have also shown that pupils expressing positive perceptions of their school environment are less likely to exhibit behaviors such as aggression. From an organizational perspective a number of studies report that negative school environmental factors, such as lower levels of adult supervision, can reduce the likelihood of pupils reporting they feel safe in the school as well as increasing the frequency of bullying (Meyer-Adams & Conner, 2008).

Because schools are embedded in neighborhoods, an unsafe neighborhood environment can influence bullying behavior via inadequate adult supervision or negative peer influences (Hong & Espelage, 2012). Although rather little research has been undertaken in this field those studies that have been published have consistently shown that youths residing in unsafe neighborhoods around schools are more likely to experience bullying victimization while on school grounds (Khoury-Kassabri, Benbenishty, Avi Astor, & Zeira, 2004), and that these neighborhoods hence tend to reflect a wider social environment where bullying and violence occur (Espelage, Bosworth, & Simon, 2000). Interestingly, little or no research appears to have examined how factors such as the design of school buildings and grounds influence the prevalence of bullying in the school. This is perhaps surprising given the well-understood associations between incivilities and features of neighborhood and housing design. Given that many of the interventions thus far implemented to reduce the prevalence of bullying have failed (Rigby, 2011) there may be additional benefits in putting more thought to the design of school buildings and school grounds to create a more open and inclusive environment where bullying behaviors are difficult to practice.

Accidents in the School Environment

Accidental injuries in childhood are a major health problem, one that is increasing in prevalence (Schalamon et al., 2007). Indeed, accidents and injuries are the leading cause of morbidity and mortality in school-aged children (Towner, et al., Jarvis, Walsh, & Aynsley-Green 1994). It has been estimated that between 20 and 30% of all injuries in children of school age occur while at school (Stark, Wright, Shiroyama, & Lee, 1997) and

despite the fact that children receive greater levels of supervision while in the school environment the evidence suggests that being at school does not reduce their chance of accidental injury (Maitra & Sweeney, 1996). Despite the considerable potential importance of the school environment as a determinant of accidents in childhood, attention has only been focused on the drivers of school accidents since the early 1990s (Kraus et al., 2011). Many publications have provided descriptive data, focusing on pupil age and gender, yet few have gone beyond this.

Designing and managing school environments so as to minimize accident risk requires a fine balance between the maintenance of safety and allowing children to participate in one of the joys of childhood, namely activities which carry a certain element of risk. Although we suggest elsewhere in this chapter that the promotion of physical activity in school children is desirable for a number of reasons, a consequence of such an approach will be an increase in accident risk, as it is well established that the most prevalent category of school accidents are those of a sporting nature. Indeed, in a recent 5-year evaluation of school accidents in Germany, almost 40% of incidents were associated with sports activities (Kraus et al., 2011). Kelm et al. (2004) found that annually 5% of all pupils sustained an injury during sport. However, very few studies have examined how other components of the school environment might be associated with accident risk.

Kraus et al. (2011) showed that next to those occurring during sports, the playground was the second most common venue for accidents, with 26% occurring in that location. However, the importance of this venue was strongly associated with the age of pupils. Among younger children (5–8 years) 44% of accidents occurred in the playground, whereas this figure fell to just 2.8% among those aged over 17 years. Conversely, among this older cohort 26% of accidents occurred on the route to or from the school, with this figure falling to 14% among younger children. These disparities reflect how children's use of different components of the school environment changes as they get older.

A study of over 3,000 school accidents among children aged 7–15 in a region of Poland by Sosnowska and Kostka (2003) represents one of the few attempts to examine the association of broader characteristics of the school environment with accident risk. They found that the incidence of accidents was higher in schools situated in an urban environment, those with a greater number of classes, with longer hours, with a gymnasium, and with a school yard. Interestingly, even when only accidents occurring during physical education (PE) classes were considered, those schools

equipped with a gymnasium saw the highest rates, a possibly surprising finding given that a gymnasium might be considered a more controlled and hence safer environment within which to practice sport. Furthermore, no association was observed with staff/student ratios. The authors concluded that school gymnasia should form the primary target for prevention activity.

Although it would be possible to reduce accident rates by eliminating sports and forbidding active play during break times, doing so would clearly be detrimental to children's overall development. Hence the key is to identify which components of the school environment might be amenable to sensitive modification so as to achieve reductions in risk while still allowing children to participate in sports and play, both activities that have been shown to enhance their general wellbeing.

The School and Children's Weight Status

The prevalence of childhood obesity increased dramatically during the latter part of the twentieth century (Wang & Lobstein, 2006). Due to the health consequences of obesity (Dietz, 1998; Maffeis & Tato, 2001; Reilly, 2005), and its potential to track from childhood into adulthood (Freedman et al., 2005), there is great interest in preventing the acquisition of excess body fat in children (Department of Health, 2010). The rapid speed of the recent rise in obesity rates suggest environmental causes, and the fact that children spend much time at school and can undertake a significant amount of their physical activity and eating behaviors in the school environment highlights the potential importance of school. Taking the example of food provision, lunches consumed at school can make a significant contribution to daily food intake, providing between 25 and 33% of energy intake among primary-school-aged children (Ruxton, Kirk, & Belton, 1996). Hence improvements in the quality of school lunches may have a positive impact on overall diet, potentially leading to improved health outcomes. Indeed, in adolescents, significant differences have been observed in some cardiovascular risk factors between children usually eating school meals, who appear to have slightly improved risk profiles, and those eating packed lunches brought from home (Whincup, Owen, Sattar, & Cook, 2005). Yet food consumed at school, and its potential association with childhood obesity, has received much negative attention from the media, with particular emphasis on the quality of meals provided by school canteens (Burgess, 2010). Taking the example

of the United Kingdom, this has led to a policy shift where in 2006 the Government announced new standards for school food. Determined by the School Food Trust, these included the introduction of interim food-based standards for lunches provided by schools. These replaced previous food-based standards which had been introduced in 2001, prior to which no government guidelines or compulsory standards had been in place (Nelson, Lowes, & Hwang, 2007).

Although it is easy to criticize the school as a cause of childhood obesity, schools also supply a potentially very important avenue for improving well-being via health promotion around physical activity and dietary behaviors. The provision of meals, the availability of physical activity facilities, and the design of the learning environment all provide unequaled opportunities to promote good weight management via healthy eating and increased physical activity (Peterson & Fox, 2007; Story, 1999).

A significant number of school-based interventions have been trialed to increase physical activity levels or improve diet. The most commonly cited include Planet Health (Gortmaker et al., 1999), Pathways (Caballero et al., 2003), APPLES (Sahota et al., 2001), and Child and Adolescent Trial for Cardiovascular Health (CATCH) (Coleman et al., 2005; Nader et al., 1999). These four interventions are largely curriculum-based, with participating schools giving targeted lessons with aims including reducing TV viewing, increasing participation in moderate to vigorous physical activity (MVPA), reducing the consumption of high-fat foods, and including additional PE lessons in the timetable. A curriculum focus is common among these programs, with those informed by behavioral choice and social-cognitive theory particularly being designed to provide pupils with the cognitive and behavioral skills required to change behavior (Gortmaker et al., 1999). However, whereas some modifications in dietary intakes have been observed, only Planet Health reported a reduction in any measure of body fat among those receiving the intervention.

The mixed nature of the results of the four studies is seen across other school-based interventions; some have seen little or no change in adiposity outcomes or behavior changes, and success varies by outcome measure used, gender, ethnicity, and age group. Several commentators have suggested potential reasons, including a lack of theoretical basis for interventions (Lissau, 2006; Shaya, Flores, Gbarayor, & Wang, 2008; Thomas, 2006), the limited time over which intervention and follow-up are run (Budd & Volpe, 2006; Ritchie, Crawford, Hoelscher, & Sothern, 2006; Sharma, 2006; Thomas, 2006; Zenzen & Kridli, 2009), little parental involvement

(Budd & Volpe, 2006; Sharma, 2006; Thomas, 2006; Zenzen & Kridli, 2009), the choice of inappropriate outcome measures (Lissau, 2006), and lack of specificity in analyses (e.g., the intervention may vary in its success by gender, race, or age) (Doak, Visscher, Renders, & Seidell, 2006; Ritchie et al., 2006; Thomas, 2006).

School social and policy environments must be considered when planning interventions. Staff supervision has been seen to improve physical activity levels (Sallis et al., 2001) and many school-food environment interventions have included changes to both food provision and additions to the curriculum.

One important consideration is that curriculum-based interventions are dependent on the motivation, quality, and training of school staff, and their ability to deliver programs consistently. Programs must find space in already full curricula, and time and financial concerns may limit their success and sustainability (Doak et al., 2006; Lissau, 2006; Peterson & Fox, 2007; Sharma, 2006; Thomas, 2006). Another potential downside of the curriculum based approach, and a failing noted among many school-based interventions, is the lack of consideration for adverse effects (Doak et al., 2006; Ritchie et al., 2006; Shaya et al., 2008). Where interventions stress the importance of weight loss and the consequences of overweight and obesity they may increase the stigmatization of already overweight children (Doak et al., 2006), especially when targeted at the overweight or those deemed at risk of overweight (Ritchie et al., 2006).

A criticism that could be directed at many school-based interventions is the lack of attention paid to the school environment. Yet, despite a growing number of studies examining the relationship between children's adiposity and elements of the school environment, it remains unclear which components are most important. This may be in part due to the complexity of the school environment and the range of opportunities related to the physical structure of the school, its environment, and the policies implemented within it which might impact both food consumption and physical activity. While the term "environment" in its broadest sense may certainly include lesson content, reviewers have stressed the importance of a more ambitious scope. For example, in their review of obesity-prevention interventions and programs, Doak et al. (2006) highlight the difference between teaching children that they should be more active and eat more fruit and vegetables, and actually giving them the opportunity in terms of time, space, and facilities to do so, recommending that interventions should "directly alter the physical or social environment."

Much cross-sectional work has tended to focus on individual elements of the school environment, such as PE requirements (Cawley, Meyerhoefer, & Newhouse, 2007) and the use of school food canteens (Finch, Sutherland, Harrison, & Collins, 2006), or school classifications such as state versus private funding (Ramos & Barros, 2007), and the ethnicity and parental education of the student body (O'Malley, Johnston, Delva, Bachman, & Schulenberg, 2007). It is, however, noteworthy that such studies have reported rather few associations with children's weight status, although a limited number of factors have been associated with an increased risk of overweight or obesity, including menus offering french fries or desserts at least once a week (Fox, Dodd, Wilson, & Gleason, 2009), school practices that offer more opportunities for the consumption of food (Kubik, Lytle, & Story, 2005), lower average socioeconomic status of the student body as measured by parental education (O'Malley et al., 2007), and household income (Richmond & Subramanian, 2008). Meanwhile, increased participation in school-sponsored sports (Elkins, Cohen, Koralewicz, & Taylor, 2004), participation in school breakfast programs (Gleason & Dodd, 2009), and strict healthy eating promotion policies (Veugelers & Fitzgerald, 2005) have been associated with a decreased risk of overweight and obesity.

It is certainly the case that investigation of associations with individual elements of the school environment has provided some important evidence on features of the school that may be amenable to intervention with regard to physical activity and dietary behaviors. However, the school is a complex system and the investigation of individual elements is problematic because a narrow view of the role of individual components may not provide adequate information to guide interventions within the whole system. In particular there is a risk of failing to capture the importance of key interactions between different components, not only of the environment in the school but also of how the school environment interacts with the broader social and physical environment within which it is situated. We have previously argued that taking a more holistic, ecological approach to understanding the influences of the food environment on children's adiposity may be beneficial (Harrison & Jones, 2012). An ecological approach to public health assumes that an individual's good health requires a supportive environment—one that provides the conditions to create and maintain good health, and which supports communities and individuals in making healthy choices (Kickbusch, 1989)—and the ecological model has been developed with respect to obesity. Egger and Swinburn (1997) coined the term "obesogenic environments" and propose that the environment and

individual biology influence behavior and therefore intake and expenditure of energy. It is important to consider the relevance of this context to the school environment.

It is suggested that by adopting a broader environmental approached, rooted in ecological theory, school-based interventions for the prevention of obesity may be more successful. We have previously published a conceptual framework, based on an ecological approach, that describes the manner by which components of the food environment may be associated with child adiposity (Harrison & Jones, 2012). The framework, depicted in Figure 12.1, is centred on the three domains of the physical school environment; neighborhood, grounds, and facilities, and highlights the associations they have with health behaviors. In Figure 12.1, the links drawn between specific elements of the physical school environments and health outcomes indicate the strength of evidence found for associations; bold lines indicate significant interventions effects, thin lines show where cross-sectional evidence of a statistically significant association exists, and dashed lines demonstrate where associations are hypothesized, but have not been investigated. In the following sections we discuss the current evidence on the importance of the school environment that underlies the different components of the framework.

The School Neighborhood as a Physical Activity Environment

Neighborhood factors do not necessarily provide easy opportunities for planned interventions, but longitudinal work following children as they move schools may help clarify associations, and natural experiments (such as the building of new schools, or significant developments in the food or physical activity environment around existing schools) could be exploited. There is also the need for work that considers measurement of both neighborhood food and physical activity environments, including factors such as crime, land-use mix, access to green spaces, and physical activity facilities, which have all been studied in relation to the home neighborhood, but not that of the school (De Vet, de Ridder, & de Wit, 2011).

The literature investigating the role of the school neighborhood as a potential determinant of physical activity is largely focused on associations with walking and cycling to school, behaviors which can make a significant contribution to overall physical activity levels (van Sluijs et al., 2009).

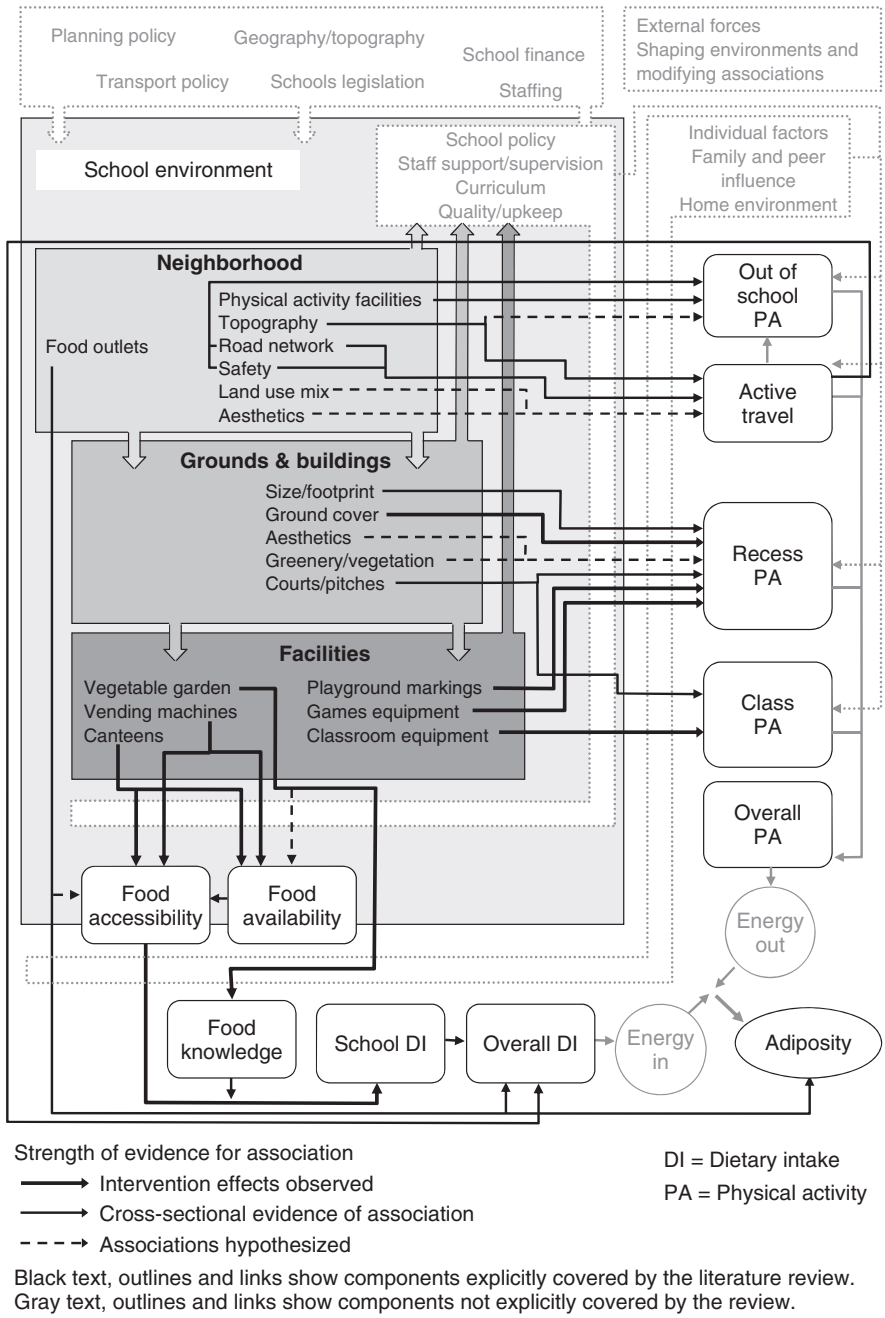

Figure 12.1. Conceptual Framework for Associations between the Physical Environments of School and Diet Physical Activity and Adiposity. From Harrison and Jones, (2012).

The characteristics of the school neighborhood and the routes to school taken within it that are most studied are related to the road network, encompassing elements of both safety and connectivity. The presence of a main road on the route to school has been seen to reduce the likelihood of active travel (Panter, Jones, van Sluijs, & Griffin, 2010; Timperio et al., 2006), as have less connective routes with fewer intersections (Schlossberg, Greene, Phillips, Johnson, & Parker, 2006). Conversely the presence of sidewalks in school neighborhoods and higher residential density has been associated with increased odds of active travel (Dalton et al., 2011). In addition the topography of a neighborhood may affect active travel behavior, with less walking and cycling seen where steep roads are present (Timperio et al., 2006).

Rather little work has looked at school neighborhood characteristics and their associations with physical activity rather than travel mode. Focusing on the immediate surroundings of the school, Jones et al. (2010) found that children attending schools with the best nearby provision for walking and cycling (e.g., cycle lanes, traffic calming) spent more time in MVPA during commuting times to and from school compared to those at schools with the worst provision. Trilk et al. (2011) investigated the association between physical activity facilities in school neighborhoods and overall physical activity. They found that girls at schools with more than five physical activity facilities nearby were more active than those at schools with fewer facilities.

Changes to school neighborhoods may require input at a national or local policy level, which may, for example, limit the siting of unhealthy food outlets near schools, or improve road safety. While individual schools themselves may not have a great impact on their physical neighborhood, an awareness of the barriers and enablers of healthy behaviors in their neighborhoods may aid schools in developing policies and curricula to improve health outcomes. For example, in one study secondary school pupils who were allowed to leave the school grounds at lunch time were seen to be more likely to eat at fast-food restaurants than those kept at school (Neumark-Sztainer, French, Hannan, Story, & Fulkerson, 2005).

The School Neighborhood as a Food Environment

Somewhat limited evidence exists for the influence of the food environment of school neighborhoods on diet and adiposity. The presence of fast-food restaurants near schools, which theoretically increase the accessibility of

fast-foodstuffs, has been associated with less healthy food intakes (more soda, less fruit and vegetables) and with increased likelihood of overweight or obesity (Davis & Carpenter, 2009). However, some studies have found no relationship between obesity and dietary intake and the presence of food outlets near schools. For example, Seliske, Pickett, Boyce, and Janssen (2009) found no association between obesity and the presence of specific food outlets although they did find a counterintuitive association whereby children at schools with generally more food outlets nearby were less likely to be obese, while Laska, Hearst, Forsyth, Pasch, and Lytle (2010) found some associations between dietary intake and food outlets in the home neighborhood, with increased body mass index (BMI) *z* score, percentage body fat, and sugary drink consumption among those living near restaurants, grocery stores, convenience stores, and other retail outlets. A further determinant of the accessibility of food in the school neighborhood is the means by which children travel to school, as it may be expected that those who walk and cycle would be more exposed to outlets around the school, and, indeed, greater confectionery consumption has been seen among secondary school children who walked or cycled to school compared to those traveling by car (New & Livingstone, 2003).

The Role of School Grounds and Design in Facilitating Physical Activity

School grounds are typically described by their size, the types of surfaces they include, and the types of spaces (e.g., courts, playing fields) they provide. The provision of greater outdoor space per child has been associated with increases in break-time physical activity measured in both preschool children (Cardon, Van Cauwenberghe, Labarque, Haerens, & de Bourdeaudhuij, 2008) and adolescents (Cradock, Melly, Allen, Morris, & Gortmaker, 2007). Similarly, building area per child has also been associated with increased movement (Cradock et al., 2007) and time spent in MVPA (Cohen, Scott, Wang, McKenzie, & Porter, 2008). Beyond the size of a school's grounds, the types of surfaces present may have an impact on their suitability for physical activity. The presence of vegetation, or "greened" areas such as woodland, wildlife gardens, or vegetable plots has been hypothesized to be a potential stimulus for physical activity. A study by Dyment and Bell (2008) found teachers reported that, while vigorous activity was more likely to occur in the turf and asphalt areas of their grounds, greened areas

supported more moderate and light activity, and they had the impression that the physical activity levels of their pupils had increased as a result of school ground greening. However, this has not been empirically tested, and some cross-sectional work has shown no association between the presence of vegetation and step counts in preschool children (Cardon et al., 2008).

Traditional surfaces in school grounds are grass fields and hard courts/playgrounds, both of which may have markings for games and sports. Qualitative work has suggested that children have a preference for grass surfaces over hard ones, but has also identified bitumen with court or line markings or fixed equipment as particularly suitable for active play (Willenberg et al., 2010). Better-designed grounds (based on a composite measure including the slope of the grounds, their suitability for sports, informal games and general play, and the presence of hard playgrounds) have been associated with increased recess MVPA (Jones et al., 2010), as has the presence of individual features including marked, hard-surface courts (Sallis et al., 2001), playing fields (Nichol, Pickett, & Janssen, 2009), and indoor gymnasia (Nichol et al., 2009). These components of the school grounds may provide the space children need in which to be active, but may also provide support for activity-promoting curricula; schools with gymnasia have been found to provided significantly more PE time than those without (Fernandes & Sturm, 2009).

In a novel study combining accelerometry and GPS measurements, Fjørtoft, Löfman, and Halvorsen Thorén (2010) found that activity across the majority of school grounds was of a low intensity, and that it occurred mostly near to the school buildings. However, they saw clusters of moderate and vigorous activity on sports pitches, especially around a handball goal. Evidence that the design of school grounds can influence physical activity also comes from an intervention study. Ridgers, Stratton, Fairclough, and Twisk (2007) found that when playgrounds were redeveloped to include differently colored zones designed for sports, multiactivity, and quiet play, pupils were seen to participate in significantly more recess-time MVPA and vigorous physical activity (VPA) than children at control schools. The effect of the intervention on MVPA was greater among younger children, and at schools with longer recess periods, while the effect of increased VPA strengthened with time, being greater 6 months postintervention than 6 weeks. It is noteworthy that relationships between grounds components and physical activity are commonly seen to vary by gender (Jones et al., 2010; Nichol et al., 2009; Sallis et al., 2001) and age (Nichol et al., 2009), and to

be influenced by the quality of the grounds (Nichol et al., 2009; Sallis et al., 2001) and the level of supervision provided (Sallis et al., 2001).

The redesigning of school grounds has shown promise in improving physical activity levels, although more longitudinal and controlled intervention studies in this area may help better define which specific aspects of the environment may best promote physical activity. It appears that providing a range of play spaces, with room for competitive games, informal play, and lighter-intensity activity may prove most effective in increasing activity levels across age and sex groups.

School Facilities for Physically Active Children

Several studies have looked at associations between the facilities present at a school and physical activity outcomes. Qualitative work has suggested that lack of playground equipment is a barrier to participation in physical activity in the school setting (Thompson et al., 2001). This observation is supported by several cross-sectional studies which have seen a positive association between the number of facilities and amount of equipment available, and physical activity at school (Haug, Torsheim, Sallis, & Samdal, 2010; Haug, Torsheim, & Samdal, 2008; Jones et al., 2010; McKenzie, Crespo, Baquero, & Elder, 2010; Nielsen, Taylor, Williams, & Mann, 2010; Taylor et al., 2011; van Sluijs et al., 2011). This relationship has been reported in girls (Haug et al., 2010) and boys (Jones et al., 2010) and at both primary (Haug et al., 2010; Jones et al., 2010; McKenzie et al., 2010; Nielsen et al., 2010; Taylor et al., 2011; van Sluijs et al., 2011) and secondary (Haug et al., 2008) schools. We note, however, that studies vary greatly in what they define as a physical activity facility; there is some overlap with school grounds components (e.g., playing fields), and some facilities are region- and season-specific (e.g., sledding hills).

The provision of games equipment for use at break has seen some success in interventions to increase physical activity. Some researchers have reported significant intervention effects of increased time spent in MVPA at recess after the introduction of additional games equipment (Haerens, de Bourdeaudhuij, Maes, Cardon, & Deforche, 2007; Verstraete, Cardon, de Clercq, & de Bourdeaudhuij, 2006). Haerens, de Bourdeaudhuij, Maes, Cardon, et al. (2007) further found that a group receiving an intervention that included parental support showed more MVPA and a smaller increase in BMI *z* score than either the control group receiving nothing or those

receiving the intervention without parental support. Another physical activity facility which has been trialed in an intervention setting is the painting of bright markings on hard-surface playgrounds. Two studies (one a development from the other) have shown increases compared to control schools in the time spent in recess MVPA and VPA after playgrounds were painted with multicolored markings (Stratton, 2000; Stratton & Mullan, 2005).

Lanningham-Foster et al. (2008) devised a new, active-permissive classroom environment ("the Neighborhood") which included standing desks, wireless laptops, portable video display units, and mobile whiteboards to allow for active lessons, and activity-promoting games. Children were allowed to move throughout the Neighborhood during lessons. Physical activity recorded in the Neighborhood (mean activity 115 m/s^2) was comparable to that observed during free-living measurements in the school holiday (113 m/s^2), and significantly higher than that seen in a traditional classroom (71 m/s^2).

The Role of the School in Food Provision

There are two broad areas of research concerning the role of food environment facilities in schools. The first covers the impact of school fruit and vegetable gardens as aids in teaching children about nutrition and healthy eating. The use of school gardens has been associated with increases in fruit and vegetable recognition, willingness to taste, and preference (Cason, 1999; Morris, Neustadter, & Zidenberg-Cherr, 2001). In intervention studies, the provision of nutritional education coupled with practical gardening lessons in a school garden has been seen to significantly increase children's preferences for vegetables (Morris & Zidenberg-Cherr, 2002), as well as their fruit and vegetable intakes, compared to both control and nutrition education only groups (McAleese & Rankin, 2007).

By far the larger area of study is that concerning the availability and accessibility of food from school canteens and vending machines. Different foods may be made available from these sources, and their prices, promotion, location within the school, and opening times in turn influence accessibility. In qualitative research, children have identified availability, choice, cost, and time and effort (accessibility) involved in obtaining food as barriers to eating a healthful diet (McKinley et al., 2005). This suggests that changing these parameters may in turn influence diet and ultimately weight status.

Vending machines offer children easy, unsupervised access to food and drinks. Their use has been associated with increased consumption of sugary drinks (Wiecha, Finkelstein, Troped, Fragala, & Peterson, 2006), confectionary, and fried foods (Thompson, Yaroch, Moser, Finney Rutten, & Agurs-Collins, 2010) while their presence in schools has been associated with lower consumption of fruit (Kubik, Lytle, Hannan, Perry, & Story, 2003), increased snack food purchasing (Neumark-Sztainer et al., 2005), and the consumption of snacks in place of lunch (Park, Sappenfield, Huang, Sherry, & Bensyl, 2010). Vending machines selling low-nutrient, energy-dense foods near canteens have been associated with greater likelihood of obesity in middle-school children (Fox et al., 2009). However, vending machines also offer opportunities to positively influence diet. Rovner, Nansel, Wang, and Iannotti (2011) found that children ate more of the types of foods their schools provided in vending machines, be they healthier (fruit and vegetables) or less healthy (sweets). The cost of snacks available from them has been seen to influence purchasing patterns outside schools (French, Jeffery, Story, Hannan, & Snyder, 1997), while changing the contents of vending machines from snacks higher in sugar and fat to healthier options (e.g., dried fruit) is seen as a viable option for schools, and as an acceptable change to both staff and students (Davee et al., 2005). Children at schools where soft-drink vending machines are turned off at lunchtime have also been seen to purchase fewer soft drinks than those at schools where machines are left on (Neumark-Sztainer et al., 2005), and French et al. (2001) saw sales of low-fat snacks from vending machines in secondary schools and workplaces increase from 25.7 to 45.8% as a percentage of all snack sales when their price was reduced.

Food provision in school canteens has been associated with a variety of dietary outcomes. Kubik et al. (2003) report poorer diets in pupils at schools with à la carte lunch programs, and an inverse relationship between the serving of fried potatoes and the consumption of fruit and vegetables. In elementary school children the odds of obesity have been seen to be higher at schools where fried potatoes and/or desserts are offered more than once a week (Fox et al., 2009). Changes in the availability of foods at school lunch time have also been associated with diet quality. Cullen and Zakeri (2004) followed a group of children as they moved from an elementary school serving a fixed lunch menu to a middle school where an à la carte menu and snack bar allowed a greater range of meal choices. They reported significant reductions in the consumption of fruits, vegetables, and milk and

increases in intake of sweetened beverages and high-fat vegetables in the pupils in the first year of middle school.

The impact of altering food availability and accessibility in schools has been tested in several interventions to improve diet and reduce obesity. The CATCH study, which modified food provided by schools as well as implementing additional health curricula, saw significantly greater decreases in percentage energy intake from fat in the diet of pupils at intervention schools than at control schools (Luepker et al., 1996), an outcome similar to the Pathways intervention (Caballero et al., 2003). In interventions focused on the intake of specific food types, Prell, Berg, Jonsson, and Lissner (2005) saw an increase in fish consumption at intervention schools where relevant changes were made to both the home economics curriculum and school meal provision, but Haerens, de Bourdeaudhuij, Maes, Vereecken, et al. (2007) saw no change in the consumption of fruit, soft drinks, or water following an intervention specifically targeting the provision and cost of these items. It is noteworthy that these interventions, and others which have included a food service component (Coleman et al., 2005; Sahota et al., 2001), have also provided additional health and nutrition education to pupils, and in some cases have also involved parents and families (Caballero et al., 2003; Haerens, de Bourdeaudhuij, Maes, Vereecken, et al., 2007), making it difficult to determine the contribution of food service changes to intervention outcomes.

Concluding Comments: Building Schools to Maximize Wellbeing

This chapter has illustrated how there is ample evidence of the potential of the school environment to maximize the wellbeing of its pupils, yet changing that environment to achieve that goal can be difficult. This is particularly so in situations where modifications may seem at odds with the principal school goals of maximizing academic achievement. Indeed, a key conclusion consistently reached from the last two decades of work on initiatives to promote health and wellbeing in schools is that progress is slow and sustainability difficult to achieve (Rowling, 2009). Nevertheless, learning from the literature suggests there is considerable potential for change.

The precise components of a school environment that are required to maximize pupil wellbeing will undoubtedly be outcome-dependent. To improve components of subjective wellbeing, for example, evidence suggests

that school curricula should take efforts to increase parental involvement in pupils' lives, both inside and outside the school environment, and that extracurricular activities should be provided in school after the end of the school day, particularly for those children who will be without adult supervision immediately after school (Bird & Markle, 2012). More generally, the development of social environments at the school within which children feel listened to may not only improve academic attainment but also deliver a range of broader benefits to wellbeing (de Róiste et al., 2012). For example, the adoption of "pupil voice" approaches, nested within broader principles of pupil participation that entail listening and responding to what pupils say about their experiences as learners, has been shown to lead to a range of positive wellbeing developments in classroom environments (Flutter, 2007).

When dietary and physical activity behaviors are considered, changes required need to be both structural and organizational in nature. Although schools alone cannot solve the childhood obesity epidemic, it is unlikely that increases in the prevalence of childhood obesity can be reversed without strong school-based initiatives to support healthy eating and physical activity (Story, Nanney, & Schwartz, 2009). Restricting the range of food options available to children within the school environment and limiting those that are provided to more healthy choices is an obvious potential target, although there can be resistance to change due to concerns over the impact that such approaches may have on school incomes. There is consistent evidence that the implementation of school breakfast programs can have positive effects on pupils' dietary quality and on their subsequent academic performance, although the extent to which academic improvements are driven by increased time at school rather than improved nutrition is less well understood (Hoyland, Dye, & Lawton, 2009). From a physical activity perspective, the provision of high-quality PE programs is undoubtedly important, but it must also be recognized that, particularly among younger children, active play in the school playground makes a considerable contribution to overall physical activity levels (Brockman, Jago, & Fox, 2010). Recent work has highlighted just how significantly school policy toward outdoor play can affect the amount of activity that children are able to accrue during the school day (Harrison, Jones, Bentham, et al., 2011), and hence opportunities need to be identified to allow children to be physically active throughout the day rather than simply during PE lessons.

Just as ecological system models have commonly been used to identify those components of the school that appear to most influence wellbeing, it seems logical that attempts to maximize wellbeing might be most successful

when taking an ecological whole-school approach (Dix, Slee, Lawson, & Keeves, 2012). Examples of such approaches include the Gatehouse Project in Australia which was a primary prevention program including both institutional and individual components to promote the emotional and behavioral wellbeing of young people in secondary schools. Evaluation of that found consistent and positive effects on risk behaviors and tobacco and alcohol abuse, although changes in depressive symptoms and social and school relationships appeared more resilient to change, highlighting the difficulties of intervention implementation (Bond et al., 2004).

Weare and Markham (2005) identified nine elements of an effective whole-school approach for improving pupil wellbeing. While the authors use a case study of mental wellbeing, it is likely that these apply to other wellbeing domains. The key elements of Weare and Markham's approach are the development of a holistic model of health, a concern with several aspects of the school, a consideration of environmental determinants, work with relevant parties at all levels, inclusion of caregivers as well as pupils, the exhibition of congruence between the various program parts, the promotion of coherence, a focus on processes as well as outcomes, and the facilitation of different types of skills. The work not only highlights the considerable potential of such programs to induce change, but also the difficulties that must be overcome to achieve successful program implementation. Indeed a major limitation to the implementation of such interventions is their inherent complexity, and that making sustained changes to school environments requires a long-term commitment by both schools and communities and an understanding that effective interventions are unlikely to be short-term quick-fix solutions. Indeed, the Gatehouse Project showed how successful approaches need a strong interface between health and education at all levels within a school, and therefore require sustained multisectorial support (Bond et al., 2004), something that can be difficult to achieve, particularly in challenging economic times where funders have limited budgets and short funding horizons.

In this chapter we have reviewed the evidence for the school environment as a determinant of wellbeing. Given that children spend a large amount of time during their formative years we have shown how the environment of the school can strongly influence their wellbeing and how associations developed during childhood and adolescence can track through into adulthood. Maximization of academic performance will undoubtedly, and appropriately, continue to be a primary goal of schools. Yet we hope that the change in emphasis already observed, where a focus on test scores is joined by a

broader recognition of the school impact on pupil wellbeing, continues. We suggest that the beneficial effects on future generations of both young people and adults will be substantial.

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13

The Built Housing Environment, Wellbeing, and Older People

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Introduction

This chapter draws on research evidence to explore the impact of the built housing environment on older people's wellbeing with insights from the U.K. context. It presents an overview of

- important factors that affect wellbeing and how they related to housing;
- the sorts of accommodation in which older people live and their suitability;
- essential design features that are needed to provide accommodation that older people want and can use, and which will remain supportive as they get older;
- approaches and standards that promote aging in place.

The focus is on mainstream and specialist housing. It does not include care and residential homes, which are generally not considered as "housing" since they do not provide self-contained accommodation, tenancy, or ownership rights.

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The Importance of Older People

People continue to make significant social, community, financial, political, and economic contributions well into old age, be it as workers, volunteers, voters,[1] family members, or carers (Communities and Local Government Publications [CLG], 2008). Indeed, around 12% of people of pensionable age (1.3 million) carry on in paid work, and it is estimated that over 60s in the United Kingdom contribute the equivalent of up to £50 billion per year providing unpaid family care. There is growing recognition that such contributions need to be supported through changes in attitudes, practices and policies so that people are even more empowered to continue to participate as citizens with full rights, and are able to age with security and dignity (Tanner, Tilse, & de Jonge, 2008).

Older people in the United Kingdom, as in many parts of the world, are a growing section of the population. Projections from 2010 indicate that over the next 25 years the proportion of over 65s living in the United Kingdom is set to rise from 17 to 23%, and numbers in the oldest age groups, those over 85, will grow the fastest. These trends are fueled by rising life expectancy and the Baby Boomer generation coming into its third age. Boys born in the United Kingdom between 2008 and 2010 can now expect, on average, to live to 78 years and girls to 82 years. At the same time, the number of people in the United Kingdom living beyond 100 years of age is multiplying and a third of babies born in 2012 in the United Kingdom are expected to live to 100 (Office for National Statistics, 2012). The number of centenarians is expected to rise above 100,000 by 2035 from around 14,500 in 2012.

Unfortunately, however, longer lives do not necessarily mean healthier lives. As longevity increases many of us are experiencing more time with ill health. Christensen, Doblhammer, Rau, & Vaupel (2009) estimate the number of people over 65 living with long-term limiting illness will increase by 39% over the period 2008–2025. One of the reasons for this is the increased prevalence of dementia because as people move into older age their risk of developing some kind of cognitive impairment increases dramatically. By the age of 80 one in five people have some form of dementia. In the United Kingdom it is expected that over 1 million people will be living with dementia by 2025. Old age also brings an increased risk of disability. In England a two-fold increase is predicted in the numbers of older disabled people between 2002 and 2041, from 2.3 million to 4.6 million (CLG, 2008).

Such changes will affect people's needs, expectations, and aspirations regarding housing and any support they might need to remain in their homes. So will the increasing diversity of the older population, which includes growing numbers from black and minority ethnic groups, each having their own particular needs and preferences. Changes in wealth status in the older population is yet another significant factor. Two thirds of home owners over 60 have an income of less than £10,000 a year and around a quarter of older people are now living below the poverty line. A large proportion of these are income-poor but asset-rich: older people in the United Kingdom are most likely to be owner-occupiers; around 67% of over-65-year-olds own their own homes outright. These households have the largest proportion classified as "vulnerable" (where occupiers are receiving principal means-tested and disability-related benefits) compared to other property tenures.

In stark contrast, a growing proportion of the older population has become increasingly wealthy to the extent that the retired are currently among the wealthiest people in the United Kingdom. They are perhaps enjoying a level of wealth and income that will be exclusive to this generation on such a scale; they are in a unique position of owning their own house(s) while at the same time receiving income from investments, pensions, and inheritances.

The recent U.K. national strategy for housing in an aging society the highlights the need for developers, planners, policy makers, and local authorities to be mindful that the over 60s are crucial players in the housing market; the decisions they make regarding whether they move, remain where they are, and make adaptations and improvements to where they live all have a strong bearing on the entire market:

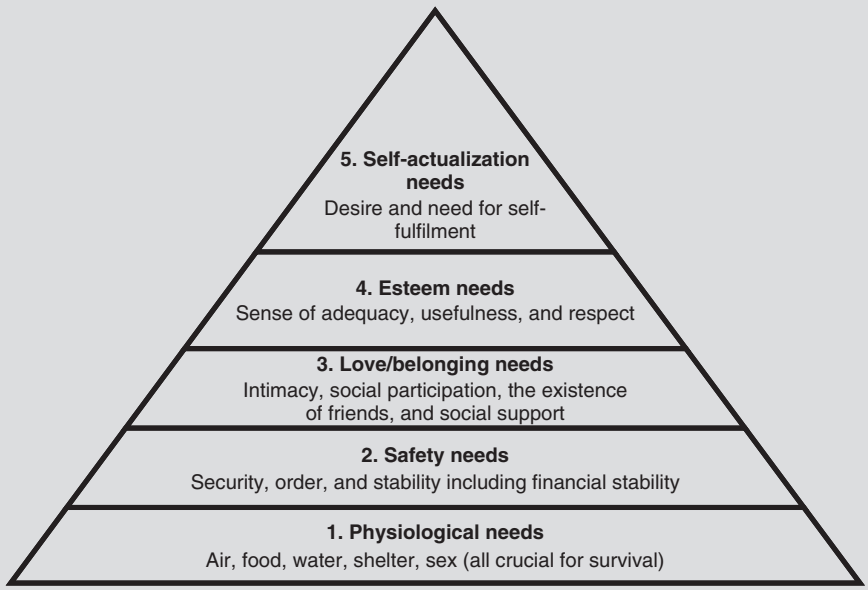
> Older people are already driving the housing market, and they will do so increasingly in the future. It is not just that the housing market needs to reflect their needs, it needs to match their aspirations.
>
> CLG (2008)

Wellbeing in Relation to Housing

People usually require their basic human needs to be met in order to attain a feeling of wellbeing. The renowned psychologist Abraham Maslow described a hierarchy of five basic human needs, which are all impacted upon by housing to a greater or lesser degree (see Box 13.1.).

Box 13.1. Maslow's Hierarchy of Needs.

See Maslow (1943, 1954).



Levels 1 to 4 are considered as fundamental, or "deficiency," needs. Once the level 1 physiological needs have been met then the next level(s) become dominant but not necessarily always in the same order as this depends on the individual. Maslow's model is a useful framework for understanding how people's housing circumstances have a key role in satisfying their basic and fundamental needs. Table 13.1 shows the variety of influences people's homes can have on these needs and how they can affect physiological, psychological, and economic states.

Looking at the term wellbeing there are very many definitions in existence, including "the state of feeling healthy and happy."[2] There is broad consensus in the literature, however, as to what important aspects contribute to wellbeing. These resonate closely with Maslow's hierarchy of needs and commonly include home and neighborhood along with good health, life satisfaction, financial circumstances, engagement, meaning, accomplishment, social roles, relationships, activities, and independence. How people perceive their own level of wellbeing is affected by their expectations. The current generation of older people tend to have relatively low expectations partly as a consequence of the hardships they have experienced in their lives.

Table 13.1. Examples of the Variety of Influencing Factors Housing Has on the Basic Human Needs Identified by Maslow. Adapted from Harris and Young (1983).

Basic need	Influencing factors of housing		
	Physical impact	**Social/psychological impact**	**Economic impact**
5. Self-actualization	Facilities/space for vocational pursuits	Proximity to aesthetic, cultural, social, and recreational interests; no/few barriers to prevent fulfilling potential	Affordability; cost of otherwise low wellbeing (e.g., medication for depression)
4. Esteem	Home ownership and/or residency; design of home and environment; furnishings; location of home; condition	Pride in ownership and/or residency; sense of personal adequacy and independence; ability to exercise choice and control over home environment	Ownership of an asset; housing tenure
3. Belonging	Ownership of place; proximity to others	Having somewhere to call your own; attachment; socially compatible neighbors; opportunities for community involvement and social participation	Maintenance of local help and support networks
2. Safety/security	Protection from harm and environmental hazards; facilities in home and surrounding area	Feeling safe and secure; adequate privacy	Affordability; cost savings; access to facilities locally; freedom from uncertainties of housing market
1. Physiological	Sound structure in which to live, with basic facilities to offer protection from the elements and maintain a comfortable temperature	Help maintain and support optimum possible physical and mental health and functional ability	Cost; affordability; cost savings in respect of fewer physical/mental illnesses and accidents

The Importance of the Built Housing Environment

The built environment of the accommodation where we live impacts on our wellbeing in a profound way on a variety of levels including those that are social, psychological, and physiological. It can affect our functioning, what we do, how we feel, and what we think. Evidence from research indicates that older people spend around 80% of their time indoors, mostly in their own homes, and this amount of time increases the more elderly they become. The home environment therefore will have a powerful influence on their lives.

A poor housing environment can cause, or exacerbate, poor health. Indeed, inadequate or poor-quality housing together with poor health is considered the principal reason for people having to move to care homes prematurely, indicating that the difficulties in coping with a poor environment can become untenable if health deteriorates (e.g., CLG, 2008). Different aspects of housing, such as its type and quality, will also affect people on psychological and social levels causing, for example, low self-esteem, anxiety, feelings of lack of control over maintenance and repairs, and fear of the surrounding neighborhood (Howden-Chapman, Chandola, Stafford, & Marmot, 2011).

In the United Kingdom a large number of older people's homes are not suitable for them and/or are in very poor condition. It is estimated that one third of older people's homes are "nondecent" or hazardous, including hazards that have high cost outcomes associated with them such as falls,[3] hospitalizations, and institutionalizations. Studies carried out by the Personal Social Services Research Unit found that 15% of admissions to care homes were as a result of serious housing problems, and 18% of relatives gave "physically unsuitable home" as direct reason for admission to a care home (CLG, 2008). If a home lacks appropriate ease-of-use, convenience, and accessibility features it can become impossible for older people to be able to take a bath or shower, get up and down the stairs, or even get in and out of the house. Housing is recognized as having a key role to play as a community care resource and as such receives significant investment from national and local government as well as the health and third (voluntary) sectors.

Having somewhere to live is in itself important. Most people have a need to have somewhere they can call "home" and their perception of, and meaning attached to, their home can impact considerably on their

wellbeing. Furthermore, the way housing is designed and where it is located can promote or inhibit social interaction, an aspect which can be of particular benefit to older people whose social networks may be in decline due to friends passing or moving away, restricted mobility, or having had to relocate themselves.

It is of great importance to most older people to be able to maintain as much independence as possible (which is beneficial both for themselves and for the wider society) and the built housing environment can exert a powerful positive or negative influence on this. Changes that come with age that impact on sensory and cognitive abilities and mobility can make it more challenging for older people to understand, move around, and function within a built environment. Enabling people in later life to live in appropriate housing, in tandem with providing any support and care they need, is essential to maximize their independence, health, and wellbeing.

Types of Places Where Older People Live

Regarding the sorts of accommodation where older people live, 65% of over 55s in the United Kingdom live in a house that is detached, semidetached, or terraced. Around 20% live in bungalows and 16% in flats. People are more likely to live in a bungalow, a detached home, or a low-rise flat as they become older.

There are two main categories of housing where older people live: mainstream and specialist. The specialist category includes sheltered housing (and retirement housing[4]), extra care, retirement villages, and senior cohousing. Rented sheltered housing comprises by far the majority of specialist housing units (see Figure 13.1). Sheltered housing is rented on the whole to social renters; there is very little specialist accommodation available for private renters or for private purchase.

Altogether there are around 600,000 sheltered, extra-care, and retirement properties in the United Kingdom. Around four fifths of these are rented and one fifth are privately owned (CLG, 2008).

Mainstream Housing

It is a common misconception that most older people end up living in a nursing or care home; in fact in the United Kingdom the vast majority of

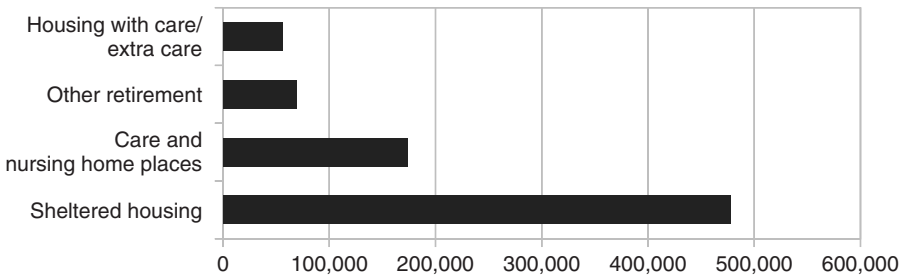


Figure 13.1. Approximate Numbers of Extra Care, Sheltered, and Other Retirement Housing Units and Care/Nursing Home Places for Older People in the United Kingdom. Data from Elderly Accommodation Council (2010, 2012).

people, about 90%, grow old in mainstream housing. This is often made possible with support, sometimes a considerable amount, from family and neighbors.

Sometimes referred to as "normal," "primary," or "general purpose" housing, mainstream housing includes houses, flats, and bungalows where anyone of any age would live. It may also be categorised as

1. general needs housing, with has no specialized features, designed without consideration for people with mobility, sensory, or cognitive impairment;
2. lifetime homes, which have been designed to meet access and adaptability standards for all, including older people, and;
3. adapted homes where changes have been made to meet the needs of occupiers.

Much of the mainstream housing in the United Kingdom is very old. Older people are less likely to live in very old or very new properties. Bungalows are a popular option and often in demand. Increased access to and use of assistive technology is enabling older people to increase their independence, wellbeing, and stay in their homes for longer.

Older people are more likely than other age group to live in housing that could accommodate a greater number of occupiers, termed "underoccupation." This is commonly where people live in a long-standing family home after their children have grown up and moved away. Demand for mainstream housing in the United Kingdom continues to grow and will do so for the foreseeable future. Research findings show that a lot of

the new mainstream housing is too small for what older people require and want.

Specialist Housing

Specialist housing is housing designed for people who have special needs. Specialist housing for older people is one of the earliest, most developed, and prevalent forms in the United Kingdom and is designed specifically for those who are not able to, or do not want to, live in mainstream housing.

All types of specialist housing for older people promote independent living for people over 55 years of age; occupiers have their own front door and have access to support and often care if needed. A diverse array exists but sheltered housing, extra-care housing, (also known as housing with care, very sheltered, assisted living, or close care), and retirement villages make up the main categories. Within each of these categories there is a wide range of diversification in terms of design, layout, appearance, facilities, management, support, and services provided. Care and nursing homes are sometimes included in the category of specialist housing although they are not strictly "housing." About 11% of people of a pensionable age in the United Kingdom live in different forms of specialist housing (including care and nursing homes) and demand currently greatly outstrips supply (Kneale, 2011). The older people become the more likely they are to be living in specialist housing. A move to specialist/retirement housing usually equates to a reduction in size for most people plus a reduction in spending on council tax and energy bills, a comfortable temperature all year round, and a safe and relatively healthy environment.

Sheltered housing.

Sheltered housing usually involves schemes with around 20–40 self-contained flats or bungalows that commonly include an alarm system, a regular warden or scheme manager service living on site or nearby, and some shared facilities such as a lounge, garden, and laundry. Some schemes also provide other facilities such as a restaurant or guest room. The term "housing with support" is sometimes used if there is an on-site scheme manager service and not just an on-call or emergency visiting service. Some schemes have a guest room for family and friends to rent for short stays.

A wide variety of designs, layouts, and formats exist. Originally sheltered housing was built by local authorities but latterly it has been built by housing associations. Both these providers target older people with high housing and financial support needs. Over the last decade or so private companies have also developed sheltered housing schemes, often referred to as "retirement housing," nearly all of which are owner-occupied.

Properties have invariably been designed specifically for older people; however, a significant number of sheltered housing properties date from the 1960 and 1970s and many are suffering the effects of aging and have become outmoded. Bedsits and shared facilities were a popular offering in those days but these are increasingly deemed unsuitable or unacceptable and demand for them is falling.

The majority of sheltered housing units are one-bedroomed flats with a kitchen, bathroom, and lounge. Newer properties are likely to have good levels of heating and accessibility features such as walk-in showers, raised electrical sockets, wider-width doorways to allow for wheelchair access and walking-frame use, and perhaps lowered worktops in the kitchen.

There is often high demand for sheltered housing and many schemes operate waiting lists. Not so popular are bedsit or studio flats, which have become hard to let; older-stock accommodation which is no longer fit for purpose; schemes with no lift; and those in undesirable neighborhoods. However, even with such negative attributes schemes with a good reputation can be popular mainly due to the personality and effectiveness of the manager or warden (Croucher, Sanderson, Lowson, Chaplin, & Wright, 2008). Many sheltered housing schemes have become a center of focus not only for their residents but for the wider community. In recent years some have embraced the "hub and spoke" model where the scheme is a location for facilities (e.g., a shop), services (such as nursing, GP consultations, chiropody, outreach care, and support services), and social activities available to the wider local community.

This form of housing is easy for older people to manage, is empowering, and provides low-level intervention and preventative services that enable residents to maintain independence and stay in their own homes. There is evidence from some research studies that sheltered housing can prevent or reduce hospital and residential care admissions, falls, loneliness, depression, and anxiety. Findings indicate that residents overall are generally very satisfied with living in sheltered housing and particularly value the following: the sense of security and peace of mind they have thanks to the staff, support from other residents, and the design features of the building (including

assistive technology and telecare); the purpose-built facilities; the service provided by the support scheme manager/warden; the companionship of other residents; and convenient locations. Residents living in schemes in small towns are generally most satisfied with location as shops, churches, and services are within easy reach. For others, transport can often be an issue particularly for those living in rural areas.

There is strong evidence, however, that many residents (particularly in public-sector sheltered housing) feel their homes are too small and cramped. This restricts what they are able to do, including having visitors or guests to stay, and what they are able to have, use, and store in their homes. Other areas often cited as where improvements could be made are maintenance, repair, and accessibility, including the provision of lifts as well as more space to move around and store mobility aids.

Extra-care housing.

Extra care[5] is a relatively new concept in the United Kingdom and has been developing over the last few years. It offers a range of flexible housing, usually apartments but sometimes also bungalows, along with domiciliary and personal care services adaptable for varying needs. It is based on the sheltered housing model but has additional facilities and services including access to on-site 24-h care, support services, a restaurant, shared kitchen areas, and often a hairdresser, shop, treatment room, and other amenities. In fact an increasing number of sheltered housing schemes are being remodeled into, or replaced by, extra-care housing, as are some residential homes.

Design models range from a "core and cluster" where the majority of communal facilities are in a central building with living accommodation radiating outwards to a fully dispersed model where facilities are located throughout. These can have groups of properties attached to their own shared lounge, kitchen, and so forth, which can be more successful in creating a homely feel and the likelihood of informal social contact, and appear to be better suited to people who have dementia.

Most extra-care housing is located in urban areas and, of great importance to residents, near shops, a GP, and other local facilities. Extra-care schemes are also increasingly providing facilities for the wider community. For example, restaurants and hairdressers are frequently open to the public which increases the resources available to people living in the local community as well as encouraging residents to interact and form links with others outside of the scheme.

As with sheltered housing there is tremendous variation in the design of the built environment. All extra-care housing schemes will

- have people living in their own homes with their own front doors;
- contain communal spaces;
- incorporate ergonomic adaptations;
- promote independence and social inclusion;
- provide opportunities for social interaction and social activities;
- have on-site care available 24 h a day;
- include alarm and intercom systems to call on-site staff.

Most will

- use many of the design criteria from the Lifetime Home standards (see later in this chapter) and provide adequate levels of access and mobility for frail older people such as wide corridors and doors, level-access showers, raised-height sockets;
- adopt progressive privacy principles;
- be made up of small flats with most commonly only one bedroom;
- have around 50 living units;
- have a communal garden, kitchen, restaurant, lounge, laundry, buggy store, assisted bathroom, specialist equipment, and guest room;
- encourage residents to have an active role in how the scheme is managed and run;
- support a range of assistive technologies (although there is some evidence that some of even the newest schemes are not taking enough advantage of assistive technologies).

Some will have

- high levels of access and mobility features such as height-adjustable kitchen hobs and sinks;
- a swimming pool, treatment room, hairdresser, shop, bar, cinema, games room, outdoor table tennis table, conservatory, greenhouse, computer/IT room, faith room, and library;
- a day center;
- a wider range of electronic assistive technologies as standard such as remote-control curtains.

Ideally schemes will

- be located near good transport links and close to shops, health care, and community amenities;
- be noninstitutional in appearance;
- have a welcoming entrance;
- provide an "enabling" environment fully accessible to all including those with cognitive, hearing, visual, and mobility impairments;
- have an easy-to-navigate layout with clear signage, and unambiguous distinction between private and public spaces;
- promote healthy active aging;
- make effective use of assistive technology;
- provide communal infrastructure such as broadband and digital TV.

Extra-care housing has become increasingly popular as a much needed, viable alternative to sheltered housing and residential homes. It is expensive to develop but numbers in the United Kingdom rose sharply in the years up to 2007 thanks largely to a substantial amount of funding from the government. Despite this it still makes up the smallest proportion of specialist housing options for older people.

Studies that have been carried out in extra care show that resident satisfaction rates are usually high. Many move to extra care because they require some help and support but want to retain their independence, they want to feel secure, they had difficulty moving around in their previous accommodation, and they no longer want or are able to attend to garden and household maintenance. Evidence to date indicates that extra-care housing is often successful in

- having a positive impact on health and wellbeing levels of independence;
- being home for life;
- preventing admissions to hospital;
- reducing the incidence of falls;
- reducing the likelihood of institutional care (a recent study found that extra-care residents are around half as likely to go into a nursing or care home compared to older people receiving domiciliary care living in mainstream housing; Kneale, 2011);
- reducing social care needs;
- increasing opportunities for social interaction.

This is despite it having some of most elderly and most frail people as residents, including many with dementia.

There is a growing amount of research evidence to help guide the design of extra-care housing. Respondents to satisfaction surveys indicate that on the whole they are happy with extra-care buildings and with their flats. They particularly value the newness of them, having their own front door, accessibility and security features, and having a good view, daylight and sunlight in their home, a balcony, and a garden. Facilities such as shops and restaurants play an important role in promoting social interaction. Interestingly it is a common finding that communal lounges are used by residents when activities have been arranged but they are generally not used on an informal basis in a lot of schemes. This may be because they do not expect to find anyone else there, because they are happy in their flats, or the space feels too big. Some studies have found that many residents like smaller communal spaces, and places where they can see what is going on within the scheme and in the wider world.

Despite the size of the self-contained accommodation often being cited as one of the reasons for wanting to move to an extra-care scheme, numerous studies have found that many residents find the extra-care flats to be very small and restricting of their daily lives, hobbies, social activities such as entertaining, and the amount of and type of possessions they could have. Also, features such as window openers and heating controls can be difficult to operate, for people with arthritis for example, and there can be accessibility issues with components such as kitchen cupboards and energy meters. These aspects cause great irritation and inconvenience for residents (e.g., Croucher, Hicks, Bevan, & Sanderson, 2007). Lifts too are often not big enough to accommodate mobility scooters, and residents can have difficulty finding a parking space in schemes which are made up of apartments.

Fixtures, fittings, and wayfinding aids infrequently meet the needs of people with sight loss and/or cognitive impairment in terms of features such as style, type, and color contrasting. A recent report published by the Thomas Pocklington Trust (2011) found designers of most of the schemes in their study had not taken specialist design guidance into account. For example, natural and artificial lighting levels in bedrooms and lounges were low in general schemes and few allowed residents to adjust the lighting level with controls such as dimmer switches. Inferior building design can have a negative impact on the emotional and social wellbeing of people with impairments, a large sector of the extra-care population.

A recent study (Barnes et al., 2011) that ran focus groups in five extra-care housing schemes found that the schemes' designs were successful in meeting the needs of residents who were relatively fit and healthy but not

of residents who had reduced physical or cognitive ability. These groups had had difficulty accessing facilities and activities, and aspects of the built environment such as poor kitchen design and inadequate provision of space and storage also reduced their independence levels. These findings concur with evidence from other research. The study also revealed that the buildings were too hot, were lit too brightly, and did not have adequate ventilation. A positive finding was that the external spaces were accessible by all residents. The authors concluded that inclusive and flexible design is needed to maximize the lifestyle and usability benefits that the built environment gives all residents in extra care, irrespective of care needs and abilities.

Retirement villages.

Retirement villages are large developments for people over 55 that are made up of a variety of housing types. Some include a care and/or nursing home and aim to enable people to live in the village until the end of life. Like extra-care housing, villages offer independent living and also provide access to 24-h care and support that can be adapted to suit changing needs and preferences, as well as opportunities for socializing and social events.

There have been retirement villages in the United Kingdom since the 1950s but relatively few until recently due to low demand, high development costs, and the difficulty in obtaining suitable land sites and planning permission (Evans, 2009). Most of these retirement village properties were private tenure with high design specifications to attract the more affluent sections of the population, and very few were available for rent meaning that this housing option was not be available to many older people. This has changed in the last few years, with the newest developments now offering a range of tenures and housing options.

Retirement villages are a popular choice in America, housing around 12% of the older population—as well as Australia, New Zealand, and South Africa—and demand is rising in the United Kingdom and in other countries such as Germany, Spain, Italy, and India (Evans, 2009). In the United States leisure activities are often the central focus of retirement villages whereas in the United Kingdom the focus has tended to be on care. Different models are beginning to emerge with some newer villages promoting "hotel-style" living and providing residents with domestic cleaners and offering choices such as having meals in a restaurant or delivered to their homes.

The size of retirement villages can vary enormously. In the United Kingdom they are designed usually to accommodate 100–300 people. Locations also vary. It can be advantageous for both the residents and the

local community for retirement villages to be sited within an existing town or village in terms of increased opportunities and access to social contact, activities, services, and facilities. However, as land in the United Kingdom is expensive and planning regulations are complex many villages are built on the edges of towns or out in the countryside. Some villages in these locations operate a shuttle bus to and from the neighboring community.

Design models and features of retirement villages include those seen in extra-care schemes. Because of their large scale, however, they are able to offer a wider range of facilities and generally include a communal lounge, dining room, restaurant, café, guest rooms, garden, conservatory, community center, shop, hairdresser, library, gym, swimming pool, activity room, treatment room, and laundry. Like extra care, some of the facilities and organized activities are open to the public.

Many retirement villages are very popular and operate long waiting lists. The limited amount of research that has been carried out indicates that older people living in retirement villages have high satisfaction rates, although some studies suggest that lower levels are reported among those with health problems including sensory and mobility impairment (Evans, 2009). Such villages have been shown to improve independence, health, and wellbeing through, for example, providing good access to services, improving social contact, and reducing the numbers of falls.

Senior cohousing.

Cohousing was first seen in Denmark in the 1970s. It is a development that is created, organized, planned, and run by the residents themselves, combining both private and communal living. Each resident has their own self-contained private home but they also benefit from shared facilities—usually in the form of a common house—such as a kitchen, dining room, workshops, meeting room, guest room, laundry, and green spaces. The cooperative communities are founded upon, and are designed to promote, social contact and sharing with neighbors much in the same way an existing close-knit community would. The initial process of designing and developing the cohousing scheme can forge very strong bonds between residents.

Cohousing developments are created based on the needs, values, and preferences of the residents and will accommodate the age ranges of their choice. Current designs include low-rise apartments, town houses, and clusters of detached houses. They generally have 15–30 fully functioning homes with their own kitchen, bathroom(s), living areas, and bedroom(s). Some include greenhouses, a gym, or swimming pool and even facilities

that are let on a commercial basis such as shops and restaurants. The built environment has a critical role, designed to stimulate social contact and a sense of community and sustain them over time. Front doors, balconies, and kitchens are situated to look out on shared spaces which may include "gathering nodes." Pathways link these with private spaces in ways that promote the visibility and occurrences of social encounters. Car parking is generally situated on the outer edges of the development so that residents will walk through the community to reach their homes. Developments are usually located close to, or within easy reach of, essential amenities such as public transport, GP surgeries, and shops.

Homes in these developments are often physically linked to reduce the cost of, enable the provision of, and maximize the benefit from shared services such as heating and water systems, and internet provision.

Learning from early cohousing developments in Denmark highlights some of the core ingredients required for cohousing initiatives to be successful (Durrett, 2009):

- formation of the resident group early on, ensuring enough people are on board before the project progresses too far (certainly before development begins);
- good management of the group process;
- a feasibility study leading to clear aims, objectives, roles, and responsibilities as well as strengthening the cohesiveness of the group;
- strong leadership by the group including careful control of the budget and cost;
- effective partnerships between the group and any professionals involved;
- ensuring that developers, if involved, have a very clear understanding of the cohousing concept.

Cohousing, including senior housing for those over 50, has become popular in northern European countries and America. In Denmark around 8% of the over 50s now live in cohousing developments. With restricted choices for people reaching middle and older age, cohousing is becoming more prevalent elsewhere including the United Kingdom where the Government, financial institutions, and housing associations are now starting to become actively involved. The Housing our Ageing Population: Panel for Innovation (HAPPI) panel was very impressed with the potential of cohousing for older people, "a positive collective housing choice to 'own' the process and create the product" (Homes and Communities Agency [HCA], 2009).

There are various initiatives underway in the United Kingdom including a Senior and Multi-Generational Co-housing Initiative in Perthshire which has two main target groups: older people, "who feel that they have still lots to contribute but need the security that, if they get frailer, they have a supporting team behind them that knows their needs and make sure they can stay where they are. As it is a cooperative they will stay in charge of their own lives," and families, who "want to create the best environment, socially and ecologically, for their children to grow up in" (UK Cohousing Network, 2012). A survey to 10,000 over-50-year-olds in Milton Keynes (347 respondents) found that 88% expressed an interest in a proposed cohousing development. Interestingly, irrespective of the size of the respondents' current home, there was a commonly expressed preference for accommodation with two bedrooms (where there were three people living together, the preference was for three bedrooms). Also, many of the respondents were working into their 70s which suggests that the provision of working areas or live/work units could be a useful addition to senior housing (Elderflowers Projects Company, 2011).

The cohousing model can provide comfortable, convenient, affordable, cost-effective, and life-enhancing accommodation. It has been shown to ameliorate residents' lives in many ways such as through reducing social isolation, encouraging active community living, development of new interests, improved opportunities for giving and receiving all kinds of support and services in kind, budget pooling, and sharing of resources (such as car journeys, lawnmowers, cooking meals, etc.).

Research into the experiences of cohousing residents in northern Europe has found that most people are satisfied with the housing and the majority would strongly recommend moving to senior cohousing schemes to others in order to improve quality of life. In some studies residents had concerns about building location and design (find out more in Choi, 2004). Evidence to date indicates that having well-designed shared areas does indeed increase the amount of social interaction and involvement in shared activities.

Learning Common to the Design of Specialist Housing

There is evidence that the more successful housing schemes are the ones that have involved residents in their design and subsequent management. It is likely that many benefits can also be gained from involving the wider

community in planning and design processes, including professionals who are likely to be working or providing services in the building.

It is paramount that the design is closely aligned to address the needs of the scheme's population, including specialist design for dementia. Crucial design elements include visual and orientation aids such as the use of distinguishing colors, landmarks, and signage, lighting, meaningful and identifiable spaces, use of artwork and memorabilia, adequate space in schemes and in each housing unit, visibility, use of color and contrast, security, unobtrusive safety features, and the effective use of assistive technology.

There is strong evidence that the appropriateness, layout, and appearance of the physical environment are important factors that contribute to the wellbeing of people with dementia (Dutton, 2009). Studies have shown that creating a pleasant, homely, and easy-to-understand environment that offers opportunities for residents to improve their functioning can increase independence and mobility and encourage food and fluid intake. Improving lighting in homes of people with dementia can have wide-ranging effects including improvements in appetite, health, and self-confidence, and decreased incidence of loneliness, temper, anxiety, and falls.

Older people tend to like smaller schemes with a homely feel, especially those with dementia who also benefit from schemes designed with circular layouts. Many would prefer to have a minimum of two bedrooms rather than one. Evaluations of individual schemes have shown that senior residents do not like homes that are too open plan. Some bathroom furniture such as taps, kitchen equipment, and underfloor heating can be difficult for people with dementia to use as they look and operate differently to what they have been used to in the past.

An interesting finding from one scheme was that its communal laundry had been designed as a meeting point for residents doing their washing but that complications arose due to confusion over whose clothes were whose and staff had to take over the washing of residents' clothes (Commission for Architecture and the Built Environment [CABE], 2009). This highlights the need for the designer to fully take into account users' behaviors, abilities, and preferences.

Aspects of the Built Housing Environment that Impact on Wellbeing

People's homes have a significant direct and indirect impact on their health and wellbeing and this is particularly true of older people. For one thing,

generally the older we become the more time we spend in our homes, hence the higher the impact they can have—positive or negative—on our health and wellbeing. The external environment is a key factor in enabling people to remain in their home and community as they get older (Tanner et al., 2008).

It is well established that poor housing has a negative impact on health. A large body of research shows that as the number of housing problems increases, such as shortage of space, noise, lack of light, poor heating, condensation, damp, rot, or pollution, so do the number of reported health problems in older people, whereas reductions in the number of housing problems produce health benefits (Pevalin, Taylor, & Todd, 2008).

There is also a growing body of evidence indicating that poor housing affects wellbeing and can lead to chronic mental health conditions. For example, research studies have linked poor building design to stress and drug and alcohol problems; and living in unpopular housing areas and high-rise flats have been linked to depression, anxiety, and distress (Pevalin et al., 2008). Other studies have shown that elements of design such as furniture configuration and privacy levels will affect behavior and wellbeing in different ways, and to different degrees, depending on the individual.

If housing is fit for purpose for older people's needs there can be dramatic results. It can significantly improve mental and physical health, and reduce the likelihood of falls and fractures as well as diseases that are common among older people such as respiratory disorders. Also, as we age the chances increase of us having poor health, illness, and disability; therefore, the need for an environment that will support recovery or stability, and enable maximization of independence, is paramount.

Condition of Housing

Most of the older population in the United Kingdom live in old buildings, the condition of which is highly variable. The age of a building is a significant factor affecting its condition. Large numbers of older people currently live in very poor housing conditions with problems such as leaking pipes, flaking paint, rot, holes, and cracks, which may in turn introduce pollutants, contaminants, microbes, and pests into their environment. The Social Exclusion Unit has estimated that there are more than 2 million households in the United Kingdom where a person over 60 is living in unfit housing, and that 13% of older people are living in homes that are in a serious state of disrepair (Office of the Deputy Prime Minister, 2006). The poorest conditions tend to be found in the private rented sector.

The condition of accommodation has a great influence on physical and mental wellbeing and these effects can increase as people age (e.g., Howden-Chapman et al., 2011). A growing body of evidence indicates that poor housing can exacerbate existing health problems, affect the immune system, and be a causative factor in many conditions such as asthma, heart disease, obesity, stress, anxiety, and depression. Older people living in poor housing have an increased risk of "winter deaths," ill health, serious injuries, and death by falling (CLG, 2008). Because older people tend to spend a lot of time in their houses they are the most at risk. The condition of housing has financial impacts too. For example, improvements that increase energy efficiency in properties, such as sealing gaps around windows and doors, and loft and cavity wall insulation, can be low cost and high gain in terms of reducing energy bills.

Some research has highlighted differences in health that depend on the type of housing tenure. This has been attributed to the fact that conditions of accommodation that is owner-occupied tend to be better than accommodation that is rented, particularly regarding problems of condensation, damp, and inadequate heating.

Common Design-Related Elements Affecting Health and Wellbeing

The design of a large number of older people's homes in the United Kingdom is unsuitable for their needs. The homes often lack appropriate accommodation and accessibility features, are costly to live in and maintain, or are situated a long way from amenities or places people want to go. This section outlines some key design elements that influence health and wellbeing.

Size and Space

The size of a house or apartment can make a big difference to wellbeing and whether a person can continue to remain in their home. Accommodation that is too spacious can become difficult and expensive to look after, maintain, and heat. Some accommodation can restrict what a person can do, how much they can enjoy their home, whether they can have pets, how many possessions they can have, whether they can have guests for a meal or to stay overnight, the use of mobility aids and equipment, how the living space can be reconfigured, and whether personal or nursing

care can be provided. Accommodation in specialist housing that has been designed for older people in the past is notorious for being restricted in the amount of space it provides. Studies have shown that most older people in mainstream housing are happy with the space they have and given the choice would not want to downsize (e.g., Edwards & Harding, 2008).

Lack of space both inside and outside the home will impact on opportunities for access, circulation, mobilization, and social contact, both in mainstream housing and specialist housing. Low levels of space provision are a key factor in whether an older person is forced to move out of their home (HCA, 2012). Having enough easily reachable storage space is also important. Older people need adequate space for their things, and they need to be able to access them without having to stretch too high or too low, which can become difficult later in life. If a person has to start standing on a chair or step ladders to reach objects then the risk of having a fall increases dramatically.

Layout

The layout of the property is another fundamental factor. In specialist older people's housing double-bank corridors with rooms on both sides are common, often without external reference points or natural light, making it easy for people to lose their bearings. As well as facilitating people to get lost, these internal spaces can appear uninspiring and institutional. Newer developments design nooks and crannies into the corridors to both add character and provide areas where people are inclined to linger or sit so they become social spaces rather than being used simply for access.

Corridors ending with a locked door can be confusing, frustrating, and cause distress if someone is suffering from cognitive impairment. Fire doors can also cause problems if they break up circulation areas, hampering visual access and navigation.

Accessibility

A large proportion of housing in the United Kingdom is inaccessible for many older people (CABE, 2009). Accessibility is very much dependent upon the adequate provision of space and good layout. Lack of ease of access to outside spaces can be problematic in specialist housing complexes, particularly ones with accommodation on more than one level.

Functionality and Practicality

In general, housing around the world has been neither designed nor constructed with the needs of older people in mind. Two key areas of difficulty experienced by occupiers of mainstream housing as they move into old age have been identified: home and garden maintenance; and lack of appropriate physical support in the home to compensate for increasing mobility and access problems. Studies have shown that large numbers of older people have to move to a care home after an admission to hospital because returning to their own home is not a practical option (CLG, 2008).

The lack of appropriate physical support can, however, often be compensated for with adaptations to the property which will improve accessibility and function such as grab rails, ramps, and stair lifts. These can be very effective in increasing wellbeing and enabling older people to remain independent and in their homes for as long as possible and in keeping them feeling safe, comfortable, dignified, and in control. There is strong evidence that housing adaptations prevent hospital and care home admissions and can enable earlier discharges from hospital. Care does need to be taken when making adaptations to the built home environment as they can have a negative impact on personal meaning attached to home (Tanner et al., 2008). Occupants need to participate in, and have choices over, what changes are made to their homes, and the changes made must of course be suited to their individual need.

Hazards/Safety and Risk

The built housing environments needs to be as safe and hazard-free as possible but not so much so that it has a detrimental effect on wellbeing in other ways. There is often a fine balance between eliminating hazards in the built housing environment and the creation of a pleasant, homely, individualized space to live in, especially where specialist housing developments are concerned. Necessary adherence to strict fire and safety regulations can have a negative impact on the functionality and appearance of shared spaces.

As people become more elderly, changes such as a deterioration in eye sight or mobility mean that aspects of an environment may become hazardous when they would not have been before. Everyday activities such as putting the bins out can also become troublesome. Good housing design and adaptations are effective in reducing risk and adverse events (such as falls), and supporting independence.

Maintenance and repair is crucially important in terms of keeping hazards and risks to a minimum, and for the ability to sustain adequate temperature and air quality. Simple and low-cost solutions such as draft-proofing and removing trip hazardous rugs can be extremely effective.

Outside Space

Many older people go for days without leaving their homes, and for some it is months or even years. Access to outside space is essential for a person's physical wellbeing, particularly to allow for some exposure to the sun, which is vital for the body's vitamin D production. Being able to get outside is also important for psychological wellbeing; for example, green spaces have a positive emotional effect and many people gain a lot of pleasure, reward, and satisfaction from creating, tending to, and looking out onto a garden or planted area.

The design of the built housing environment has a key role in encouraging older people to go out into the open more often, for example through the provision of appropriate, adequately sized balconies, or an easily accessible attractive garden area.

Temperature

Older people are less able to control their body temperature and this can have serious consequences. For example, for each degree that the temperature falls below the winter average in the United Kingdom there are around 8,000 additional deaths. Good design is paramount to help prevent older people getting too hot or too cold as well as enabling them to afford to heat or cool their homes when they need to.

Cold and damp pose the greatest risks to health. Cold houses are more likely to have condensation and dampness which lead to the appearance of molds that cause respiratory problems. As well as this, living in a cold house has been linked to heart disease and strokes as well as an increased use of health services and early deaths among older people. Cold homes can also have a negative affect on general wellbeing. Studies have shown links between the presence of molds and the incidence of depression, tiredness, headaches, and anxiety.

Housing in the United Kingdom is among the least thermally efficient in northern Europe (Pevalin et al., 2008). Poorly constructed and older houses are generally difficult and costly to heat and have been blamed for

contributing to excess winter deaths among older people, who are twice as likely not to be able to afford fuel in winter (CLG, 2008). Better design, home improvements, and a reduction in the prevalence of fuel poverty[6] are all essential to reduce the amount of ill health and premature deaths associated with inefficient housing.

Air Quality

Good ventilation and air quality are vital for health but many houses and apartments, even newly constructed ones, lack enough natural ventilation. Poor ventilation encourages the buildup of water vapor and carbon dioxide, and allergens such as dust, mold, and bacteria, and can pose substantial risks to health. Pollutants in the air have also been shown to diminish feelings of wellbeing.

Light and Lighting

Ensuring sufficient daylight and good artificial lighting not only ensures that people can see to the best of their ability (and avoid potential hazards, etc.) but also improves health and wellbeing. Exposure to daylight is essential as it affects the body's hormone production and daily rhythm cycle. Insufficient amounts can lead to depressive symptoms and disturbed sleep patterns. On the other hand, exposure to a reduction in light at night can also be important in helping to regulate sleep patterns and aid day/nighttime orientation. This is often not the case in specialist housing complexes, which may have corridors that are lit 24 h a day.

In larger buildings, imaginative design is needed to ensure there is sufficient daylight in all rooms, especially ones in which people spend a lot of their time. Ideally there should be no glare and an even level of light (avoiding the appearance of dark shadows and big changes in light levels). It is important that switches are easy to operate and located in accessible positions. Focusing lighting on particular features can help with orientation or with enabling people to carry out activities safely such as cooking or chopping vegetables on kitchen worktops.

Sound/Acoustics

Poor insulation from noise is a common complaint by residents in new buildings. Regular disturbances from whatever source—be it neighbors, traffic,

or airplanes—has been shown to cause psychological distress, anxiety, and depression, and older people can be very sensitive to extraneous sounds. Common areas in specialist housing schemes can be problematic; for example, laundry rooms, particularly when washing machines are used at night. Building materials that provide good insulation are needed. In addition, noise levels will be diminished through absorption by carpets, curtains, and furniture such as sofas. Angled ceilings and walls can also help to break up sounds. The quality of the acoustics in a property matter particularly to those with hearing or cognitive impairment. Acoustics in a room are affected by the number of hard and soft surfaces, along with its proportions and size.

Color

Color can have a strong influence on the way people feel. The effect of color is highly complex and people's perceptions and responses will vary depending on aspects such as physiology, culture, and personal experiences. Blues and greens in general are widely considered to be calming and soothing, and oranges and reds more stimulating and vitalizing.

The use of color and color combinations will affect how spacious a room and building feels, how aesthetically pleasing it is, and what aspects can be identified by people with cognitive or visual impairment. It can be used to enhance contrast (between doors and the wall, for example), and improve visibility of objects or walking areas, and promote location identification and way finding. For an evidence-based design guide to using color and contrast see Bright, Cook, and Harris (2004).

Exterior and Interior Design

How a dwelling place looks is very important for many older people and something they can gain a lot of pride and pleasure from. In the recent past the design of specialist housing for older people has more often than not placed greater emphasis on meeting physical needs than mental, emotional, or spiritual ones,

> A relatively uniform and formulaic design stereotype has dominated the design of sheltered and retirement housing for about the last fifty years . . . this stereotype, which has admittedly been generated by functional requirements and especially by cost constraints, is nonetheless experienced and perceived by many older people as stigmatising and demeaning.
>
> Hanson (2002)

The style of furnishings and decoration of interior spaces chosen by inhabitants reflects their personality, makes them feel comfortable within it, and makes the place feel their own. To maximize wellbeing, specialist housing complexes should provide surfaces, fabrics, and coverings that look homely and provide tactile and sensory stimulation; and bathrooms and toilets that do not look clinical or medicalized. Products and fittings used should be universally accessible and should have undergone a user-centric design process.

Electronic Assistive Technology

Electronic assistive technology (or EAT) can be an essential component of the process of designing housing for older people, or homes for life, that can further enhance the functionality and usability of the built environment. Good use of electronic assistive technology is effective in enabling people to keep their independence, remain in their own homes, and increase their wellbeing. As a form of preventative service it can also save money. Electronic assistive technology can both support people to carry out activities of daily living and monitor and respond to risks and adverse events.

There is an ever-growing range of functions that electronic assistive technologies have in the built housing environment, including operation of doors, communications, appliances, and equipment; visitor access control such as video entry systems; control of lighting, temperature, and air quality; support with wayfinding using, for example, GPS technology; memory aids such as audio reminder messages triggered by movement towards the front door during nighttime hours; monitoring where people are in a building or if they have exited from it, providing alerts where required; and alerting if smoke, gas, or flooding is detected.

Maximizing the Ability of Housing to Meet Needs as We Age

Where Do Older People Want to Be?

Surveys consistently show that older people prefer to stay in their own homes for as long as possible, preferably until the end of their lives. Most (90%) in the United Kingdom succeed in doing so and remain in mainstream housing. For many, however, it is likely that their independence and quality of life could be improved by living in housing that has been designed to Lifetime Home standards (see later in this chapter), maximizing accessibility and manageability.

For some older people moving to smaller, more manageable, and/or specialist accommodation can be a positive and proactive decision. Reasons for people wanting to move typically include dissatisfaction with the home, because for example it cannot support age-related frailty, or the local area. However, even if the will is there it is not always possible to move due to a lack of appealing and viable alternatives available nearby. This can lead to a difficult choice between staying in housing that is increasingly unmanageable and unsuitable but which is familiar and holds emotional ties, and moving away to a new place, leaving behind important social networks (CLG, 2008). For other people a move to alternative accommodation comes about following a crisis, after which hurried, reactive decisions are often made, or because they can no longer afford to stay where they are due to rising costs of living coupled with a limited income. In many places there will be few, if any, choices for older people who would like to stay in their community but live in smaller, more affordable homes.

Ability to Age in Place and Live Independently

In 1994 an agreement was reached by the Organisation for Economic Co-operation and Development (OECD[7]) countries that

> Elderly people, including those in need of care and support should, wherever possible, be enabled to continue living in their own homes, and where this is not possible, they should be enabled to live in a sheltered and supportive environment which is as close to their community as possible, in both the social and geographical sense.
>
> OECD (1994)

Over the last few years, as in many countries, "aging in place" and "independent living" have become priority drivers in the United Kingdom. Independent living has been shown to boost self-esteem, life satisfaction, and health, all essential for successful aging. It is also seen as an essential cost-effective solution to the care and support of an expanding population of older and very old people.

Adaptations, repairs, and maintenance.
Adaptations, repairs, and support with maintenance help people to remain in their home and preserve their wellbeing and independence. Improvements can be made to ameliorate health and safety conditions, warmth, comfort, aesthetics, cost-effectiveness, accessibility, and so on. Help with home and

garden maintenance is often top of the list of necessities for many older people. The simplest things can make a huge difference, such as replacing a blown light bulb or renewing a tap washer.

Home adaptations range from clearing away hazards such as rugs and obstructive objects, draught proofing, installing assistive devices such as grab rails, ramps, and automated reminder systems, changing the location of activities such as moving the bed to the downstairs dining room area from the upstairs bedroom, through to renovations such as improving the wiring so that extension wires no longer need to be used, door widening to allow access for a wheelchair, and installing a roll-in shower. Not all homes are suitable for larger-scale undertakings; those with concrete structures or restricted accommodation layouts, and small one-bedroomed flats among them.

Research evidence shows that home adaptations provide significant benefits in terms of health and wellbeing as well as cost savings by due to the preventative nature of the service. Adaptations can enable earlier hospital discharge and also reduce hospital and residential care admissions through the prevention of accidents and through supporting the maintenance of independence.

Providing Homes that are Desirable and Suitable for Older People

In terms of satisfaction with their current accommodation, studies show that older people are on average the most satisfied age group compared with other age groups but this could, to a large extent, reflect the fact that current generation of older people tend to have lower expectations generally due to different mindsets and attitudes, and having experienced greater hardships (e.g., CLG, 2008). Attitudes, behavior, and lifestyles evolve over time and those of the upcoming older generation, the Baby Boomers, will undoubtedly be distinctly different. They have had different experiences, are more assertive, and are certainly more demanding. They will have different expectations, needs, and desires for their housing requirements.

Design essentials.

Box 13.2. lists important design-based features that are needed for housing to be suitable and desirable for older people. The list is made up of information from older people about what they want and require from housing, and a range of evidence-based guidelines and recommendations from various sources including HCA (2009, 2012), CLG (2008), and World Health Organization (2007).

Box 13.2. Important Design-Based Features in Housing for Older People.

Design essentials

- Universal/inclusive design
- Well-constructed, flexible, and adaptable "homes for life" that can meet needs of all ages and changing occupants
- Comfortable accommodation
- "Care-ready" so that current and future technologies, such as telecare and community equipment, can be easily installed
- Adequate space to be able to live in uncramped conditions, allowing free movement in all rooms and passageways, as well as accommodating visitors or guests; ideally at least two bedrooms
- A fair-sized kitchen that can accommodate a washing machine and dishwasher
- Ample storage space within easy reach
- Avoidance of internal corridors or single-aspect flats
- Level floor surfaces
- Easy to access, use, and maintain, including a downstairs toilet, shower, and bath
- Safe and secure accommodation and safe surrounding area
- Good insulation and thermal efficiency; cost-effective to heat with controllable temperature
- Provision of means of shading from the sun, to keep cool, and/or reduce glare if necessary
- Healthy living environment
- Plenty of natural light and good artificial lighting
- Good ventilation
- Private outside green space; balconies can work well
- Attractive both inside and out
- Surrounded by, and views onto, greenery such as trees, hedges and other planting
- Sensory needs (particularly for those with visual impairment) and cognitive needs (especially for those with memory problems) taken fully into consideration

- Proactive consultation and inclusion of prospective residents in the design, planning, and testing of housing, and in determining what the available choices are

Also required

- Reliable and easy to understand information about what housing options are available, including housing adaptation services and sources of financial assistance
- Sufficient, affordable, and effective support to stay in own home including reliable repairs and adaptations services from providers who understand the needs of older people

Design essentials specific to specialist housing

- Noninstitutional look and feel both internally and externally
- Nonclinical look and feel in toilets and bathrooms
- Preferably smaller-scale domestic environments
- External design in keeping with local area
- Adequate space to accommodate aids and adaptations such as hoists, and other equipment such as oxygen cylinders
- Direct access to attractive, spacious private outside areas that are imaginative seasonal, safe, and reflect residents' needs and preferences
- Good-quality shared social space(s)
- Adequate number of lifts
- Spacious multipurpose internal area where residents, and potentially the wider community, can meet and take part in a range of activities (unless sited close to such amenities, or the development is too small)
- Layout that encourages the use of circulation areas, the shared spaces, and connections to the wider world
- Attractive views
- Effective use of assistive technology
- Approaches that promote healthy, active lifestyles
- Adequate number of parking spaces
- Desirable location with good access to shops, amenities, services, and transport links.

Approaches to Enabling Aging in Place

Along with the availability of appropriate support and care services, the opportunity to "age in place"—to stay in the family home or in specialist housing—to a great extent depends on the design of the built environment. There are a variety of design approaches that have been devised to increase the likelihood of being able to age in place including universal design, inclusive design, Lifetime Homes standards, and aging-friendly design. Many of these approaches have very similar aims and objectives.

Universal Design and Inclusive Design

"Universal design" is an approach to the design of the built environment, furnishings, and products that are appealing and inclusive to all, to the greatest possible extent, irrespective of cognitive, sensory, or physical abilities. The idea is to make environments easy to use for most people with little additional expenditure. Key principles include equitable use, flexibility in use, simple and intuitive use, perceptible information, tolerance for error (minimizing hazards), low physical effort, and size and space for approach and use. Universal design features for housing include those identified by Lifetime Homes and others such as variable work-surface heights and antiscald valves on sinks, showers, and baths.

"Inclusive design" is a very similar approach but has additional focus on the ways in which the aims can be achieved. The term is explicitly clear that no design can meet the needs of all people all of the time.

Examples of universal or inclusive design products are Braille markings on washing machines and microwaves, nonslip surfaces, curbless showers, and rocker light switches.

Lifetime Home standards.

Lifetime Home standards were developed over 20 years ago. They incorporate 16 different design criteria which aim to maximize the flexibility and adaptability of ordinary mainstream housing at minimal cost, to make homes better accommodating and easy to use for everyone including younger and older people. A revised version was published in 2010[8] and cover the following areas:

1. sufficient car parking width;
2. access from car parking (nearby and level or gently sloping);

3. approach gradients (level or gently sloping);
4. entrances (well lit; level threshold access; covered main entrance);
5. communal stairs and lift (easy access; full accessible);
6. doorways and hallways (sufficient width);
7. wheelchair accessibility (adequate turning and circulation space);
8. living room at entrance level;
9. entrance level bed space;
10. entrance-level WC and shower drainage;
11. bathroom and WC walls (suitable for adaptations);
12. stair lift/through-floor lift (provision/space for);
13. tracking hoist route;
14. bathroom layout (ease of access);
15. window specification (ability to see out when seated; ease to open/operate);
16. controls, fixtures, and fittings (height of switches, sockets, ventilation, and service controls usable by all).

Decent Homes Policy and Standard

In 2000 the U.K. Government launched its Decent Homes program in England and Northern Ireland as part of the national strategy for neighborhood renewal. This sought to improve conditions in deprived neighborhoods and achieve "a decent home for all." Decent Homes has had a key role in improving the standard of living for vulnerable people and disadvantaged groups through such activities as helping to tackle fuel poverty and health inequalities. The policy drew up a detailed standard of decency as well as a set of challenging targets which included ensuring that all social housing was made decent by 2010. The target population was later broadened out to include vulnerable people in their own homes (including privately owned sheltered and supported housing properties, plus houses where there is shared ownership with a Registered Social Landlord), not just homes rented from a private landlord: 70% of vulnerable households[9] in the private sector were to be up to Decent Home standard by 2010.

All property owned and managed by the public sector (councils and housing associations), and private-sector housing occupied by vulnerable households, is now required to meet the Decent Homes standard. These properties must

- meet the current statutory minimum standard for housing;
- be in a reasonable state of repair;

- have reasonably modern facilities and services; and
- be warm and weatherproof.

Included in the detailed criteria are efficient insulation, efficient heating, adequate ventilation, damp-free, and adequate lighting.

"Aging-Friendly" Design

Aging-friendly design is rooted in the concept of "active aging" which promotes wellbeing as people age through the optimization of opportunities for health, participation, and security in the built environment (World Health Organization, 2007). Aging-friendly design applies to physical, technical, and social domains. It

- recognizes the capacities and resources that older people have;
- foresees and responds flexibly to changing needs and preferences of older people;
- takes into account personal preferences, decisions, and lifestyle choices;
- protects the most vulnerable;
- encourages inclusion in and contribution to community life.

The Impact of Design Approaches and Standards

Over the last few years there has been a major impetus in the United Kingdom for all new homes to be built to Lifetime Home standards including the Government's strategy *Lifetime Homes Lifetime Neighbourhoods* (Communities and Local Government, 2008). Existing mainstream homes too are gradually being developed to improve quality, incorporate universal design principles, and include specialist adaptations. For example, an outcome of the Decent Homes policy is that "An estimated £40 billion has been made available for the work in the social sector alone, which has paid for, among other things, the installation of 700,000 new kitchens, 525,000 new bathrooms, over 1 million new central heating systems and the re-wiring of 740,000 homes" (Communities and Local Government Committee, 2010). The vast majority of social housing has been brought up to standard but private-sector properties are still lagging behind.

Such approaches and standards are reducing the overall need for people to move out of their own homes, as well as providing those who have moved to specialist housing with a suitable, supportive, and adaptable living

environment. However, it is not a quick process and there is still a long way to go; the volume of existing housing stock is immense and a sizeable section of it will not be suitable for adaptation for cost, structural, or spatial reasons. Accessibility improvements in particular can be expensive. The gap between the supply and demand of affordable, suitable housing for older people will undoubtedly persist for some time to come.

Even if such standards and approaches are widely adopted it will always be the case that aging in place will not be an achievable goal for everyone. It still may be practical or desirable for people to move when approaching, or living in, older age. They may feel their current home has become too big for them, if for instance their family has moved out, or they cannot afford to maintain, manage, and heat the property, or they may be lonely and want to move somewhere where there will be more opportunities to interact with others.

Summary

At the very least, fit-for-purpose housing is accommodation that should help—not hinder—the fulfillment of basic human needs; needs that include shelter, safety, protection from health risks, belonging, attachment, and social contact. Good housing is essential for older people in particular as their home is the place where they spend a very large proportion of their time. Home can be a place that causes stress, illness, isolation, and dependency or it can be a place that promotes comfort, optimum health, social contact, and independence: the design, quality, and location of housing have significant impacts on health and wellbeing.

Most people aim, and continue, to live in their own homes. Services, adaptations, and support from family and others contribute enormously to making it possible for them to do so. The wellbeing of a great number of these people would undoubtedly be improved if their homes were better maintained and modernized, with allowances for varying sensory, cognitive, and mobility abilities fully integrated into their design. Currently such homes are few and far between but clear progress is being made with the implementation of strategies, programs, and standards such as Decent Homes. There is a shortage of options and of good-quality, affordable specialist housing for those who want or need to move to accommodation that is specifically designed to meet their needs as they age. Those who do move often have to leave their local communities behind as there is nothing close by that is suitable. Demand will rise in the foreseeable future for both mainstream and specialist housing that is affordable, suitable, and desirable

for older people. Expectations are also rising and changing as the Baby Boomer generation moves into its third age.

There is now a large evidence base that communicates the overarching needs and desires of older people in terms of the design of the built housing environment, and what additional support and guidance are necessary for them to be able to age in place. There are clear messages coming through: better quality, greater adaptability, better looking, fewer stereotypes, and active involvement of older people in the design process being among them. New buildings built to Lifetime Home standards and inclusive design principles are improving the prospects of future generations, and there are many fine examples of good and innovative practice to learn from. Continuous changes and wider access to assistive technologies, mobile devices, social networking, and services such as online shopping are going to have a major impact on people's homes, how they use and live in them, and how best they can be designed to suit the changing sensory, cognitive, and mobility needs experienced by people as they age.

Notes

1. Seventy-five percent of over 65s voted in the last U.K. general election compared to only 37% of 18–24-year-olds.
2. http://dictionary.cambridge.org/dictionary/british/well-being?q=well-being
3. Falls and fractures account for more than 4 million bed days a year in England, costing more than £2 billion annually.
4. Retirement housing is a term generally used for owner-occupied flats that have a scheme manager but no other services.
5. Also known as very sheltered, assisted living, housing with care, or close care.
6. Fuel poverty is defined as when more than 10% of one's income has to be spent on fuel to keep the home at a reasonable temperature.
7. There are currently 34 OECD member countries around the world including the U.K. and other European countries, the United States, Canada, and Chile.
8. See www.lifetimehomes.org.uk.
9. Vulnerable households are classed as those with little or no capacity to change their own housing circumstances due to insufficient income, illness, or disability.

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14

Workplace and Wellbeing

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Introduction

Remember the old joke about nobody on their deathbed ever wishing they'd spent more time in the office? It rarely fails to raise a smile. But behind our amused recognition of an uncomfortable truth lies a darker reality: the modern workplace of the past 100 years or so has been incompatible in its management and design with many of the human values we hold most dear. Its ruthless prioritizing of organizational efficiency over individual wellbeing has created an environment—both physical and psychological—that is often self-defeating in its failure to safeguard and support the performance and morale of office workers.

Loss of workplace productivity through sickness or stress is well documented. Absence from work cost the U.K. economy more than £17 billion in 2010 according to the Confederation of British Industry (2011). That year, around 26.4 million working days were lost, according to the Health and Safety Executive (www.hse.gov.uk/statistics/causdis/stress/stress.pdf); 22.1 million of them were due to work-related ill health (predominantly stress, depression, anxiety, and musculoskeletal disorders) and 4.4 million due to workplace injuries. Physical injuries in the workplace have reduced from a generation ago but mental health problems are sharply on the rise, costing the UK economy the equivalent of £1,600 per employee according to the U.K. National Work-Stress Network (2012).

This picture is part of a worldwide trend: workplace stress, for example, is rising in countries as diverse as Spain, South Africa, Mexico, and India, with

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the fastest growth recorded in China and the greatest severity experienced by business people in the Unites States (Regus, 2009). As a result there is now unprecedented organizational interest in the real costs of actively disengaged employees and in ways to improve workplace wellbeing, satisfaction, and engagement (Pangallo & Donaldson-Feilder, 2011).

Some of the stressful problems that workforces around the world are experiencing can be put down to poor employment policies, inadequate training, and plain bad management. Some of the lack of wellbeing and comfort can be laid at the door of badly configured and time-wasting technology systems. Management of both people and IT can unravel as the speed of global business change accelerates (Myerson, Bichard, & Erlich, 2010). But the built environment is also a major culprit in making us sick of work. The buildings in which we work today are complex, highly engineered, socially programmable constructs in which the wrong decisions about the environment can have harmful impacts over a long period.

Since the 1980s, with some important precedents before, studies in workplace environmental psychology have consistently pinpointed the relationship between physical environment and the experience and performance of workers (Sundstrom, 1986); this body of research has not only focused on such factors as the effects of ambient conditions (temperature, noise, air quality, illumination, and so on) and workstations (seating, equipment, personalization) on the individual, but also the impact of different layouts and types of workspace on groups and interpersonal relations.

As a consequence we now know a lot more about the interplay between workplace design and the psychological processes that can lead to more positive outcomes for the individual (in terms of personal performance, satisfaction, and wellbeing) and for the group (in terms of team cohesion and effectiveness). That does not mean that current problems in terms of lost productivity and worker disengagement are close to being solved. On the contrary, the historical development of the modern office as an industrial hierarchy has created a legacy effect that is tough to transform, as we shall explain. However, there is a platform for change beginning to take shape.

In this chapter I want to explore the connections and contradictions between wellbeing and the office workplace, with reference to a number of research projects in which I have participated and from a perspective that recognizes the growing importance of psychological as well as physical health at work. In particular I want to investigate different notions of "comfort" by drawing on the work of Canadian environmental psychologist Jacqueline

Vischer, a key member of the New Work Environments Research Group at the University of Montreal.

Three Levels of Comfort

Jacqueline Vischer's "environmental comfort" model (2008) addresses the limitations of simply measuring user satisfaction by making a helpful distinction between three different levels of comfort that people require in the workplace: physical, functional, and psychological comfort. Physical comfort is the most basic level and relates to providing an environment that is habitable; in other words, a workplace in which people can breathe and see, that has light and air and is not ear-splittingly noisy, freezing cold, or insufferably hot. In an era of expanding health and safety legislation, relatively few modern buildings now fail to meet this basic threshold of acceptability, although when elevators or washrooms are out of order basic physical comfort can be compromised at work.

The concept of functional comfort sits at a level above only providing what workers need to survive. This is about increasing comfort to the point at which users are better able to perform tasks. In this model the difference between a supportive and an unsupportive environment is the degree to which people can focus their energy on the task at hand rather than having to expend it on managing adverse working conditions. Issues such as lighting, acoustic control, thermal quality, and ergonomics are therefore addressed from the perspective of supporting performance, not just enhancing user satisfaction or mood.

Most contemporary workplace design stops at this second level of functional comfort. However, there is a third, underdeveloped level—psychological comfort—right at the top of the pyramid of user need. This relates to psychosocial factors such as territoriality, privacy, and control over the environment (including the ability to physically adjust furniture and lighting), and explores individual feelings of attachment and belonging. In its focus on environmental control this level also links broad notions of wellbeing to the current drive to make workplace buildings more sustainable.

I want to advance the view in this chapter that the health and wellbeing of office workers will not be significantly improved until workplace design does more to tackle the demands of psychological comfort. This, as Vischer points out, is the hardest level to identify, measure, and calibrate.

Traditionally, design professionals made office buildings habitable; then they moved smartly into making work environments fit for particular purposes. Numerous studies of ergonomics and basic environmental conditions have resulted in a good understanding of the basic physical conditions that are most conducive to making work happen, with many of these principles enforced by rigorous design standards. Now designers must increasingly address a new psychological landscape in which giving users more control might necessarily involve them more closely in codesign processes, and might conceivably cede to them more creative ownership of new work environment schemes.

Up until relatively recently most of what has been known about an employee's psychology in the workplace has concerned job satisfaction, largely evaluated by assessing individual preferences. Many business managers have simply not seen any particular advantage in investing in workplace design simply to make people feel happier. The physical office has been a necessary space in which to house employees, rather than an asset that could positively influence the performance of staff (Veitch, Charles, Farley, & Newsham, 2007). Workplace design has therefore tended to only consider the effects of the environment when it actively demotivates people.

A Short History of Discomfort

This current mismatch between workplace and wellbeing can be traced directly to the birthplace of the modern office as a bureaucratic by-product of rapid industrialization. The earliest office workplaces took their spatial template from the factory floor and adapted the management theories of Frederick Taylor (1856–1915), the American founding father of scientific management who pioneered such practices as time-and-motion studies. Taylor's values were based on order, hierarchy, supervision, and depersonalization. At the dawn of twentieth century mass manufacturing his theories about creating "superior methods and machines" were swiftly adopted in workplaces around the world (Merkle, 1980).

Before Taylor, the office clerk of the late nineteenth century had enjoyed high status and job satisfaction: this esteemed employee worked on a series of skilled tasks, sitting at ornamental furniture designed to provide a degree of privacy and signify a master of his own domain (Forty, 1986). Taylorism removed the clerk's high-backed chair and high-sided roll-top

desk, opening up the clerk to the gaze of a suspicious supervisor. The job was broken down into a series of simplified, repetitive tasks that could be carried out by a lower-status (and lower-paid) worker sitting on a fixed, machine-like, pivoting seat. The seeds of modern worker discomfort were sown, in which the human factors of individual performance would be consistently overlooked for several decades.

As the twentieth century progressed, efficiency-obsessed business organizations stepped up the drive for economies of scale and division of labor in their buildings, centralizing office functions and rigidly segmenting employees between large open areas, for more junior and lower-status workers, and cellular accommodation for higher-status managers and for specialists to carry out particular tasks.

In the years after the Second World War offices began to compete for labor against mines and factories by providing a more pleasantly designed environment with an acceptable level of physical comfort and even some recognition of the value of human interaction at work. But the demands of the organization always took precedence over the needs of the individual, and management efficiency was never compromised by attention to worker wellbeing.

Taylorism managed to cast a shadow over even the most progressive advances in office design, which saw the introduction into 1950s Europe of the *Burolandschaft* (office landscaping) model pioneered by the German Quickborner team. This organic, free-flowing spatial concept, based on analyses of work communication, contrasted with the more rigid, rectilinear American model and was designed to make for more openness and democracy in the office. But, as Knobel (1987) points out, open-plan landscaping of this type meant that "quite a few personal liberties were lost: no personal window to open or close, no light-switch to control."

In the 1970s, the activism of strong white-collar unions in northern Europe, particularly in Scandinavia and the Netherlands, helped to humanize the office. The Centraal Beheer insurance building at Appeldorn, the Netherlands, designed in 1973 by Dutch architect Herman Hertzberger, was the standout scheme of this period in that it made a conscious attempt to balance corporate objectives with employee wellbeing. It did so by creating a complex, interlocking interior comprising a series of concrete block "work islands." Each unit housed 16 workers who were free to decorate the space as they wished and even bring in their own plants and pets.

Hertzberger's project was popularly acclaimed for its unique pitch towards psychological comfort as well as physical and functional comfort. It addressed territoriality, privacy, and control, and also took into consideration the group as well as the individual. However, it was very much a one-off experiment, even though the interior scheme survives intact at Centraal Beheer to this day.

Within a few short years, the technology revolution of the 1980s was giving the organization even more of a whip hand over the worker. Amid a service and property boom, amid deregulation and state sell-offs, the workplace of the 1980s was ruthlessly streamlined to meet business objectives: high-speed lifts, computer-controlled lighting, and centralized air-conditioning removed environmental control from the individual and allowed management to set the agenda. People seated at bullpens deep inside large city-center blocks could no longer recognize whether it was day or night, or what the temperature was outside: this was something that not even Frederick Taylor had denied the office clerk 70 years before. Generic office templates were provided for a generic workforce rather than for a corpus of real people with individual requirements (Freeman & Knight, 2009).

By the end of the 1980s hard-pressed workforces were feeling the ill effects of their environment. A group of researchers identified Sick Building Syndrome as comprising flu-like symptoms of lethargy, stuffiness, and headaches caused by oppressive conditions. The main cause of this syndrome was pinned on poor indoor air quality. This would suggest that many office blocks failed the most basic, habitable level of physical comfort. However, closer analysis revealed a psychological component to the ailments presented: employees were denied a view of the outside, were unable to open windows, walk downstairs at their own speed, or switch desk lights on and off; in other words, they were unable to exercise individual choice and control over their own environment. What was missing was psychological comfort.

Other work-related illnesses such as repetitive strain injury and tenosynovitis emerged at the end of the 1980s, again suggesting a failure of physical comfort. Intense focus on workstation design coupled with new, mandatory European health and safety directives helped to raise standards in the 1990s, although improvements were not uniform. A doctoral study of 3,000 office employees at the University of Dundee (Anjum, 1999) painted an unhealthy picture: about one fifth of UK workplaces failed to provide an adequate work environment and staff in a quarter of UK offices had

serious complaints about such environmental factors as layout, furniture, temperature, and noise control.

Work as a Social Activity

This pattern of dissatisfaction and disengagement would be repeated around the world as the open-plan office became the default format for workplace designers into the new century. Part of this trend was driven by cost, but also more positively by a perceived need to improve collaboration and communication to boost innovation in an increasingly knowledge-led economy.

The primacy of work as a collaborative and social activity led to extensive design investment in new workplace schemes, but tearing down walls and barriers did little to stem the tide of worker discomfort. What was gained in communication with others was lost in terms of an individual's ability to concentrate. Companies in this period experimented heavily with office redesign, especially in creating new settings for highly valued knowledge workers, but didn't appear to learn much in the process (Davenport, Thomas, & Cantrell, 2002).

However, one useful departure in practice was a widespread move away from deep space to narrower floorplates in 'finger-style' offices buildings to afford more workers a view of daylight, the outside, and green space. This approach can have a positive impact on personal wellbeing according to many studies (Cooper, Boyko, & Codinhoto, 2008).

In 2003, I worked closely with the magazine *Management Today* and ICM Research to undertake a workplace study with 600 senior managers in the UK. We were looking for best new practice but the results were discouraging. Nearly a third of those canvassed said they'd be ashamed to bring clients or contacts into their own workplace (this was despite six out of 10 managers saying that the design of their office had been reviewed within the past 12 months). And 45% of managers told us they'd consider changing companies—even if the role, salary, and benefits in the new job were identical—in return for a better work environment. Right at the top of the executive wishlist was the provision of relaxation and thinking spaces, a reflection of how stressful the workplace had become.

Two years later, in 2005, a new British study commissioned jointly by the Commission for Architecture and the Built Environment and British Council for Offices revealed that the physical workplace is responsible for 24% of

total job satisfaction and can affect staff performance by 5% for individuals and 11% for teams. Its message that poor workplace design reduces business performance and raises stress levels among employees was a welcome one. However, the study was less clear on how to use office design to improve health and wellbeing.

This was despite a wealth of academic research in the areas of environmental psychology, organizational identity, and organizational symbolism that provided evidence that office design influences individual identities, creativity, and mood in addition to traditionally researched variables such as physical comfort, safety, and ergonomics. A number of studies persuasively demonstrated that increased job satisfaction and identification with the employer results in lower staff turnover, greater productivity, and increased profitability. Workplace design also plays a role in creating a cohesive shared identity and culture, enhancing employee recruitment and retention.

Job satisfaction is an affective, emotional reaction to the experience of work, encompassing a wide range of factors including challenge, autonomy, and working conditions. A clear link has been established between satisfaction with the physical environment and job satisfaction. This is critical to an organization's effectiveness in terms of maintaining low rates of absenteeism and turnover. Carlopio (1996) found that satisfaction with the physical environment and job satisfaction both had a positive relationship with commitment to the organization and intent to stay.

Wells (2000) found that environmental satisfaction positively influenced job satisfaction, and wellbeing. Harter, Hayes, and Schmidt (2008) studied 36 companies, examining the relationship between employee satisfaction and organizational outcomes. Their findings indicated that the average job satisfaction for each organization was consistently related to productivity, turnover, customer satisfaction, accidents, and profitability.

Developing higher levels of identification with the employer and attachment to place can in turn be associated with the development of a shared social identity (Vischer, 2005). This factor has been found to be a major determinant of desirable social behaviours within groups such as trust, communication, courtesy, and positive influence, all of which help to combat psychological stress and discomfort at work. However, the construction of social identity has not been a real priority in office design, which has tended to focus more explicitly on raising productivity through functional comfort to meet the competitive demands of the global economy.

A Welcoming Workplace?

In 2008 my own research group, the Helen Hamlyn Centre for Design at the Royal College of Art, completed a qualitative study involving around 80 office workers aged over 50 in three knowledge-intensive industries: pharmaceuticals, technology, and financial services (Myerson & Bichard, 2009). Working with academic partners in Japan (at the University of Kyushu) and Australia (at the University of Melbourne) we engaged groups of senior knowledge workers who rarely draw attention to themselves; typically, mature research chemists, process engineers, and financial analysts who comprise the "corporate memory" of their employers and whose departure from the organization due to ill health or disaffection would leave a hole in the knowledge base.

We interviewed these people in their organizations in London, Yokohama, and Melbourne and also quizzed the discipline managers responsible for their welfare and productivity in such areas as facilities, estates, human resources, occupational health, and diversity. Based on what we learned we then rapidly constructed experimental work settings for them to experience changes to the environment in terms of lighting, acoustics, furniture, technology, and ambience over a period of up to 2 weeks. These interventions were designed to gather additional information and insights on needs and aspirations; how people adapted and responded to them was monitored and analysed.

The study, entitled Welcoming Workplace, raised serious questions about standard open-plan working. In particular the research team found that key aspects of knowledge work, such as individual concentration on complex tasks, were poorly catered for by the general design of the open-plan office. An overriding emphasis on collaboration and teamwork neglected the fact that knowledge work requires intense periods of deep, uninterrupted concentration and thinking, often undertaken alone. To achieve this people often had no option but to take work home. Noise and distraction at work had a negative impact not just on productivity but also on general wellbeing, a finding that recalled many earlier studies (such as Kahn, 1981).

These older knowledge workers did not dismiss the importance of collaboration but regarded it as poorly served by nothing other than physical proximity in bland open-plan areas. Proper team settings were preferred that really supported project working through enhanced display media, lighting, layout, and protocols of use. Participants in the study also articulated a need for suitable spaces to contemplate—to think, relax, and physically

recuperate during the working day—shielded from the daily social grind of being constantly on show within the organization.

Well-planned contemplation space emerged as a missing dimension in office design. However, this presents a challenge in terms of workplace culture. With age, sensitivity to and dependence on the physical work environment increases. Older workers are less able to adapt to poor acoustics, bad lighting, or uncomfortable furniture, and they feel the loss of control over their environment more keenly. Many feel tired during the working day but do not perceive that they have permission to rest and reflect, and there are very few appropriate spaces in which to do so. Many "breakout" areas in offices—originally designed to take a break from work with soft seating, low lighting, and so on—were swiftly redesignated as alternative work settings as soon as laptops and smartphones became ubiquitous.

The Welcoming Workplace study produced design guidance for architects and developers of office buildings, in association with the British Council for Offices. It advocated a range of dedicated settings for concentration, collaboration, and contemplation, each with special features to address the particular demands of knowledge work and the physical consequences of the aging process. However, its practical recommendations came with a broader call for a change of culture to improve the health and wellbeing of aging workforces, who are in danger of burnout as working lives extend. Some of the comfort challenges to older knowledge workers are functional ones, related to acoustics, lighting, and ergonomics; the most profound, however, relate to psychological issues such as privacy, status, and belonging: many older workers remarked how disassociated they felt from their own organizations due to what they perceived as an institutional ambivalence to aging.

Limits of Lean Working

All the companies we visited as part of the Welcoming Workplace research shared the same characteristics: their knowledge workers were accommodated in large open-plan spaces with "clean-desk" policies. Many had recently been ejected from their own private offices and were now part of so-called smart working schemes. This "lean working" approach deliberately echoes the concept of lean manufacturing and is a direct legacy of the Taylorist obsession with order. As W. H. Leffingwell, Founder of the National Office

Management Association, wrote in 1919: "Clerks in a disorderly office tend to become as their surroundings" (Sundstrom, 1986).

The model does not appear to have changed. Much contemporary practice supports the idea that people work more productively in a "lean" environment. Lean spaces can be characterized as being uniform, clean, and depersonalized, with a focus on minimizing distraction, standardizing working methods, and maintaining strict control over the working environment. A clean-desk policy allows people to have out only those things that they need for the task at hand. Personal objects and photographs that might provide some psychological comfort are not permitted. Nor are paper files.

However, this assumed link between superficial order and efficiency—the rationale for the "lean" environment—has no basis in empirical evidence. In fact recent research suggests that, far from being a model of productive efficiency, a lean space over which employees have no control is psychologically impoverished and, according to Haslam and Knight (2010), "the least productive use of the working environment."

Psychologist Craig Knight carried out a series of studies to test productivity and wellbeing in different environmental conditions as part of his PhD research under the supervision of Professor Alex Haslam (Knight & Haslam, 2010). The first stage involved using questionnaires to ask more than a thousand office workers about their working lives. The results showed that where employees felt that they had control over their workspace they reported a greater sense of psychological comfort. This was then associated with greater identification with the organization and enhanced job satisfaction.

The next step was a series of experiments to test whether these early findings had any measurable impact on business outcomes, with an emphasis on productivity. These experiments started from the premise that lean space management offered the best outcomes for business. Participants were randomly assigned to one of four different workplace conditions and asked to complete a series of tasks designed to test speed, comprehension, and accuracy in the processing and management of information. All of the conditions were in an enclosed single-person office with a single window.

The variations in each condition were: *lean* (the office space comprising nothing other than office furniture, a pencil, and paper), *enriched* (the office space decorated by a designer using a selection of plants and corporate art), *empowered* (the office space decorated by the research participant, who was allowed to choose and position up to six plants and six pictures from a selection provided by a designer), and *disempowered* (the participant was

allowed to decorate the space as in the empowered condition, but the design was then rearranged by "management:" in this case, the experimenter).

The results of the experiments indicated that wellbeing and productivity are enhanced by enriching a space, and then further still by empowering participants within the same working environment. Disempowering participants has the effect of significantly compromising both wellbeing and productivity. People in an enriched space worked approximately 15% faster than in a lean office, without any more errors. Perhaps we should not be surprised: it has been known for some time that if any animal is placed in an empty cage devoid of stimuli they begin to exhibit stress behaviors; why should it be different for people in an office?

Learning from the Theater

Such evidence not only lends credence to Jacqueline Vischer's environmental comfort model but also provides a catalyst for design research seeking to develop more psychologically enriched workspaces. In 2011 Royal College of Art architectural researcher Imogen Privett began a study, Living Stages, supported by furniture manufacturer Haworth, under my supervision. This actively sought to learn from the language of theater design, which is expert in manipulating our psychological responses through scenographic techniques.

Many companies have been experimenting for some time with more elaborate narrative-driven office schemes that appeal to the senses and are based on projecting brand values to improve company culture (Myerson & Ross, 2006). However, Privett identified that that while psychologically impoverished lean workspaces neither enhance organizational performance nor support individual wellbeing, those highly customized and expensive one-off settings at the other end of the spectrum of office design are difficult and expensive to build and replicate. Her study therefore sought a middle ground, exploring how stage design could provide inspiration to create more expressive and effective office environments using a simple "kit of parts" approach.

Drawing on the idea of "maximum effect through minimal means," the project began with archival research into the pioneers of modernist stage design, among them Edward Gordon Craig and Adolph Appia. A generic vocabulary of elements and effects was identified to create mood and atmosphere based on the application of light and shadow, projection

and effects, screens, steps, color, and vista. These key theater techniques and components were then adapted to the office environment to investigate how a sense of common purpose and shared social identity within organizations could be heightened.

Choice and Control

Living Stages and other projects of a similar intent can be seen as part of a wider approach to workplace design that seeks to loosen the grip of top-down managerial control. The introduction of scenographic techniques (framing action, projecting imagery, changing light scenes, and so on) can be viewed in the context of providing more choice and control for the individual. There is extensive literature in social and organizational psychology that suggests choice and control are powerful motivating tools for work, with productivity and wellbeing enhanced by including employees in decision-making processes.

Alongside Vischer and Knight, other researchers have made the link between feelings of control and productivity. A 2010 study at Chung-Ang University in Seoul surveyed nearly 400 employees at Michigan companies and found a relationship between people's perceived control over their work environments and their ability to focus (Haslam & Knight, 2010). In this instance, "control" was largely defined as being able to move furniture around within the workspace and customize displays. Survey responses indicated that when employees felt they had a say in the physical aspects of the work environment the negative effects of noise and other distractions were reduced.

The benefits of empowerment can be extended to the design process itself: if users are involved in workplace decision making they are more likely to invest in those decisions. This helps to develop a sense of shared identity, which enhances their motivation and productivity. All of this suggests that to be successful major changes in the workplace environment need to be carefully managed rather than imposed from above (Vischer, 2003).

A postoccupancy study of the US Federal Aviation Administration buildings found that after 1 year the employees who were consulted and involved in design decisions were significantly better satisfied with their building than were occupants of a second building where participation had been minimal (Sundstrom, 1986). The benefits of this kind of codesign strategy are predicated on carrying out genuine and meaningful consultation between

managers, employees, and designers, and not simply using consultation on design as therapy or a placebo.

Empowerment through participation in decision making is also an important component of territorial control (Vischer, 2005). The perception of territory is strongly linked to a sense of identity. Fritz Steele (1986) identifies a cohesive sense of identity as one of seven areas of ecological impact within organizations: it is a key factor that provides a context for action. Recent research from both sociologists and psychologists has shed new light on the important role of office layout and decoration on perceptions of identity and culture in organizations. Elsbach and Bechky (2007) state that office décor in the form of personal mementoes (forbidden by clean-desk policies) may be "critical" for affirming the distinctiveness of individuals, while décor in the form of task-relevant objects may be critical for affirming the status of groups.

Office décor and design can be thought of as the visible part of the culture of an organization, just as anthropologists point to objects as the visible manifestation of culture. Interaction with objects is part of what creates our sense of self. Over time, people develop emotional bonds with the objects that make up their workplaces. Office design and décor can therefore be considered to create "something like an emotional home" for the people who work there. This use of design to promote this kind of "place attachment" can make workers more satisfied with their office environment by generating emotional bonds to their workspace over time (Elsbach and Bechky, 2007).

Social Sustainability

Place attachment is an integral component of psychological comfort, which provides a platform for improving job satisfaction, commitment to the employer, performance, and wellbeing. But to reframe office design and décor from such an anthropological perspective requires a sea change in managerial attitudes. One positive factor in encouraging companies to think more broadly about building culture is the current drive to make office buildings more sustainable.

In this context the challenge of individual control over the environment becomes more aligned with corporate objectives to reduce energy costs by, for example, switching off lights and raising blinds to make better use of daylight. Ecological sustainability is therefore intrinsically aligned with

social sustainability, as companies can only do so much to reduce the carbon footprint at the level of the technical systems of the building: much depends on the behavior and attitudes of staff inside the building.

A Helen Hamlyn Centre for Design study in partnership with Johnson Controls, an international facilities management company, looked at three large organizations in the United Kingdom and the Netherlands to explore different "cultures" of workplace sustainability (Greene, Myerson, & Puybaraud, 2012). The research team identified a framework with four distinct models—"pragmatist," "libertarian," "housekeeper," and "campaigner"—in terms of attitudes toward sustainability, based on beliefs about relative costs to the company and employees (low to high). These four "cultures" represented the majority opinion within the companies, the types of sustainable policies they might consider, and the conditions under which they might implement them.

Within the pragmatist culture people believe that only initiatives that require low cost or no cost to either employee or company can be viable and realistic. The libertarian culture sees sustainability as a company issue that should not impose any cost on employees. Within the housekeeper culture, companies will not bear the cost of sustainability and instead expect employees to make changes and carry the burden. In a campaigner culture, both the company and employees take responsibility for sustainability and accept that there are costs that each must take on.

Both the housekeeper and campaigner cultures imply that employees will necessarily exercise more control and intervene more directly in their environment in the interests of sustainability (the campaigners with company support and the housekeepers without it). This opens a door to higher levels of psychological comfort in the future workplace, as the demands of a low-carbon economy encourage workers to take matters more into their own hands (through recycling waste or car pooling, for example). This may give workers a greater feeling of involvement and empowerment with corresponding wellbeing benefits.

Greater employee ownership of corporate energy-reduction targets will take time, in much the same way that, more generally, greater employee engagement in the corporate workplace will also be slow to achieve. After a century or more in which psychological health and wellbeing at work has been largely overlooked, designers need to look beyond the considerable ergonomic challenges of physical and functional comfort in the office to address our higher needs. Only then will we enjoy workspaces that don't make us sick.

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15

Linking the Physical Design of Health-Care Environments to Wellbeing Indicators

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Introduction

Maintaining a healthy life plays a key role in a human's wellbeing and quality of life. Throughout life there are times when physical and mental health issues need to be addressed, requiring consultation with health-care professionals and access to health-care facilities. Of course, the medical care received is of upmost importance, but the environment in which the care is received can also impact the recovery process and broader aspects of wellbeing. This chapter examines how the physical design of health-care environments impacts on wellbeing.

Health-care environments incorporate a broad range of necessary health-care services and range from large teaching hospitals, providing acute services for thousands of patients, to small care homes, providing long-term care for only a handful of residents. Health-care environments need to be able to support all age groups, at all stages of health. Primary, acute, and long-term facilities include: general practice surgeries, dentists, outpatient departments, radiography departments, hospices, mental health units, rehabilitation wards, and spinal injury centers: the list is endless, the environments diverse, and their purpose varied.

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Wellbeing is also a broad term encompassing a number of concepts and is defined in a multitude of ways. A report for the Scottish Government described wellbeing as "even more ambiguous, abstract and nebulous a term" than quality of life, "put simply, an accepted, uniform definition of either term does not exist" (Galloway & Bell, 2006, p. 10). In many policy reports, and health and research papers, wellbeing is a commonly used term, yet it is loosely defined, if at all. The same is true for research examining the relationship between health-care environments and wellbeing. Instead of documenting how wellbeing is examined or measured and how it, or aspects of it, are influenced by the environment, the possible mechanisms involved are left for the reader to infer through the implied meaning of the word, wellbeing. This lack of definition and consistency in reporting reduces the chance of producing clear, evidence-based design guidelines for the environment to improve or support wellbeing.

Early research exploring the relationship between the physical environment of health-care settings and health outcomes focused primarily on hospital environments. The design of hospitals in the 1970s responded to the challenges of increasing technology and rapid change, mainly through functional design solutions (Devlin & Arneill, 2003). In the 1980s and mid-1990s the focus changed towards creating more welcoming hospital environments and an interest in the therapeutic role of the physical environment on patient outcomes began to develop.

More recently, and in response to the growing body of evidence supporting the therapeutic effects of health-care design, health policy in the United Kingdom is taking an increased interest in the physical environment of health-care settings. Policy changes such as Private Finance Initiatives created new privately funded, public hospitals, and the opportunity to consider the impact of the physical environment on wellbeing (Gesler, Bill, Curtis, Hubbard, & Francis, 2004). Initiatives such as the Enhancing the Healing Environment programme, from the King's Fund (Waller & Finn, 2004), have developed with the aim of providing multidisciplinary projects to improve aspects of health-care environment design such as waiting areas, gardens, or staff facilities.

Environmental design impacts on all users of a health-care system, including patients, visitors, and staff. Each user has varying needs; their use of a health-care environment differs, along with their expectations and subsequent evaluation of the environment and its impact on their wellbeing. Patients' evaluation of the environment will vary depending on their cognitive, emotional, and physical state as well as their anticipated needs.

For example, children may enjoy a colorful attractive play area to serve as a welcome distraction while they recover in hospital (Pelander, Lehtonen, & Leino-Kilpi, 2007), but for those with severe mental health problems strong colors and abstract art can be overstimulating (Payne & May, 2009; Phiri, 2006).

Visitors' wellbeing also needs to be considered as their emotional welfare and the subsequent physical problems that can arise from supporting or caring for someone are important. Their expectations and needs from a health-care environment are also not necessarily the same as those of patients. Similarly, health-care staff use the same environments as patients and visitors, but over much longer periods of time. This can result in staff habituating to poor environments, resulting in a lack of awareness of the impact it has on patients, or themselves in the long term. Staff need the environment to be supportive of their work, and allow them to provide care to the best of their ability. Indeed, Directors of Nursing ($n = 265$) considered hospitals' external (39%) and internal (37%) spaces to be very important in the recruitment and retention (35%) of nursing staff (Commission for Architecture and the Built Environment [CABE], 2004).

There have been a number of reviews evaluating the effect of environmental features in health-care environments. These have included an examination of the effects of the physical environment on patients (Devlin & Arneill, 2003) and staff outcomes (CABE, 2004; Phiri, 2006), including through socially and psychologically mediated effects (BMA Science & Education, 2011; Tanja-Dijkstra & Pieterse, 2010; Ulrich et al., 2008). These reviews have provided a firm base in identifying key environmental features that are (dis)advantageous when people interact in the various settings. Although the reviews and reports often refer to "wellbeing," it occurs largely without explicitly stating how the environment affects specific indicators associated with wellbeing. This chapter aims to tease out these connections between the reported health-care environment outcomes identified in reviews and other research and explores their relationship with wellbeing.

The New Economics Foundation (NEF) model of wellbeing (Michaelson, Abdallah, Steuer, Thompson, & Marks, 2009) is used in this chapter as a framework to explore the relationship between wellbeing and health-care environments. The NEF model defines and measures wellbeing through two main indicators: personal wellbeing and social wellbeing. Personal wellbeing contains the component indicators *emotional wellbeing*, *satisfying life* (not covered in this review), *vitality*, *positive functioning*, as well as

resilience and *self-esteem*. Social wellbeing is comprised of the component indicators *supportive relationships*, and *trust* and *belonging*. Together these components are used as indicators to measure overall wellbeing and can be applied within specific life domains, such as "wellbeing at work." As the NEF model includes many of the components used in the varied definitions of wellbeing, it is used in this chapter as an illustration of the indicators involved, rather than as a preferred definition or model of wellbeing per se.

Personal Wellbeing

Emotional Wellbeing

Emotional wellbeing consists of two subcomponent indicators: the presence of positive feelings and the absence of negative feelings. The physical environment of health-care settings can have an immediate effect on emotional wellbeing as patients and visitors attempt to find their way to the appropriate department. Hospitals are often complex sites with many departments and corridors, making wayfinding (orientating and navigating between places) difficult. As one in five people arrive anxious, the additional burden of finding their way around without getting lost can result in increased anxiety and frustration (Department of Health, 2005). Confusing layouts (e.g., entrances not at the front of buildings) and lack of environmental cues (e.g., landmarks at entrances) result in a wayfinding system that is overreliant on signage. This in turn can result in increased patient and visitor anxiety if they are unable to interpret and follow the numerous (unclear) signs (Department of Health, 2005). In contrast, well-designed wayfinding systems and "naturally" designed wayfinding routes (e.g., visibility of entrances) may reduce and prevent unnecessary anxiety. An environment that has a limited need for signage is also more conducive and manageable for visually impaired patients and visitors (NHS Estates, 2003). Recommended wayfinding systems include, but are not limited to, considering the journey people take from start to finish, such as before they arrive, how they arrive, consistency in the terms used throughout a location, careful use of color coding, and the use of additional sensory cues to aid visually impaired people (Department of Health, 2005).

Wayfinding problems can also result in anxiety for older patients in nursing homes as spatial skills decline with age. Without simple layouts and clear memorable environmental cues, people with cognitive impairments struggle

to do simple tasks like moving from the lounge to their bedroom, as they get lost en route (Passini, Pigot, Rainville, & Tetreault, 2000). The size of living area, circulation spaces without changes in direction, and one lounge/dining room were found to improve wayfinding for residents with moderate or severe dementia in 30 nursing homes in Germany (Marquardt & Schmieg, 2009). In 13 care homes, residents with dementia ($n = 104$) appeared to find their way around more easily in properties converted from older establishments that were aided by meaningful decision points as landmarks (Netten, 1989). Residents with Alzheimer's disease found changing floors and using elevators particularly problematic, creating anxiety as it involved long attention spans (waiting for lift to arrive), fast decision making (recognizing the correct floor before doors close again), and agility (movings in or out before doors close) (Passini et al., 2000). The effectiveness of color to aid wayfinding may be limited due to older people's ability to discriminate between colors (Rule, Milke, & Dobbs, 1992). However, a review by Fleming and Purandare (2010) suggests there is only weak evidence to support the use of signage and displays of personal memorabilia to aid wayfinding in care home.

Having found the desired location, anxiety levels may increase waiting for an appointment or examination. It has been proposed that attractive waiting areas can reduce anxiety in patients (Sadler, Joseph, Keller, & Rostenberg, 2009). However, the relationship between self-reported anxiety levels ($n = 205$) and the attractiveness of waiting rooms, hallways, and examination rooms in five New York hospitals were only weakly correlated (< 0.3) (Becker & Douglass, 2008). Additionally, renovated waiting areas of a U.K. cardiac outpatient ($n = 181$) and neurology unit ($n = 145$) that were rated significantly higher on a number of evaluative terms (e.g., attractiveness, pleasantness, how welcoming, light) did not significantly lower self-reported pain, anxiety, and stress levels (Leather, Beale, & Lee, 2000; Leather, Beale, Santos, Watts, & Lee, 2003). There were also insignificant differences between patients' pulse rates and arterial pressure measurements before and after the renovation in the cardiac outpatient waiting area (Leather et al., 2000). However, stress levels of patients in the renovated neurology waiting area did decrease after spending a short amount of time in the new waiting area (7 min) (Leather et al., 2003).

Stress levels of postoperative patients ($n = 97$) only significantly decreased in a renovated U.K. coronary angiography daycase unit once additional "lightboxes" were installed (Leather et al., 2000). Patients' arousal levels were also higher in the presence of the lightboxes, positioned above their beds, that could also provide a variety of nature scenes. Differences in

emotional wellbeing due to the availability of light is highlighted by the increased incidence of postsurgical depression, antipathy, and unpleasantness in studies of patients placed in rooms without windows, reviewed by Phiri (2006). For patients in a psychiatric unit, Canada ($n = 174$), those occupying rooms with more sunlight stayed an average of 2.6 days less than those in rooms with less natural sunlight (Beauchemin & Hays, 1996). Likewise in an Italian institute, patients with bipolar disorders placed in rooms on the east side stayed an average of 3.67 days less than those on the west side, who received less morning sunshine (Benedetti, Colombo, Barbini, Campori, & Smeraldi, 2001). Postoperative spinal surgery patients ($n = 89$) in the United States who stayed in brighter rooms with 46% more natural daylight than those in identical rooms reported significantly less stress following an operation (Walch et al., 2005).

In addition, rooms with windows have been found to improve emotional wellbeing, providing a sense of connection to the outside world. Windows are a source of fresh air, and patients reported them as a positive environmental change after the refurbishment of a psychiatric intensive care unit (Payne & May, 2009). In offices, employees with windows are significantly more interested in their job, physical working conditions, and overall job satisfaction (Phiri, 2006). Such results are likely to be transferrable to health-care staff, who often work long hours in windowless environments. The preference and desirability for windows is in part because daylight is preferred to artificial lighting (Phiri, 2006). However, the contents of window views are also reported as important in supporting individuals' wellbeing. In one well-known study, 10 years of data from postoperative gall bladder patients placed in a U.S. suburban hospital room with a view of nature (a group of trees) or a brick wall were examined (Ulrich, 1984). Those with a view of nature (trees) spent less time in hospital after the operation, took fewer strong painkillers, and received fewer negative evaluation comments from staff.

When views of nature are not feasible, "surrogate views" such as images of nature or other artwork may be feasible alternatives. In a dental clinic, patients reported feeling calmer and less tense in the waiting area when there was a mural depicturing a nature scene compared to no mural (Heerwagen, 1990, cited by Phiri, 2006). A systematic review of artwork in health-care settings concluded that it may reduce anxiety and depression in specific groups of patients, and positively affect clinical and behavioral outcomes (Daykin, Byrne, Soteriou, & O'Connor, 2008). Murals and images need to be carefully considered, although as the use of abstract pictures resulted

in patients having strong negative emotions while those who had images of nature (open view of water) resulted in reduced postoperative anxiety (Ulrich, Lunden & Eltinge, 1993, cited in Phiri, 2006). It is therefore recommended to avoid using complex art as it challenges the individual's perspective, potentially increasing their stress levels.

Access to natural settings is important in health-care settings. Seventy-eight percent of interviewed users ($n = 143$) of four U.S. health-care gardens reported feeling more relaxed, less stressed, calmer, and content after spending time in the garden, while a quarter felt refreshed, rejuvenated, stronger, and able to think, find answers, and cope (Cooper Marcus & Barnes, 1995). Differences were also found in how staff, visitors, and patients benefited from the garden; staff and visitors in particular felt calmer and relaxed, while a small percentage of patients had a spiritual or religious mood shift. Health-care gardens can provide users a calming alternative space, but unfortunately their peacefulness can be disturbed by neighboring traffic, preventing the pleasant natural sounds from being heard (Cooper Marcus & Barnes, 1995). A health-care garden that provides a pleasant natural soundscape in contrast to the numerous sound-producing machines and hard surfaces in hospitals, is a key reason why patients, visitors, and staff wish to use the garden (Cooper Marcus, 2000). Therefore, the positioning of a health-care garden in relation to the surrounding infrastructure is important as its soundscape plays a role in creating a calm and restorative environment (Payne, 2013).

Pleasant external sounds are important as internal sounds of health-care environments can have a negative impact on people's wellbeing. Self-ratings of noise-induced stress significantly explained (14%) self-report measures of burnout by critical care nurses ($n = 100$) in two U.S. hospitals (Topf & Dillon, 1988). The nurses cited telephones, equipment alarms, and monitor beeps as moderately to extremely distressing noise-related sources. Installing sound-absorbing ceiling tiles, which reduced sound levels by 5–6 dB in the central area of an intensive coronary care unit and patient rooms, reduced staff's experiences of pressure, strain, and demands ($n = 36$) (Blomkvist, Eriksen, Theorell, Ulrich, & Rasmanis, 2005). Acoustic ceiling and floor tiles are recommended for critical care units to reduce ambient sound levels and in turn reduce staff stress, for example carpeting heavily used areas, fitting swinging latch-free doors, rubber stripping in doorways, insulated walls, glass sliding doors in patient rooms, and the provision of separate rooms for conversations (Topf, 2000). Additionally, a review by Ulrich et al. (2008) cites single bedrooms compared to multibed wards

as important design features that affect sound levels and greatly improve patient satisfaction with hospital soundscapes.

Sounds can also be used to positively enhance the environments of health-care settings. Systematic reviews have shown that listening to music has a significant reduction in anxiety (self-rating measured, State-Trait Anxiety Inventory) for patients with myocardial infarction and mechanically ventilated patients, but not for those who have just undergone cardiac procedures (Bradt & Dileo, 2009; Bradt, Dileo, & Grocke, 2010). The interventions often did not account for the ability of patients to choose their own music, amount of time the music was played, and varied music preferences; it was suggested results could be stronger and further-reaching than current experimental evidence (Bradt & Dileo, 2009).

Nurses identified lighting and ambient temperatures as the top two most frequent "hassles" within a U.K. emergency department (Helps, 1997). Half of nurses interviewed ($n = 500$) strongly agreed that working in a poorly designed hospital increased their stress levels (CABE, 2004). Nurses ($n = 44$) working in the open-bay section of a neonatal intensive care unit versus single-family care rooms reported significantly higher levels of stress and lower levels of job satisfaction (Shepley, Harris, & White, 2008). In particular, conflicts with physicians and problems with supervisors and colleagues were a source of stress in open wards, suggesting social support systems (social wellbeing) were also affected by differences in ward layouts.

Vitality

Vitality is the "state of having energy available to the self" (Ryan & Deci, 2001) to be able to perform functions that involve mental or physical vigor and provide a sense of liveliness and animation. First, basic physiological mechanisms must be met to improve patients' health or staff productivity levels. These can include meeting food, drink, and thermal requirements, blood pressure levels, heart rates, low pain levels, and the ability to sleep and avoid fatigue.

Patients' blood pressure and heart rates can be detrimentally affected by raised sound levels (BMA Science & Education, 2011; Joseph & Ulrich, 2007). Although the World Health Organization has produced recommended guidelines for sound levels in patient rooms [35 dB(A); Berglund et al, 1999] they are constantly exceeded in hospitals, often by 20–40 dB(A) (Busch-Vishniac et al., 2005). Sensible environmental design can reduce sound levels, such as the use of sound-absorbing ceiling tiles (Blomkvist

et al., 2005) and single bedrooms instead of multiple open-plan wards, and by eliminating or reducing noise sources through improved product design or the considered placing of equipment (Joseph & Ulrich, 2007).

Not all sounds have a negative impact, however, and the introduction of certain sounds can be beneficial. Systematic reviews of clinical trials using music as an intervention found music significantly lowered heart rates of patients with coronary heart disease and those on mechanically ventilated systems (Bradt & Dileo, 2009; Bradt et al., 2010). Results were inconsistent, though, and the effect size of the heart-rate reduction was larger when patients were able to choose their own music (an increased reduction of around 3.5 beats per minute) (Bradt & Dileo, 2009). This suggests the importance of control (*autonomy*) over environmental aspects as an important interaction in physiological wellbeing. Respiratory rates were also reduced for mechanically ventilated patients when listening to music suggesting that the resultant combined effect was relaxation, which is beneficial for their recovery process (Bradt et al., 2010).

Blood-pressure levels were not significantly reduced for mechanically ventilated patients who listened to music compared to control patients (Bradt et al., 2010). However, for patients with coronary heart disease, systolic blood pressure levels but not diastolic blood pressure levels were significantly reduced through such music interventions (Bradt & Dileo, 2009). Systolic blood pressure levels have also been significantly reduced by placing images of natural environments above people's beds compared to images of sports scenes or no pictures at all (Coss, 1990, cited by Phiri, 2006). This is particularly important to consider in health-care environments for people who are likely to spend large amounts of time lying down, staring up at the ceiling.

A systematic review by Bradt and Dileo (2009) found music significantly reduced self-reported ratings of pain by coronary heart disease patients, although results were inconsistent with only small effect sizes. Natural sounds of birds and running water, along with an image of a mountain stream and meadow, were found to reduce patients' ($n = 80$) self-reported level of pain control (one item, five-point scale) but not their anxiety levels (STAI measure) during a flexible bronchoscopy procedure, compared to patients without audiovisual nature (Diette, Lechtzin, Haponik, Devrotes, & Rubin, 2003). Reported problems with the tape machines provided (e.g., difficulty in changing the volume) to patients potentially hampered changes in anxiety results.

Views from windows have also been reported to affect levels of pain experienced by patients in health-care settings. Surgical patients in rooms with windows looking on a natural scene had shorter hospital stays and took fewer strong painkillers postoperation than those patients with windows facing a brick wall (Ulrich, 1984). Although this study is well known for the beneficial effects of nature on improved health, the outcome differences could have also been influenced by the amount of daylight received (luminosity levels were not reported). For example, in a study of postoperative spinal surgery patients, those in rooms that had 46% more natural light compared to identical rooms used significantly less pain medication (analgesics) on their first day in the room (Walch et al., 2005). These patients continued to use less pain medication on subsequent days too, resulting in an overall 22% reduction in analgesic use, which converts as a 21% reduction in their analgesic costs, thereby benefiting the hospital. Although all age groups decreased the amount of pain medication taken, it was the younger patients (22–49 years old) in particular for whom a significant decrease in pain medication was found. In a more extreme example, mortality rates over a 4-year period in a cardiac intensive care unit were higher for patients placed in a bed in a dimly lit room compared to a bed on the sunny side of a Canadian hospital (Beauchemin & Hays, 1996).

For patients suffering from injuries or recovering from heart surgery, gardens with a variety of informed and marked walking routes are useful for rehabilitation (Cooper Marcus, 2000). A variety of paths that increase in length and gradient encourage exercise during long stays in hospital. Care home guidelines recommend gardens that encourage activity (Day & Cohen, 2000); however, health and safety regulations as well as risk of physical harm were cited by care staff to impose the greatest constraint on the use of outdoor space for residents with dementia (Gibson, Chalfont, Clarke, Torrington, & Sixsmith, 2007). Of course, the need for access to nature depends on the type of health-care setting, as it is understandably low in importance for environmental features for emergency department patients (Walsh & Knott, 2010).

Poor environmental design can be detrimental to patients' health, potentially prolonging their road to recovery and affecting vitality levels. For example, the review by Phiri (2006) found some evidence that bedrails may increase the number of falls and injuries, and the severity of the fall, especially for those in a "nonrational state." The review described how the use of bed restraints can make an individual lose their sense of freedom, dignity, and *autonomy*, which are all-important aspects of wellbeing. Further research

into alternative design solutions such as lowering beds is necessary (Hignett & Masud, 2006) as well as addressing patient and staff attitudes to risk and care (Phiri, 2006).

Falls can be a significant problem in hospital settings and are associated with increased lengths of stay and health-care costs (Oliver, Daly, Martin, & McMurdo, 2004). A recent systematic review by Choi, Lawler, Boenecke, Ponatoski, and Zimring (2011) assessed the effectiveness of fall interventions implemented in hospitals. Seven of the 14 studies identified in the review had implemented an environmental assessment and modification interventions as part of a multifactorial falls programme. The authors reported that although most multifactorial interventions resulted in a reduction in falls, it was not possible to tell how each component of the programme had contributed to the results.

Design features such as doors and distances between spaces can potentially effect patients' recovery. Patients suffering from chest pains ($n = 2024$) admitted to an emergency department were more likely to wait over 10 min to be seen by a doctor if they were placed in rooms with doors and were further from the physicians' work area (>7.6 m) (Hall, Kyriacou, Handler, & Adams, 2008). This ultimately prolonged their diagnosis and the commencement of pain medication. The positioning of doors in a department is also important when considering airflow, because draughts are a common source of discomfort and irritation for patients (Gulrajani, 1995). Designing for thermal control is particularly important in the burns units where patients' skin is even more sensitive to temperature changes (Mazuch & Stephen, 2005).

The physical environment of health-care settings can also be important for staff vitality. The configuration of hospital departments and wards (radial layout or single corridors), location of nurse stations (decentralized or centralized), stores, and drug cupboards all affect staff walking levels (Ulrich et al., 2008). Longer walking distances for staff unnecessarily increase fatigue levels and reduce the time available for direct patient care. Emotional and cognitive burnout, in part caused by environment-induced fatigue, can result in staff absenteeism which is a common problem in health-care settings. Physiological problems such as back pain are also a factor in staff absenteeism which can be managed through sensible environmental design. For example, the inclusion of ceiling lifts in a Canadian long-term care facility, to help with repositioning and moving of patients, was found to significantly decrease staff discomfort compared to manual lifting, as well as reducing perceived risk ($n = 30$) (Miller, Engst, Tate, & Yassi, 2006).

The implementation of the ceiling lifts also helped staff perceive their job as less mentally demanding and resulted in a 70% decrease in claims the following year, saving hospital money from staff absenteeism. A review by Joseph (2006) discusses the negative impact, such as back pain, that patient lifting, hard floors (as opposed to rubber flooring), and poorly designed work areas that require unnecessary twisting can cause for staff.

Finally, the physical environment can either help or hinder people's ability to sleep and in hospital environments, unfortunately, the latter is often the case (Ulrich et al., 2008). For example, consistently loud sound levels and series of noises in hospital wards are often described by patients as problematic when trying to sleep (Coughlan & Corry, 2007; Solet, Buxton, Ellenbogen, Wang, & Carballeira, 2010). Lighting conditions can also affect patients' circadian rhythms with poor natural and artificial lighting affecting patients' ability to sleep (Ulrich et al., 2008). Research and design for creating the right lighting conditions to help patients and neonatal babies fall asleep quicker and for longer periods is ongoing (Building Better Healthcare, 2012). A lack of quality sleep [frequent and long rapid-eye-movement (REM) periods] results in mental fatigue, as depleted cognitive resources are not given time to recover, reducing individuals' capacity to process and act on information. Moreover, in clinical care units psychoses (withdrawal, disorientation, and delusions) have been reported due to sleep deprivation (Topf, 2000). In addition to cognitive problems, disrupted and poor-quality sleep can result in emotional problems (e.g., depression) as well as physiological problems such as weight gain and increased risk of falls (Solet et al., 2010).

Resilience and Self-Esteem

Resilience represents the ability to recover quickly or easily from illness and adaptability to a situation due to one's psychological resources (Michaelson et al., 2009). *Self-esteem* can be defined as "how much value people place on themselves" (Baumeister, Campbell, Krueger, & Vohs 2003, p. 2) and can be affected by the physical environment. For example, the remodeling of six adult wards (lowered ceilings, created separate seating areas, regrouped furniture, recessed lighting) improved patients' negative self-image (Christenfeld, Wagner, Pastva, & Acrish, 1989), but further understanding of the specific features that resulted in the improvement is needed.

In health-care settings self-esteem may be particularly important to maintain for children and teenagers, who are naturally developing an increased

awareness of themselves and how others perceive them. Self-esteem therefore needs to remain high despite any current health problems. Focus groups with health-care researchers, staff, and architects suggested that environmental features such as color, temperature, light, sound, the ability for personalization, and privacy all affect the self-esteem of children in health-care settings (Rubin, Owens, & Golden, 1998). Interviews with young patients ($n = 80$) in a Canadian hospital found similar results (Adams, Theodore, Goldenberg, McLaren, & McKeever, 2010). The large public atrium in the hospital was designed to be a welcoming place where patients, visitors, and the public could freely interact, yet many adolescents reported feeling "embarrassment or pressure to look 'presentable' in the atrium" (Adams et al., 2010, p. 663). The public characteristic of the space may prevent the patients using it, although the researchers felt the atrium would actually help the adolescents come to terms with their new identity. Further research in this area is therefore needed and perhaps multiple spaces with varying degrees of public or coshared access are needed to help children's self-esteem develop.

Positive Functioning

Competence.

Competence is the ability to deal with a matter sufficiently and the feeling of accomplishment from the achievement (Michaelson et al., 2009). A patient's physiological, cognitive, and affective state may mean they do not necessarily have the same capacity for environmental mastery, which is "the capacity to manage effectively one's life and surrounding world" (Ryff & Keyes, 1995, p. 720). In a review (Phiri, 2006) it is suggested that the influence between the physical environment and a likely fall depends on the competencies of the individual; the less competent an individual is at performing various tasks (e.g., walking, transferring between seats), the greater the impact of the environment in supporting or hindering their desired activity. For example, environmental and social features (extrinsic factors) are more likely to be the cause of falls in people aged 65–74 years, whereas above this age individuals' states and traits (intrinsic factors) become more important (Accidental Injury Task Force, 2001). To help increase people's competency in moving around, appropriate and supportive environmental conditions should be created that match individual needs. This may mean clearing obstacles in pathways to prevent tripping, or placing stable objects en route to act as handholds (Phiri, 2006). In addition, people's usual wayfinding ability can be reduced by their

affective state (e.g., stress, anxiety) and cognitive attention to other pressing matters, thereby limiting their competence in processing environmental cues.

Attentional capacity has consistently been found to be enhanced by accessing nature, including for patients with current health problems (Hartig, 1991). For example, female breast cancer patients contracted to do three restorative activities a week, such as walking in a park, observing nature, and reading a book, performed consistently better over time on the combined results of a number of tasks measuring attentional capacity than those who were not contracted to do such activities (Cimprich, 1993). The indoor health-care environment can also affect people's attentive skills. U.K. cardiac outpatients ($n = 181$) had significantly improved attentional spans when in a new significantly positively evaluated waiting area (e.g., higher pleasantness, relaxing, and welcoming ratings) than prior to the renovation (Leather et al., 2000). Patients completed an attentional task in a significantly faster time and with fewer errors than those who had been in the "old" waiting room, suggesting that a "pleasantly designed environment is less mentally demanding on patients" (Leather et al., 2000, p. 29). Good cognitive attention levels are necessary for patients to retain and understand information about their illnesses, any procedures, and therapies, as well as helping them return to work in a timely manner.

The environment can also impact staff's fatigue levels and subsequent competence. Without opportunities for attentional recovery, such as the provision of expansive views and nature, fatigue levels can be exasperated. Fatigue results in omission errors, reduced problem-solving capabilities, reduced motivation, and decreased productivity (Page, 2004). A review by Phiri (2006) found that attentional mistakes due to fatigue, workload, and the lack of correct working facilities (e.g., no desk) can result in prescription errors by doctors, while distractions can significantly lead to dispensing errors at pharmacists. Noises were also found to be disruptive, distracting, and adding to staff's cognitive load, although there was mixed evidence as to whether it increased employee's error rates. High sound levels in health-care environments have been linked to errors, in part due to the communication difficulties they cause (Berglund, Lindvall, & Schewela, 2000). In interviews with 15 nurses a noisy work environment was the most frequently mentioned obstacle to their work in an intensive care unit (Gurses & Carayon, 2009). They also described a number of other negative design features, such as insufficient desk space to write up work and assigning staff to patients positioned in distant physical locations.

Chaudhury, Mahmood, and Valente (2009) conceptualize nursing and medical errors as arising from three areas; latent conditions such as staff stress, fatigue, and satisfaction; managing decisions and organizational processes; and the physical environment including architectural design and interior aspects relating to ergonomics and the senses (e.g., light, noise). Although humans are always prone to making errors, systems, and safe designs can be put in place to prevent a number of errors from arising, such as providing adequate lighting (Kohn, Corrigan, & Donaldson, 2000). Inadequate lighting can result in errors being made on drug selection and quantities (Phiri, 2006). Providing appropriate levels of lighting can sometimes involve decreasing luminosity, at no detrimental cost to medical errors, if spotlights and temporary alterations in levels are possible for examinations. Providing control over lighting levels is particularly beneficial in neonatal intensive care units where low ambient levels of lighting are thought to be suitable for developing babies (retina protection) (Walsh-Sukys, Reitenbach, Hudson-Barr, & DePompei, 2001).

Daylight, however, tends to be preferred over artificial lighting and a minimum daylight factor of 1% within hospital wards was set by a U.K. governmental department, with window sizes, glass panes, and location needing to vary for this to be achieved, while avoiding glare and overheating for nearby patients (Phiri, 2006). Functionally, windows help illuminate an area to allow staff to carry out their jobs competently. Staff also consider natural light to be less draining than artificial lights (CABE, 2004), thus reducing the chance of fatigue and subsequent drop in competence. A review by Phiri (2006) suggests people's performance on experimental tasks is reduced in offices with windows; however, carrying out meaningful tasks (e.g., care of another human) is very different to meaningless experimental tasks, and these results may not be transferrable. Moreover, a systematic review of intensive care patients (Stein-Parbury and McKinley, 2000, cited by Phiri, 2006) found impaired cognition occurred in only 41% of patients if they were in units with windows, compared to 50% for those without windows.

Autonomy.

Autonomy is described as "a sense of self-determination" (Ryff & Keyes, 1995, p. 720), the liberty to control one's own affairs with a freedom from external influence. Having control over one's environment is particularly important if a lack of control negatively impacts on physiological conditions such as body temperature. For example, an inability to shut doors to avoid

draughts causes a negative impact on patient's health. Choice can help a person feel in control and reduce stress (Evans & Cohen, 1987) whereas a lack of control over the ambient environment such as temperature can increase stress levels and cause frustration and dissatisfaction in both patients and staff (CABE, 2004; Devlin & Arneill, 2003).

Gardens are theorized to help mitigate stress if they provide a sense of control and privacy, as well as an opportunity for movement and exercise, a place for social support, and a chance to engage with nature (Ulrich, 1999, cited by Cooper Marcus, 2000). A greater sense of control is achieved through providing choice, such as locations for seating and walking, the types of seats available, and if they can be in a secluded or expansive location (Cooper Marcus, 2000). In contrast, providing a view of an inaccessible rooftop garden was found to be a point of discontent and even a reminder of the lack of control that psychiatric patients had over their environment; "you can look but you can't touch" (Payne & May, 2009, p. 82). Accessing a garden provides a sense of escape, letting patients momentarily take control of their life by being in an environment free from the constraints of the interior health-care setting.

The environment can constrain patient behavior particularly when visual and auditory privacy is compromised, such as through the use of curtains instead of structural walls. This can result in patients not wanting to talk openly with family and friends about emotions. It may even prevent patients from divulging all necessary information to clinical staff as they don't want to be overheard resulting in increased risk of incorrect diagnoses. In one study some emergency department patients ($n = 4$ out of 84) refused certain physical examinations because of inadequate privacy, and older people in particular believed they could overhear others' conversations in curtained cubicles (Barlas, Sama, Ward, & Lesser, 2001). This suggests privacy may be particularly important for older patients.

Achieving privacy is affected by the perceived density of an environment. The perception of density is more important than actual density, as the "size of space and the number of people are significant, not as parts of a mathematical density factor, but as they interact to create certain psychological density conditions" (Wolfe, 1975, p. 219). Besides from a minimum recommended space per person, the amount of space required to encourage the particular behaviors likely to occur in the room is needed. For example, observations of children in a psychiatric ward led to recommendations that space sizes per person should vary depending on if the room was private or shared (larger space per person), and the number of people sharing (larger

space per person if two sharing compared to four) (Wolfe, 1975). It was concluded this was because large single rooms could be frightening, while twin shared rooms can result in greater privacy loss and perceived intrusion on another's space than if there were four people in a room, where social interactions may be less forced. In addition, privacy and desired personal space can be dependent on the individual and the choices they have available to them within the environment (Ittelson, Proshansky, & Rivlin, 1970).

Privacy concerns were the reason ward sizes in Mental Health and Learning Disability Institutes were considered problematic by a third of patients and their visitors (Royal College of Psychiatrists' Research Unit, 2005). Moreover, an environmental audit designed from evidence-based standards, whereby staff assess predefined features of these institutes ($n = 194$), found compliance to national standards for environmental features that aid privacy to be relatively poor. In particular, toilet and bathing facilities were not clearly marked (34%) and access to external covered spaces were low (37%). In mental health services, between a quarter and half of the responding patients ($n = 1560$) reported dissatisfaction with the availability of private spaces for spending time by themselves or with families, resulting in demoralization (Royal College of Psychiatrists' Research Unit, 2005). Overall privacy satisfaction ratings and descriptive responses from the staff and patients highlighted how these environmental features affect their autonomy, as well as other aspects of wellbeing.

The ability to move around an environment independently can greatly influence autonomy. A review by Dalke, Littlefair, and Loe (2004) states people with visual impairments, including age-related degeneration, use tonal colors for contrast to help identify objects and obstacles. The review suggests lighting can highlight important features and signs useful for wayfinding, although strong lighting from behind can cause glare for people with cataracts. Low-level lighting is also recommended to help the visually impaired, wheelchair users, and children, as is the use of textural elements.

In addition to navigation, people need to make decisions about the routes to take. Independently directing oneself between desired locations without assistance maintains autonomy. To help direct people in one direction and limit their movement in another, environmental cues as reference points can be implemented, such as pictures, color, or features to differentiate floors. For example, residents in a nursing home for people with Alzheimer's disease perceive a black dark strip as an obstacle which prevents them from accessing undesirable areas (e.g., fire escapes) (Passini et al., 2000). Reference points need to be relevant to susceptible people as

what the staff perceive as useful (e.g., a clock) may not be noticed or used by patients (Passini et al., 2000). However, a Cochrane systematic review by Price, Hermans, and Grimley Evans (2009) found no clear, conclusive evidence for the use of various environmental cues in preventing people with cognitive deterioration or impairments from wandering.

Engagement.

Engagement is "feeling absorbed in what you are doing and that you have opportunities to learn" (Michaelson et al., 2009, p. 21). There is little research on engagement in life as an outcome of interacting with health-care environments. Interventions considered to help with wellbeing indicators including engagement involve patients' interaction with various art forms such as creating and examining art, music, dance, and theater (Clift et al., 2009; Staricoff, 2004). However, the "passive" viewing of art or nature within health-care settings and its potential to enhance engagement has hardly been examined. Focus groups with mental health patients found the addition of art provided interest and stimulation compared to rooms dominated by a TV (Daykin, Byrne, Soteriou, & O'Connor, 2010). They concluded that art inspired engagement. Results from findings in other settings could also be extrapolated to some extent. For example, "healing" gardens may help an individual feel engaged with something, without draining their cognitive capabilities or any other vital resources, as nature contains properties that are inherently fascinating and use involuntary attention (Kaplan & Kaplan, 1989). This is also a key benefit of windows, as it can offer views of natural elements (e.g., sky, time of day, trees) as well as of people and their social behaviors (Phiri, 2006). The window therefore provides a connection to the outside world, helping the individual feel part of something bigger (engaged) and less isolated and separated from the rest of the community.

Social Wellbeing

Supportive Relationships

The environment can help foster relationships by providing spaces that enable people to gather, share private moments, and meet new people in welcoming and nonthreatening surroundings. Health-care places need to offer an array of social spaces that are suitable for its users, be that patients,

visitors, or staff. In a refurbished psychiatric intensive care unit the provision of separate spaces for visiting families and friends was welcomed by patients (Payne & May, 2009). People commented that it helped visiting children feel more comfortable and welcome as they did not have to interact with other patients. Presumably the spaces provided a greater sense of privacy for maintaining these core relationships.

Gardens can support relationships by providing a calming contrast from the busy, noisy hospital wards, allowing social and potentially private communications. The majority of staff ($n = 84$) and visitors ($n = 21$) interviewed in four U.S. health-care gardens reported having conversations while in the garden, although only half of the patients conversed ($n = 37$) (Cooper Marcus & Barnes, 1995). A garden designed with subclusters of seats allows small groups of people to discuss things privately (Cooper Marcus, 2000). The freedom to converse with relatives and friends is important to maximize and develop *supportive relationships*. The provision of private places to enable this is important, given that auditory privacy is often absent in hospital environments.

The presence of shops and a staff canteen can further enhance the feeling of a social community, being described as a "village atmosphere" by U.K. nurses (CABE, 2004). Maggie's Cancer Caring Centers have been designed with the aim of providing a *supportive community*, often using the kitchen as the focal welcoming point to draw people in for conversations (Department of Health Gateway Review and Estates and Facilities Division, 2011). As well as the open-plan kitchen they also provide separate rooms for individual or group counseling, and access to a garden, thus providing a variety of spaces to satisfy people's varying social needs at different times.

The function and layout of each space is also important. The arrangement of furniture in care homes can promote social interaction if chairs are facing each other in small groups rather than side-by-side in rows, and positioned to allow views that encourage conversations about observed events (Rule et al., 1992). Given a choice, most residents interviewed (77%) in care homes preferred seating in small groups rather than seating around the edge of the room (Burton & Sheehan, 2010). Grouped seating areas along corridors and by the front entrance of care homes are also useful spaces to seek companionship, yet these are often underutilized (Cutler & Kane, 2005). The opportunity for moving furniture so that people can arrange seats in a manner they choose for their social needs, at that particular time, is important to help support relationships by enabling discussions (BMA Science & Education, 2011).

Trust and Belonging

Trust and *belonging* require feeling safe, secure, and connected with people at individual and community levels. Through planning health-care environment sites and the structuring of their land, a connection between the surrounding community can be produced, forging a relationship between neighbors, patients, and staff (Department of Health Gateway Review and Estates and Facilities Division, 2011). A hospital's publicly accessible land, such as surrounding green space, can break down the barrier of the hospital being perceived as a separate entity and may calm any tensions over infrastructure issues (e.g., heavy transportation). Design aspects, such as location and provision for visitors, increases the connectivity of care homes with the wider community and are associated with increased levels of resident activity (Parker et al., 2004).

The internal structure of the health-care environment can also enhance feelings of trust and belonging. The layout of buildings can help people feel part of a community, potentially decreasing perceived threats and increasing trust and social support networks (Riger & Lavrakas, 1981; Zaff & Devlin, 1998). Long corridors leading to a number of places can reduce cooperation and increase perceptions of perceived crowding (Baum, Harpin, & Valins, 1975). Long corridors, as may be found in residential buildings for older people, promote anonymity, which can result in increased levels of conflict (Zaff & Devlin, 1998). Corridors have also been found to have higher rates of violent incidents than other areas in psychiatric units, possibly due to their high use (Phiri, 2006). In one U.S. hospital a large atrium at the entrance was designed as a public space to connect the hospital to the surrounding community (Adams et al., 2010). In general, young patients appreciated it as a mixed-use space that let them see visitors arrive/leave, watch people go by, and see the city lights. However, other parts of the hospital resulted in feelings of entrapment and containment, as the wire structures made the children feel like they were in a jail rather than providing a supportive environment.

The acoustics of an environment can impact on people's trust in the care being provided. Using sound-absorbing ceiling tiles which decreased sound levels by 5–6 dB, and reduced the likelihood of patients hearing sounds from the corridor, significant improvements in patients' perceptions of staff attitudes and the ward health care was achieved ($n = 94$) (Hagerman et al., 2005). The authors suggested the change in perceived care could have been due to patients previously interpreting the noisy sounds of nurses as being inconsiderate and not thinking about how their behavior was impacting

on patients. The improved acoustic environment could also have enabled sleep, enhancing patients' cognitive and emotional recovery and resulting in a greater understanding of nurses and their provision of care.

Conclusion

A developing awareness and understanding for the role of physical aspects of health-care environments on people's personal and social wellbeing is complemented by a growing volume of research. This chapter has sought to examine the relationship between environmental features and specific wellbeing indicators specified by the NEF model.

The initial structural design and layout of a health-care environment has important implications for the way in which the physical environment affects individual wellbeing. Specifically, the distances between rooms affect staff vitality, while the complexity level for wayfinding can impact on patients' emotional state and autonomy. In contrast, clustered rooms compared to long corridors beneficially impact on patients' feelings of trust and belonging. Room sizes dictate what behaviors can occur there and impact on feelings of visual and auditory privacy, thus affecting autonomy. A range of public to private spaces is necessary for patients to manage their self-esteem while providing opportunities for supportive relationships to develop.

Research into individual health-care rooms, such as waiting areas, highlight the impact on patients' emotions and competence if waiting for some time. However, it is not known which specific features within the room produce these effects, although the arrangement and positioning of seats is known to affect opportunities for enhancing supportive relationships. Specific room features such as bed rails, ceiling lifts, and floor types have been found to impact on both staff and patient vitality, while the presence of doors in hospital wards can negatively impact on vitality but increase privacy and autonomy.

Windows provide natural light which impacts on emotional wellbeing and vitality through reduced length of stays. Lighting levels can also impact on staff's competence, whereas views of nature from windows can increase both staff and patients' competence through reducing fatigue and increasing attention levels. Views of nature also positively impact on emotion, vitality, and engagement, although more research into the latter within health-care environments specifically is needed. Health-care gardens enhance these benefits further and if there are many routes and seats for the patients

and staff to choose, autonomy and supportive relationships are fostered. When the gardens extend to public use the institute becomes a part of the community, helping to generate feelings of trust and belonging.

When access or views of nature are not feasible, images of nature can provide some emotional and vitality support. Artistic images can also provide some emotional support and opportunities for engagement; however, the results on this are mixed and more research is necessary into the effects of passively viewing art in health-care environments by different population subgroups. Research into music as an intervention has commenced, with some suggestion of emotional and vitality support, although the data is currently limited. In contrast, there is much research on the negative impact of noise in health-care environments on emotions, vitality, competence, and feelings of trust and belonging. This has resulted in numerous suggestions for improving environmental design, product design, and the placing of equipment to reduce and limit noise levels. Integrating these solutions into refurbishments or new-build health-care environments will involve determining the financial implications the environment has on wellbeing indicators, such as savings made from reduced length of patient stay and medication usage.

An environmental design can impact on more than one wellbeing indicator at any given time; generally the effect is in the same direction. Similarly, environmental features considered important to one person may be less so to another due to the varying needs of health-care users. A number of wellbeing indicators are more closely linked to the environmental design of health-care settings than others. However, it is unclear whether the latter is due to weak relationships or a lack of research in this area.

This chapter has identified a number of studies whereby the relationship between the physical environment and wellbeing is present, but many studies were small and had methodological limitations. Previous reviews have highlighted the overreliance on cross-sectional studies and the need for more qualitative studies to help understand how the environment may impact on psychological health (Clark, Myron, Stansfeld, & Candy, 2007; Evans, 2003). Devlin and Arneill (2003) suggested the studies' methodological limitations is the result of an absence of a research tradition in architecture, medical research overlooking the role of the physical environment, and difficulties in conducting research in health-care settings. However, overall these studies emphasize the importance of the physical design of health-care environments on wellbeing. By examining the specific features, attributes, and design of the environment and how they impact on specific wellbeing

indicators, either singularly or collectively, future designs of new-build and refurbished health-care environments can be informed to the benefit of all health-care users.

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Part 3
Wellbeing and Green Spaces

16

Wellbeing and Green Spaces in Cities

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When she felt overwhelmed like this, Bernice liked to walk to the little green space next to the public library. It was not large but did have a few trees, some grass, and a couple of benches. There was a row of shrubs that separated the space from the street. In this little sanctuary she felt as though she were a thousand miles away from the demands of her job, children, finances, and the troubles with her mother. After a while of walking or sitting among the green she felt she could face her challenges again. She so treasured these moments of restoration that when an apartment overlooking this little space became available, she moved there to be closer to it. Sometimes she would find herself at the window, looking into the green space. It was as though the little space provided a balm for her mind.

Because she'd walked to and in the little green space over a number of months, Bernice recognized many of the people who lived around it and would walk within it like she did. She would sometimes stop and chat for a moment with some of these folks. But most often, she would simply smile at them and go about her walk.

Bernice is aware of something that scientists have been investigating: the quality and characteristics of the settings we inhabit—the places in which we live, work, and play—impact our health and wellbeing. Most of us recognize

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that places have the capacity to threaten our health: crowded settings with poor water quality, cities with high levels of air pollution, homes with a lot of mold. What many people do not yet know is that some places actually promote wellbeing. Bernice has found just such a place.

There is mounting evidence that exposure to green spaces enhances the resources necessary to manage the demands and pressures of modern living. Settings that include trees, grass, and open space have been shown to reduce the symptoms of both mental fatigue and stress. Places that provide views of, or direct exposure to, trees and other forms of vegetation are associated with an increased sense of wellbeing, higher levels of self-reported peace and quiet, and greater satisfaction with home and neighborhood, less crime, lower levels of domestic violence, and—for some urban residents—lower levels of mortality.

There is also emerging evidence suggesting that green settings promote stronger ties among neighbors, an outcome that we know has important consequences for health.

How is it that something as simple as a view to a neighborhood green space, a daily walk in an urban park, or a few trees clustered in a public housing neighborhood can have such diverse and important impacts on people? What is it about humans that make us react to green spaces in this rich variety of ways?

In this chapter we will address these questions first by examining how it is that places impact wellbeing. Then we will explore three pathways through which exposure to urban green spaces might promote wellbeing. We will examine a theory and recent published studies in support of each of the three pathways. The chapter ends with a summary and a call to ensure that people around the world have access to nature at every doorstep.

How Might Places Impact Psychological Wellbeing?

Not long ago, most social scientists believed that our reactions to a place were a product of our education and socialization. That is, an individual's responses to a place were seen as a result of the content of the setting and what that person had learned about those contents in prior experiences. Although there is certainly some validity in this explanation, scientists have come to see this conception as incomplete. Today, a growing number of scientists see our responses to places as being some combination of what we

have learned and how our minds evolved to solve problems in humanity's ancestral environment.

Imagine the conditions our ancestors lived in over the last few hundred millennia. A child was born into a family that lived with a small band of others, perhaps 30–150 people. Her people were nomadic hunter–gatherers who traveled in search of a large variety of animal and vegetable foods, water, and other resources. They traveled over a large area, perhaps 160 km^2, in the savannah-like landscape of east Africa. They sought to avoid a variety of dangers such as predators; hostile strangers; and poisonous plants, spiders, snakes, and other creatures.

In this setting, our ancestors' competitive advantage was not that they could run fast, or that they were large and powerful. Their advantage was that they were unusually good at gathering and processing information. Their brains had evolved to solve problems by interpreting sensory input (very often visual input), devising schemes to deal with the challenge at hand, selecting a course of action, and taking action. Over time, and with respect to specific challenges that were typical of the setting (e.g., presence of spiders, snakes, a steep precipice, rotten food) our ancestors' brains developed a large number of specialized neural circuits that recognized the challenge and immediately suggested a solution (e.g., move away from the precipice, don't eat the rotten food). These suggestions were experienced as subconscious preferences that motivated people to act.

We carry these neural circuits with us today and they still do their job. That is, they predispose us to take action of one type or another when we are faced with challenges that were typical in the environment that our ancestors survived in for so many hundreds of thousands of years. Today, these neural circuits have important implications for human wellbeing. We feel well when our preferences are satisfied and uneasy when they are not. The unease we feel is presumably adaptive in that it motivates us to seek out safer, or healthier, conditions.

We are not the only animals that experience satisfaction or stress in various environments. Biologists have shown that all organisms capable of moving on their own will seek specific habitats. Although seagulls can fly, they do not fly everywhere. Rather, they search for particular environmental conditions that support their functioning. The same is true of dolphins, bees, and every other animal capable of movement.

Biologists call this general phenomenon habitat selection: the process by which animals find settings that support a significant part of their life cycle, if not their entire life. According to the basic biological argument

underlying habitat selection theory, natural selection favors individuals that are motivated to explore and settle in environments likely to afford the necessities of life and to avoid environments with poorer resources or that pose higher risks (Orians, 1980, 1986; Orians & Heerwagen, 1992). The neural circuits involved in habitat selection are shaped by natural selection because individuals seeking supportive environments produce, on average, more progeny than individuals indifferent to such concerns.

There is compelling evidence that it is not simply reproductive success that suffers when animals occupy unfit habitats. When cats, for instance, are placed in unfit habitats, they become antisocial and a great deal more aggressive. They stop playing, and there is continuous hissing, growling, and fighting (Leyhausen, 1965). For rats, the social impacts of being in an unfit habitat are even more pronounced. Wilson catalogues the consequences as including "hypertension, . . . cannibalism, and atypical and nonfunctional nest construction, with infant mortality rising to 96%" (Wilson, 1975, p. 255). Thus, the evidence suggests that unfit habitats lead to unhealthy patterns of behavior and functioning in which social and psychological breakdowns occur. In other words, unfit habitats lead to a psychological state that is the opposite of wellbeing.

Although our distant ancestors lived for millennia immersed in the natural world—in what the eminent biologist Gordon Orians referred to as a lifelong wilderness vacation—too many people in the developed world today live largely disconnected from nature. A lifelong wilderness vacation stands in stark contrast to the amount of nature that many modern-day humans experience. With our city centers often devoid of green space—or even street trees—and new suburban developments that dot the countryside on what were recently agricultural fields, too many of us live today without a hint of nature nearby. Are there costs of living so far removed from the landscapes occupied by our ancestors, from the landscapes that shaped and supported human development for 99.9% of our time on earth?

In the next section we will consider theory and evidence demonstrating multiple ways in which having everyday contact with green spaces might enhance wellbeing.

Three Pathways to Wellbeing

Consider some recent findings regarding the relationship between urban green spaces and the wellbeing of individuals and communities.

- Girls in a Chicago public housing neighborhood who had greater exposure to green spaces outside their apartment windows scored higher on multiple measures of self-discipline than their counterparts who lived in the same development but who had less green outside their apartments (Taylor, Kuo, & Sullivan, 2002).
- A 5-year study of the adult population of England that accounted for income and a host of variables known to impact health found that individuals who had greater exposure to green spaces were significantly less likely to die than their fellow citizens who lived in less green areas (Mitchell & Popham, 2008).
- Studies of various neighborhood designs have shown that increases in natural features or perceived greenness were associated with higher levels of social contact and increased feelings of social support among neighbors (Kim & Kaplan, 2004; Maas, van Dillen, Verheij, & Groenewegen, 2009).

How is it possible that green spaces near a person's home could have such wide-ranging impacts? To address this question, we examine three pathways through which exposure to nearby nature can impact health: through attention restoration, stress reduction and immunization, and increased social interaction. Let's consider each of these in turn below.

Do Green Spaces Help People Pay Attention?

When Bernice felt overwhelmed with the demands of her life she sought the little green space in her neighborhood, and for good reason. There is powerful evidence that contact with urban green spaces helps restore and replenish a resource that is essential to functioning in our modern world: our ability to pay attention (S. Kaplan, 1995; Kaplan & Kaplan, 1989).

Our ability to pay attention is one of the most important and useful resources humans possess. We use it constantly; indeed, you are using it now as you read this volume. We use our attention to accomplish nearly everything that is important to us. It is a requirement for planning, problem solving, negotiating, setting goals, monitoring, and regulating behavior, and engaging in effective social interactions.

It turns out that humans have two modes of absorbing and attending to information. Some objects, ideas, settings, and situations are effortlessly engaging and require no work as we take them in. Kaplan and Kaplan call

this mode *involuntary attention* (1989). It takes no effort, for instance, to watch a fire, look at a waterfall, or gaze at the birds in the trees outside your window. Indeed, it is difficult *not* to pay attention to some things: a toddler who is approaching the stairs, a story of someone being cheated, a deer or fox or other wild creature immediately outside your home.

Other stimuli and settings oblige us to focus on the matter at hand; that is, they require us to pay attention, or as the Kaplans say, to *direct attention*. Unfortunately, however, our capacity to direct attention is finite. As you have likely noticed in your own life, after a period of focused concentration—writing a proposal, planning a budget, an intense effort to complete a project—your capacity to focus your attention diminishes. Just like muscles that require rest after a period of intense use, our capacity to deliberately direct attention declines with use.

The costs of attentional fatigue (sometimes called mental fatigue) are profound and far-reaching; they include becoming inattentive, withdrawn, irritable, distractible, impulsive, and accident-prone. This is certainly not a welcome state, but one that is strikingly familiar to all of us who lead busy lives.

The good news is that some places have the capacity to alleviate mental fatigue and help restore a person's capacity to pay attention. Places that gently hold our attention (e.g., a view of green space with trees and grass, being in a park, watching water) allow individuals to recover from mental fatigue (Kaplan & Kaplan, 1989). Natural settings and stimuli such as green spaces seem to effortlessly engage our attention, allowing us to be in such settings without focusing attention, thus restoring our capacity to pay attention.

This set of ideas is part of attention restoration theory (or ART) (S. Kaplan, 1995; Kaplan & Kaplan, 1989), which has proven to be one of the most productive theories in environmental psychology.

To sum up so far, attention restoration theory poses that we have two modes of attending to things. One requires no effort (involuntary attention) and thus does not fatigue. Another requires considerable effort (directed attention, or paying attention) that is subject to fatigue. Because natural settings most often invoke involuntary attention, they allow us to rest and restore our capacity to pay attention. Thus, the theory proposes, we should be better able to pay attention after being exposed to nature than to other kinds of settings.

Quite a number of studies have examined these ideas and the outcomes are impressive. Exposure to green settings consistently boosts a person's capacity to pay attention. The findings come from very green settings such as large and small forests (Park et al., 2011; Shin, Shin, Yeoun, & Kim,

2011), rural areas (Roe & Aspinall, 2011), wilderness settings (Hartig, Mang, & Evans, 1991), and prairies (Miles, Sullivan, & Kuo, 1998). But they also from more modestly green settings such as community parks (Fuller, Irvine, Devine-Wright, Warren, & Gaston, 2007; Hartig, Evans, Jamner, Davis, & Gärling, 2003; Korpela, Ylén, Tyrväinen, & Silvennoinen, 2008; Krenichyn, 2006), schools (Matsuoka, 2010), and neighborhoods (Kuo & Sullivan, 2001b; Rappe & Kivela, 2005; Taylor et al., 2002; Tennessen & Cimprich, 1995; Wells, 2000).

In one fascinating study, participant's attention was assessed in a University of Michigan laboratory (Berman, Jonides, & Kaplan, 2008). Following the assessment, each participant was asked to walk for 50 min in either downtown Ann Arbor or in the University's arboretum. When they returned from their walk, their attention was assessed again. The following week, these individuals came back to the lab and repeated the same activities except those had who originally walked downtown walked in the arboretum and vise versa. The results were compelling. After the walk in the arboretum, participants' attentional performance improved by 20%, but no gains in performance were found after the walk downtown. A 20% improvement in one's capacity to pay attention is no trivial matter. It is on the order of a clinical dose of attention-deficit drugs such as Ritalin, Adderall, or Dexedrine. In other words, a 20% increase in attentional performance is a huge increase that will certainly have significant implications for a person's functioning.

Thus, it is clear that being in or looking onto a green space can improve a person's ability to focus their attention. But is the effect of green space on attention available to everybody or only a small segment of the population? The evidence shows that a wide variety of people benefit from exposure to green spaces. Studies have demonstrated links between green spaces and higher performance on attentional tasks in public housing residents, AIDS caregivers, cancer patients, college students, prairie-restoration volunteers, and employees of large organizations.

Perhaps most strikingly, children diagnosed with attention-deficit hyperactivity disorder (ADHD) have been found to benefit from exposure to urban parks and other green spaces near their homes. In a series of studies, such access has been consistently linked with a reduction in ADHD symptoms (Kuo & Taylor, 2004; Taylor & Kuo, 2009; Taylor, Kuo, & Sullivan, 2001). In findings similar to those in the University of Michigan study described above, Taylor and Kuo (2009) report that children with ADHD concentrated significantly better after the walk in a park than after the downtown walk or in a neighborhood.

Let's consider the implications of these findings. We live in attentionally demanding times. That is, most of the things that are important to us require us to pay attention. This is certainly true with respect to our employment but increasingly so with respect to our leisure activities such as Facebook, Twitter, and computer games. The costs of being mentally fatigued have profound implications for wellbeing. Mentally fatigued individuals (as most of us can attest to) have difficulty concentrating. They also are more likely to be withdrawn, irritable, distractible, impulsive, and accident-prone.

Attention restoration theory poses that a walk in an urban park or a view to a green area outside a window will reduce symptoms of mental fatigue. Given how important our capacity to pay attention is in the modern world, it may not be surprising that evidence is now pouring in demonstrating that a dose of nature can have important consequences not only for our ability to focus our minds, but also for our wellbeing more generally. Indeed, individuals who report greater exposure to green spaces also report higher levels of life satisfaction and wellbeing (Figure 16.1) (Dravigne, Waliczek, Lineberger, & Zajicek, 2008; R. Kaplan, 1993).

Figure 16.1. A View from Home of Trees in the Street has been Shown in Multiple Studies to be Associated with Lower Levels of Mental Fatigue.

Do Green Spaces Help Reduce Stress?

The activities of modern living not only put great demands on our attention; for many of us they also create considerable stress. We usually think of stress coming from negative things such as an exhausting workload or a rocky relationship. But stress can come from positive events too; many people are familiar with the stress that can accompany buying a house, going to college, or receiving a promotion.

Stress can come from external factors such as financial problems, major life changes, relationships, or demands at work. But stress can also come from internal factors such as pessimism, unrealistic expectations, perfectionism, or an inability to accept uncertainty.

It is helpful to distinguish stress from mental fatigue. Stress is a *physical* response to events that make you feel threatened. When you sense danger—whether it is real or imagined—your nervous system responds by releasing a flood of hormones that rouse your body for action. Your heart pounds faster, breath quickens, muscles tighten, blood pressure rises, and your senses become sharper. These physical changes increase your strength and stamina, speed your reaction time, and enhance your focus, preparing you to either fight or flee from the danger at hand (Smith, Segal, & Segal, 2011).

Mental fatigue, on the other hand, is a *psychological* response that results from an extended period of paying attention. Although mental fatigue may result from a stressful event it can also arise out of hard work on a project one enjoys (Kaplan & Kaplan, 1989).

In small doses your body's stress response is an amazing cascade of physiological steps that can protect you. It can save your life by giving you extra strength to defend yourself or spur you to slam on the brakes to avoid an accident. But chronic stress can cause significant damage to your health and wellbeing. Chronic stress can impact your mood, productivity, relationships, and quality of life (Smith, Segal, & Segal, 2011). People who experience chronic stress are more likely to get a serious illness and die at an earlier age than individuals who experience less stress.

For centuries philosophers, poets, and artists have suggested that people can reduce the stress they feel by escaping to nature. Emerson, Whitman, and Thoreau all wrote about the sense of peace and tranquillity that comes with being in nature. But could this be true for urban green spaces? What

evidence exists that contact with urban green spaces reduces the physical and psychological experience of stress?

One line of studies concerning the relationship between contact with nature and lower levels of stress comes from reports of individuals feeling calm or being able to function more effectively after being in or viewing a green space. In one such study, individuals exposed to urban forests reported feelings of "peacefulness," "tranquillity," and "relaxation" (Ulrich, 1993). Another study showed that individuals who had participated in a nature vacation reported decreased levels of occupational stress after the vacation (MacDonald, 1994).

Similarly, in a study of patients about to undergo dental surgery, views of an aquarium with fish reduced anxiety and discomfort, and increased scores for patient compliance during surgery (Ulrich & Parsons, 1992). A more recent study demonstrated a connection between visiting an urban green space and levels of stress: the more often the visits, the fewer reported illnesses related to stress (Grahn & Stigsdotter, 2003).

For children, exposure to green spaces has been shown to moderate the impact of stressful life events. In a study of 337 rural children, the impact of life stress was lower among children with high levels of nearby nature than among those with little nearby nature (Wells & Evans, 2003).

Another line of studies concerning the relationship between contact with nature and lower levels of stress comes from clinical tests of *physiological functioning*. For instance, 120 individuals watched a stressful film and then were shown videos of either urban or natural settings. Individuals who watched the nature settings showed significantly faster physiological recovery from stress than individuals who were assigned to watch the urban scenes (Ulrich et al., 1991).

In a similar study, 160 individuals viewed one of four different videotaped simulated drives through outdoor environments immediately following and preceding mildly stressful events. Participants who viewed drives that showed very little vegetation, relative to participants who viewed nature-dominated drives, experienced higher levels of stress as measured by a variety of physical indicators such as elevated blood pressure. In addition, participants who viewed nature-dominated drives experienced quicker recovery from stress and greater immunization to subsequent stress than participants who viewed drives that showed very little vegetation (Parsons, Tassinary, Ulrich, Hebl, & Grossman-Alexander, 1998).

Similar findings have resulted from studies of workers exposed to indoor plants (Lohr, Pearson-Mims, & Goodwin, 1996), and workers in rooms

Figure 16.2. A Growing Body of Evidence Demonstrates that People Recover from Stressful Events Faster when they have Views to, or can Walk in, Green Spaces.

with views that varied by level of naturalness outside the window (Chang & Chen, 2005). Another recent study examined the link between exposure to neighborhood green spaces and levels of the stress among unemployed people in poor neighborhoods in Dundee, United Kingdom (Thompson et al., 2012). The scientists measured stress by assessing the concentration of the hormone cortisol in participant's saliva. Their findings showed that the greener the neighborhood, the lower the levels of cortisol. That is, the greener the neighborhood, the lower the level of stress experienced by these unemployed individuals (Figure 16.2).

In sum, there is considerable empirical evidence that contact with urban green spaces reduces stress. These findings come from cross-sectional studies that focused on individuals. Thus, we know that, at specific points in time, when those studies were conducted, individuals who had greater contact with urban green spaces experienced less stress or recovered from stress more quickly than people who were exposed to less urban nature. But is there any cumulative impact of living near an urban green space? Is there any evidence that these small doses of nature make any difference over time? Three recent studies suggest that the impacts are considerable.

The first study measured the amount of green space and ease of walking in green spaces for elderly people in Tokyo. The results were stunning. Individuals who lived near an urban green space (as opposed to living in a less green urban area) lived longer. In other words, living in areas with walkable green spaces was positively associated with longevity of Tokyo's senior citizens independent of their age, sex, marital status, baseline functional status, and socioeconomic status (Takano, Nakamura, & Watanabe, 2002).

A more recent study used different methods and a different population but reported similar results. This was a study of all residents of England between 2001 and 2005. Mitchell and Popham (2008) classified the population of England at younger than retirement age ($n = 40{,}813{,}236$) into groups on the basis of income and exposure to green space. They obtained individual mortality records ($n = 366{,}348$) and established that an association between income and mortality varied by exposure to green space. Mitchell and Popham report that all-cause mortality, and mortality from circulatory diseases, were lower in populations living in the greenest areas. The effects were particularly impressive for individuals in the middle- and low-income categories.

Finally, in another study from 2008, Hu and his colleagues found that, in northwest Florida, neighborhood greenness and household income were negatively related to the incidence of mortality from stroke (Hu, Liebens, & Rao, 2008).

Thus, there are growing hints suggesting that exposure to urban green spaces reduces the level of stress that individuals feel and that, over the years, these lower levels of stress result in longer, healthier lives.

Do Green Spaces Help Increase Social Ties Among Neighbors?

Social ties among individuals, neighbors, and members of groups can be critical to wellbeing. The number of individuals in a person's social network and the quality of ties to those people are strong positive predictors of mental health (Umberson & Montez, 2010), healthy behaviors (see a review in Umberson, Crosnoe, & Reczek, 2010), and physical health (Uchino, 2006). Having a strong social network is also associated with longevity: on the whole, individuals with more people in their social network and stronger ties to these people live longer than their peers who have relatively weaker ties (Brummett et al., 2001; Ertel, Glymour, & Berkman, 2009).

Social ties are especially important for older individuals. When compared to their counterparts who have weaker social ties, elderly individuals with strong social connections have better health, less fear of crime, lower rates of suicide, and greater longevity. In addition, elderly people with stronger social ties have significantly higher levels of psychological wellbeing (Thomas, 2011).

Although most of us can point to a relationship that has caused us stress, worry, or heartbreak, on the whole social ties are good for individuals: people who are more socially connected are healthier, behave in healthier ways, recover from illnesses faster, and live longer than their more isolated peers.

Social ties are also good for groups. Social ties are a primary source of social support and sense of community. They help create neighborhoods that are more capable of forming local organizations and mobilizing for political purposes (for review, see Kuo, Sullivan, Coley, & Brunson, 1998). Neighborhood social ties lead to what is known as informal social control: the positive action of adults in a community (rather than the police or other authorities) who intervene when they observe undesirable behavior.

The built environment can have profound impacts on the formation and maintenance of social ties. Some settings reduce social interaction and thus the development of social ties. Dilapidated, crowded, and dangerous settings are associated with social withdrawal and have been shown to discourage individuals from establishing social relations (see Evans, 2006). For children, living in close proximity to traffic noise is associated with less outdoor play, smaller social networks, and diminished social and motor skills. For adults, the impact of living near heavy traffic is also considerable. As Appleyard and Lintell showed in the 1970s, households on streets with higher traffic volume interact less with their neighbors relative to those residing on less congested streets.

The built environment can also *promote* social interaction by providing recurring opportunities for individuals to have informal social contact with each other. A shared common space that is not noisy or crowded (e.g., a central dining room or lounge area in elderly housing, or green common spaces in neighborhoods) has been shown to promote informal face-to-face contacts. Individuals who have frequent face-to-face contact are likely to form and maintain social ties. After neighbors experience repeated day-to-day visual contact, some become acquaintances and engage in social activities. These acquaintanceships sometimes develop into friendships. In

this way, by providing individuals the opportunity to have repeated face-to-face contact with each other, the built environment can play an important role in the development of social ties among neighbors (for a review of these concepts, see Kweon, Sullivan, and Wiley, 1998; Kuo, Sullivan et al., 1998).

A number of recent studies demonstrate the positive impacts that access to urban green spaces can have on the amount of social interaction, and ultimately, the strength of social ties, among neighbors. Green urban spaces appear to attract people outdoors, increasing opportunities for casual social encounters among neighbors and fostering the development of stronger neighborhood social ties. Indeed, there is a compelling body of evidence demonstrating that access to urban green spaces is reliably related to

- enhanced social contacts and increased levels of social support among neighbors;
- more acquaintances among people of different age groups and racial, ethnic, and cultural backgrounds;
- increased sense of community among neighbors.

Let's review some of the evidence demonstrating a connection between green spaces and social interactions. The evidence comes from a variety of settings: neighborhoods, parks, hospitals, schools, and community gardens.

Green spaces promote social interaction among neighbors in urban and suburban areas. Among residents of an inner-city public housing neighborhood, researchers found that higher levels of nearby vegetation (e.g., trees, grass) are associated with greater use of outdoor spaces (Coley, Kuo, & Sullivan, 1997) and higher levels of social activity in the neighborhood (Kuo, Sullivan et al., 1998; Kweon et al., 1998; Sullivan, Kuo, & DePooter, 2004). Furthermore, residents of buildings with more trees and grass report that they know their neighbors better, socialize with them more often, have stronger feelings of community, and feel safer and better adjusted than do residents of more barren, but otherwise identical, buildings (Kuo, Sullivan et al., 1998).

Research in Chicago's public housing neighborhoods indicates that residents who live in "greener" surroundings report lower levels of fear (Kuo, Bacaicoa, & Sullivan, 1998; Kuo, Sullivan et al., 1998) and fewer incivilities (Brunson, 1999). Another study compared levels of aggression and violence in an urban public housing neighborhood where residents were randomly assigned to levels of greenness. Levels of aggression and violence

were systematically lower for individuals living in green surroundings than for individuals living in barren surroundings (Kuo & Sullivan, 2001a). These findings were reinforced by research using police crime reports for 98 Chicago apartment buildings with varying levels of nearby vegetation. Results indicated that although residents were randomly assigned to different levels of nearby vegetation, the greener a building's surroundings the fewer crimes were reported. Furthermore, this pattern held for both property crimes and violent crimes (Kuo & Sullivan, 2001b).

The social benefits of green neighborhood spaces are not restricted to individuals who live in urban public housing neighborhoods. Studies conducted in new urbanist communities and traditional suburban developments show that increases in natural features or perceived greenness in these neighborhoods were associated with higher levels of social contact and increased feelings of social support among neighbors (Kim & Kaplan, 2004; Maas et al., 2009).

The establishment of community gardens in neighborhoods has been linked with increased social interaction, leading to improved social networks among neighbors (Armstrong, 2000), increased community building among nearby neighbors (Teig et al., 2009), and enhanced interpersonal relationships among juvenile offenders (Cammack, Waliczek, & Zajicek, 2002).

Green spaces have been shown to promote social interactions on hospital grounds. Hospital staff and patients often use green spaces for privacy and socializing (Barnhart, Perkins, & Fitzsimonds, 1998; Sherman, Varni, Ulrich, & Malcarne, 2005; Whitehouse et al., 2001). One study found that staff and patients selected open, green settings for passive behaviors (i.e., sitting, viewing scenery), and more enclosed settings for active behaviors (i.e., walking, socializing) (Barnhart et al., 1998).

On school grounds, greener playscapes are associated with more active, social play among children (Dyment & Bell, 2008; Fjørtoft, 2004; Herrington & Studtmann, 1998). Studies have found that social interactions among children improved when natural features were introduced (Herrington & Studtmann, 1998). The findings of one investigation revealed that interactions in areas around trees and shrubs became based more on cognitive, social, and emotional skills rather than primarily physical prowess (Herrington & Studtmann, 1998).

In light of these findings it may not be surprising to learn that public urban green spaces, including recreation and nature parks, have been found to play an important role in increasing social activity among community members (Chiesura, 2004). These activities include neighbors making contact with

Figure 16.3. Green Neighborhoods are Associated with Stronger Social Ties.

individuals of different racial, ethnic, or cultural backgrounds (Figure 16.3) (Gobster, 1998; Seeland, Dübendorfer, & Hansmann, 2009).

Summary

Green settings in neighborhoods are associated with greater social cohesion among neighbors. The presence of trees and grass in neighborhood spaces increases the use of those spaces and the number of individuals involved in social interactions within them. By increasing face-to-face contact and the number of individuals involved in social interactions, trees and grass in urban common spaces contribute to the social cohesion and vitality of a neighborhood.

The findings from these studies show that social interaction and the development of supportive relationships among urban residents can be fostered and enhanced by providing nature contact in a wide variety of settings. Designers and planners can help create more supportive, cohesive places by the way they design neighborhoods. It also suggests that we can demand a higher standard than that provided by the sprawling suburban

development so typical of the late twentieth century in North America. We should work to create walkable, human-scaled, safe neighborhoods that contain a number of shared public and semipublic spaces such as parks, squares, and tree-lined neighborhood streets that promote, or at least provide opportunities for, social interaction.

Nature at Every Doorstep

Cities can be such vital places: centers in which imagination, ideas, and people collide and thus in which innovation flourishes (Lehrer, 2012). They bring us easy access to art, music, and the theater; a great diversity of people and food; abundant leisure activities; and employment. Cities are home to nearly 80% of North Americans, the vast majority of all Europeans, and more than half the people on earth. In terms of wellbeing, cities can add considerably to our lives.

But cities also present barriers to our wellbeing. They put considerable demands on our attention, increase the stress we experience, and sometimes thwart our capacity to develop social ties with one another. This chapter raises a number of possibilities for increasing the wellbeing of urban dwellers.

Our cities should be green with vegetation, especially with trees. Cities demand from us one of our most precious resources: our capacity to pay attention. As we have seen, this capacity is limited, at once so necessary to our ability to achieve our goals and yet so fragile that with just a bit of expenditure it diminishes. Just like the muscles of an athlete who has been lifting weights, our brains can pay attention for only so long before getting fatigued. But as we have seen, having a view of a green space, or taking a walk within one can restore our capacity to pay attention and in doing so, can help bring out the better parts of our nature.

Cities can also be stressful places. We have all experienced the stress associated with being stuck in traffic, feeling unsafe, or feeling lost in a new part of town. The costs of living with stress are considerable. Chronic stress threatens wellbeing in part by making a person more susceptible to all kinds of diseases; from the common cold to back pain, depression, diabetes, and heart attack. It turns out, however, that having a view to a green space or having a green space near your home is a powerful way to combat stress. People seem to recover from stressful experiences faster in green spaces than in similar spaces that are not green. And in three studies that control for all kind of variables that predict longevity there is evidence that people who

have ready access to green spaces live longer than their counterparts who experience less green neighborhood spaces. Green spaces appear to calm us down, not just psychologically but also in terms of reducing the stress hormones in our blood. Most of us cannot avoid stress, but we can seek out green spaces in an effort to help reduce the immediate and long-term costs of stressful experiences. Doing so will surely improve our wellbeing.

The vast majority new communities built in North America during the past half-century isolate people from one another. A person living in a typical Midwestern suburban neighborhood can get up in the morning, get ready for work, and go from kitchen to car to the office without ever stepping into their neighborhood. When they return in the evening these same people use their automatic garage door openers to reenter their homes without setting a foot in their neighborhood. It is as though these neighborhoods (if they can be called neighborhoods!) were designed to keep people from seeing each other out of doors. Neighborhoods such as these produce levels of social interaction that have profoundly negative impacts on a community: lower levels of voter turnout, reduced participation in volunteer organizations, and withdrawal from civic affairs (Krassa & Flood, 2000). But green streets and nearby neighborhood parks fight against these isolating features. Neighborhoods with trees and other green spaces pull people out of doors and into the public realm. In doing so, they provide opportunities for individuals to have recurring contact with one another. Over time, some of these recurring contacts result in social ties: the glue that binds a group of unrelated individuals into neighbors.

Think for a moment about the cost of weaving green spaces into the fabric of our cities. Maintaining healthy trees and green spaces is not free: there are real costs associated with providing a healthy green infrastructure. But these costs are likely trivial compared to the costs of the drugs we buy and social programs we support to reduce our mental fatigue and anxiety.

At the beginning of this chapter, we learned about Bernice, who walks in a neighborhood green space when the demands of life get to be too much for her. The results from a wide range of studies reported in this chapter demonstrate the wisdom in her approach and the wide range of benefits that urban dwellers gain from having everyday exposure to green spaces. For individuals, the benefits include an enhanced capacity to concentrate and pay attention, greater ability to cope with life's stressors, higher levels of life satisfaction, and increased levels of psychological wellbeing. For neighbors and communities they include stronger ties among neighbors, lower levels of

incivilities, fewer instances of aggressive behavior, reduced levels of violence, and fewer reported crimes.

Those of us with the capacity to influence urban design can help create cities that provide abundant opportunities for people to have contact with nature. In an effort to promote the wellbeing of people who live and work in cities we might begin by ensuring that there is nature at every doorstep.

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17

Environmental Interaction and Engagement

Supporting Wellbeing

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Introduction

The material presented in this chapter draws upon a long period of experience and underpinning research, with which the author has been closely involved, that looked at specific aspects of environmental interaction covering a range of situations varying from urban to rural, in various countries, and with different participants. When put together it gives some greater clarity regarding the ways that individuals interact with the environment and how this interaction impacts upon people's lives. In relation to wellbeing, such interaction either supports or detracts from (or does nothing for) the quality of life of citizens. In essence, this material gives an indication of how these interactions support individual wellbeing. The reference to the individual here is deliberate as throughout these studies it has become increasingly clear that wellbeing has to be explored in relation to the individual to take account of the unique qualities of the interaction that is occurring and the way that it is processed by the individual; that is, the ways that a given interaction is tagged with a specific meaning. There is a reality that in interpreting the environment, personal experience, which includes the sum of all the experiences to which one is exposed, will make a major impact upon our perceptions of different environments. The fact that others

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have different views becomes evident when one explores what others say in relation to a common experience. It is easy to think that others experience and process encounters in the same way as oneself, but this is not true. The importance of looking at the ways that people express their encounters is particularly enlightening. The language used to express the reality and quality of environmental experience is a strong aspect of most of the studies over the years. In particular, the act of verbalization—telling stories (collectively, narratives)—brings out and demonstrates the personal meaning behind environmental encounters and clearly indicates the extent of emotional attachment with which they are associated. These can include a range of references to pleasurable, remembered experiences, and childhood or other environments, resulting in a specific moment of reverie or which move the individual to the opposite extreme, a moment of fear or trepidation. Language also reveals examples of a mismatch between professional and local attitudes as well as differing reasons for like or dislike of the landscape. This is so even when there is apparent consensus regarding an environment being positive. The positive interaction summarizes that this is a good experience, that the interaction is satisfying and engenders wellbeing, but the actual personal individual reasons for it being positive may actually vary considerably. By asking individuals to describe their encounters; that is, to verbalize them in the form of a narrative, reveals the diversity of meaning associated with each individual and also the presence of any common facets.

In relation to wellbeing we can talk about environments being "supportive." By this we mean that they are capable of fostering a positive experience as we move through them and interact with the various elements. The various encounters that we experience thus have the capability to confirm or deny our present state, moving us into a level of greater or lesser positivity; that is, thus contributing to, or impeding wellbeing. Our relationship with the environment is deep: we monitor the weather, the presence of others, and security all within the context of our intentions, desires, and needs (see, for example, Hancock & Perkins, 1985). How we do this is made complicated by the extreme diversity of an urban environment and the fact that we use the same environments for different functions; that is, regarding work, rest, and play, in different circumstances (e.g., alone, with friends, or with family). Each encounter can thus affect us differently according to the purpose or context of the visit, the presence of others, strangers, and friends, our level of confidence, as well as the cues that are contained; for example, an invitation to sit and stay through the inclusion of seating, or a feeling of unease where there are signs of neglect through poor maintenance.

As identified, in this chapter the aim is to consider what we can learn from the range of studies referred to and for the reader to consider the material in light of their own professional or indeed personal contexts, which might help support the wellbeing of others or increase an awareness of the factors that contribute to our personal wellbeing. Elsewhere in this volume the notion of wellbeing is discussed in detail, and such discussion is not repeated in this chapter save to comment that much of the work related to wellbeing and the environment refers to overall mental wellbeing, the quality of feeling satisfied with one's life, and a positive outlook and is set in the context of "mental restoration" (Hartig, 2001; Hartig & Staats, 2003). Mental restoration refers to the suggestion that urban life and modern lifestyles cause stress and that there is a need for people to destress; hence the term. However, much of the existing research involved in looking at mental restoration has examined the "restorative qualities" of natural environments versus urban places (e.g., Hartig, 2001; Hartig, Mang, & Evans, 1991; Herzog, Black, Fountaine, & Knotts, 1997; Kaplan & Kaplan, 2009; Ulrich, 1977, 1983), where the results of studies are identified by a range of approaches—questionnaires, interviews, and clinical measurements (e.g., heart rate, blood pressure, and more recently the levels of the stress hormone cortisol)—to demonstrate a clear link to physical and mental wellbeing.

The examples considered in this chapter are not confined to natural spaces but embrace a greater diversity of interactions that occur in the modern environment. In reality it is not considered particularly helpful to distinguish too precisely between mental and physical wellbeing as a positive environment engenders physical interaction by virtue of inviting the user to walk and experience its qualities. Physical and mental wellbeing are both components of positive environmental interaction where access, physicality, sensory interaction, and mental restoration operate together. As an example, this is demonstrated by examining the responses of participants who took part in Walk 2000 (urban walking routes of 2000 m in length) to encourage exercise and mobility as a prescription for treating health problems. Although any route would be accepted for a walk and achieved the overall aim of physical exertion, the preferred routes encompassed green elements such as the canal, parkland, or alongside woodlands, where participants would respond to the various sensory cues and engage with each other in conversation concerning the plants or the landscape encountered, which indicated that both physical and mental wellbeing were supported.

It is the desire in this chapter to concentrate on issues and aspects relating to modern society and modern environments, particularly in relation to

the complexity of urban living. This is of course not a new discussion as there are plenty of texts and guidance regarding what constitutes good urban design with best practice examples. In relation to this the reader is referred to the *Urban design compendium* (English Partnerships, Housing Corporation, 2007). Within these texts is the desire to design and manage cities which are vibrant and effective in meeting the diverse demands of citizens, accommodating their individual and group needs for work and leisure and which are intended to provide high-quality environments which engender positive social interaction. There is also the added dimension regarding the dynamic nature of (particularly) urban environments which is driven by a multitude of factors, precedents, histories, cultures, and economies as well as the natural processes of nature.

The Biophysical Environment

Discussion starts with a brief consideration of the environment to which we are exposed in our everyday lives, which consists of a complex of components including such aspects as the vegetation, water, the weather, buildings, and roads which have a specific functionality. This can be referred to as the "biophysical environment;" that is, the sum of the biological and physical components to which we are exposed. Accordingly, the term biophysical environment refers to the elements contained within urban forms, and other locations where we live; in particular, where we spend a large proportion of our lives especially in our daily activities. Accordingly, the examples considered in this chapter specifically relate to environments or issues concerning everyday access rather than planned trips away from the home. Natural environments are considered when contained within an urban context where the issue of everyday access is a major consideration in their potential to support wellbeing. Thus the structure of our cities, towns, and villages make up the biophysical surroundings where individuals, families, and communities, live. Their attributes affect the human psyche through their direct sensory impacts—what we see, hear, or touch—but they also influence our thoughts and feelings by the way that they inhibit or filter our experience of other things. In addition, our biophysical surroundings mediate, affect, inhibit, or encourage our social and personal relationships where an adequate living environment balances sensory inputs. Here they provide a mix that is/should be congenial and consistent with people's

culturally and evolutionary conditioned needs (Hall, 1968; Herzog et al., 1997; Kaplan, Kaplan, & Ryan, 1998).

As such, study of our immediate surroundings is especially important regarding the mainstream planning of our urban and rural environments or public health priorities (Frumkin, Frank, & Jackson, 2004; Hancock & Perkins, 1985; Lalonde, 1974; Lindheim & Syme, 1983) since they are readily accessible and experienced by many as an everyday part of life (Coles & Caserio, 2001; Dwyer, Schroeder, & Gobster, 1991; Hibberd, 1989; Kaplan, 1983; Kaplan et al., 1998; Westphal, 2003; Wolf, 2005). Together these authors summarize the main interactive aspects as a complex of

- the natural environment;
- the human-made environment;
- social arrangements; and
- human consciousness.

Theories Relating to the Positivity of Environmental Interaction

As identified, work concerning how different environments affect our well-being has largely been considered in relation to the positive effects of nature on the individual and thus it is appropriate to briefly consider the related literature before widening this to other theoretical perspectives. It is now fairly clear through a range of studies that exposure to nature has a positive effect on both physical and mental health and that exposure to nature is an essential part of the human condition. The argument for this is that the effect is a by-product of human evolution (Balling & Falk, 1982; Kaplan, 1987; Ulrich, 1983, 1984). According to this view, human preferences have developed because they have been crucial for our survival as individuals and that we still need contact with nature to satisfy our innate, evolutionary desires.

The notion of environmental preference as an evolutionary adaptation and its positive impact on health is supported by the available data from many studies. These are based on work which looked at landscape preferences comparing, for example, different landscapes from the experience of actually being in nature, and distant nature (viewed from a window, Ulrich, 1984), as well as surrogate landscapes (landscapes featured in images) but are also related to clinical studies which assess recovery from illness (Ulrich,

1984). Through these studies, research has consistently identified specific natural features that increase the attractiveness of landscapes that appear to be synonymous with a positive health impact. Accordingly, these begin to identify the key positive and negative attributes of naturalistic landscapes. Naturalistic landscapes are landscapes that are largely based upon natural ecosystems; although these landscapes are not truly natural, "naturalistic" is a more useful term when considering urban situations.

Considering the phenomenon of exposure to nature and the broad impact upon human physiology and psychology (Hartig, 2001; Hartig & Staats, 2003; Kaplan, 1987; Kaplan & Kaplan, 2008, 2009) demonstrates that, in almost all cases, these preferred landscape features are exactly the ones which would have offered a good combination of safety and necessary resources to early humans. Woods and forests feature strongly in terms of producing a positive response. For example, open meadows surrounded by woods are very well-liked (Zube, Pitt, and Anderson, 1975). Forests are most strongly preferred when there is little underbrush and an abundance of grass cover (Daniel & Boster, 1976; Schroeder, 1991). Water is another highly significant, highly preferred part of any natural scene (Hull & Stewart, 1995; Yang & Brown, 1992). The quality of the water is carefully monitored; clarity and freshness are important with mountain lakes and rushing water, especially waterfalls, extremely well-liked. In contrast, swampy areas or water covered with algal blooms receive lower ratings (Calvin, Dearinger, & Curtain, 1972; Herzog, 1985; Kaplan, 1984). In general, such associations are referred to as "survival theories" in that the landscapes considered contain the basic requirements for survival, especially water, or resemble the woodland edge that is thought to have been the natural evolutionary habitat of early humans. This relates to our innate need to be able to feel secure (Appleton, 1975).

In the context of urban environments, the situation appears to be more complex as, while urban environments contain encapsulated woodlands and water bodies, these are often in a highly modified form. In addition, the view held by some is that we are not fully adapted to an urban existence (Kellert & Wilson, 1993). Kellert and Wilson in particular suggest the theory of "biophilia" (Table 17.1) in which we are attracted to the natural biological aspects of our cities and that in the absence of exposure to natural components we suffer stress (Kaplan, Ivancich, & De Young, 2007). Accordingly, when we experience natural environments we undergo mental restoration and we are brought back to a positive state by our interaction with the natural world.

Table 17.1. Terms Used to Describe the Ways in which we Interface with the Environment. Together these appear to offer a comprehensive summary of the main facets of environmental interaction; for further information see the main text.

Term	Description	Notes
Biophysical surroundings	Sum of the biological and physical components that constitute an urban form or location relative to the population	Emphasis on sensory engagement and our experience of other things
Survival theory	Evolutionary consequence of needing contact with environments that would have supported humans	Refers to our affinity with nature to underpin health and wellbeing
Biophilia	Love of nature	Positive consequence of contact with the natural elements of the environment
Cultural landscapes	Evolutionary consequences of human society and settlement over time	Opportunities presented by the interaction between the natural environment and social, economic, and cultural forms
Associationist aesthetics	Visual landscapes conjure up positive or negative associations in the mind of the individual	Emphasis on linkages between remembered places and events
Subjective approach	Individuals construct their own experiences	Based on experiences and emotions
Compatibility	Environment which is conducive to meeting personal goals	Allows/facilitates desired actions
Affordance	What the environment offers for humans	What it provides or how it drives towards good or ill

For urban residents, the separation from nature is considered to be greater than in other forms of human settlement. However, urban environments do contain natural elements in a great diversity of locations and these need to be considered in terms of their role in supporting healthy human functioning (Hull & Harvey, 1989). In considering such, we need to do this in relation to the wider sensory experience with which they are associated. Accordingly, it draws the reader into studies where the distinctions between natural and built components of the landscape become blurred, a situation

reflected in the studies considered later in this chapter. Importantly, there is a need to consider the totality of the built environment in relation to human interaction.

The idea that the quality of nature in people's home neighborhood affects health is not a new one but it requires further exploration of how specific elements impact upon individuals, what this impact might be in considering the sensory engagement offered by encounters, and what the effect is upon wellbeing. This includes the sequencing of experiences as one moves from one location to another as well as the context of these encounters; for example, the purpose of a journey, or the desired activity. It also includes the cultural context or perhaps more specifically the past life events of the individual.

Cultural Associations and the Importance of Experience

The second strand concerning theory recognizes and emphasizes that responses to places, including those with vegetation, occur through past experience (Kaplan, 1983) and from what are termed cultural values (Tuan, 1974, 1977). Cultural values are connections made with the environment that are based upon prior experience, including aspects of family, upbringing, and education. They indicate that the individual is predisposed to favoring certain landscape associations as positive or negative in the light of past encounters or taught values. As with studies which suggest a survival response they are based upon work which considers the ways that people respond to images and actual environments (e.g., see Flannigan, 2005; Gorman, 2004).

The United Nations Educational, Scientific and Cultural Organization (UNESCO), in defining the cultural landscape, describe it thus:

> the "combined works of nature and of man" . . . illustrative of the evolution of human society and settlement over time, under the influence of the physical constraints and/or opportunities presented by their natural environment and of successive social, economic and cultural forces, both external and internal.
>
> UNESCO (1996)

The UNESCO definition clearly relates to the composition of our towns and cities and complements quite nicely the description of our biophysical surroundings. It emphasizes that environments are shaped through human endeavor and it is how they are interpreted that is the prevalent consideration. In fact, it can be argued that all landscapes are cultural in the sense that they are perceived and created through human interaction; in other words they

are given specific meaning through interaction, encounter, and reencounter (Ingold, 1993; Millman, 2012). This is so even for environments that are regarded as natural. For example, Lyndon recognizes this, emphasizing that "the natural world [is] given shape by people through cultivation and construction or through representation and verbal description" (Lyndon, 2000). The reference to representation and verbal description is important here since it is important to recognize that landscapes are given meaning through the experience of the individual. This has important implications for wellbeing as it implies that a landscape needs to be given a positive meaning by the individual for it to engender positive wellbeing. Furthermore there are indications that this might only be fully understood or fully realized, even by the individual, when it is verbalized or described to another.

Lyndon's view is echoed by several other authors. For example, Wylie discusses the wider landscape, stating that it "is neither something seen, nor a way of seeing, but rather the materialities and sensibilities with which we see" (Wylie, 2005), meaning that landscape is not immutable or universal, but rather it is the result of the way we each see, informed by our individual experiences and identities. Landscape is not only an effect of being in the world, but it also affects how we are in the world. Such authors emphasize the need to explain the experience of all environments within the human dimension. Hiss (1998) takes the relationship between the need for certain landscapes and our experience of it a little further, in that "the places where we spend our time affect the people we are and can become" and vice versa (Hiss, 1998).

Hiss refers to a cultural interaction, and seems to suggest that the landscape is indicated by the development of an interactive loop between the individual and the landscape being encountered. However, it is easy to suggest that such a loop also exists between our evolutionary needs, contact with the natural environment, and health requirements. In reality, it is probable that survival and cultural theories operate together where there is interaction, reaction, and rationalization of the experience involving innate (evolutionary) and learned responses. Cultural associations suggest that individual loops are created by past experience and memories which surface when accessing a landscape and natural loops due to the innate need for contact with nature. Natural innate association (e.g., response to water) may be universal but cultural associations will be individual. In this respect landscapes can be described as "polysemic"—having multiple meanings (Millman, 2012)—where individual interpretation is the rule and where the specific meaning to the individual is emphasized; if it were possible to see all these different interactions and meanings they would be stacked up on each

other layer upon layer. This would mean, for example, that while a local community (such as a population located in a group of residential streets) might reveal general positive values about the environment (or indeed negative ones), the specific ways that this value is constructed is likely to vary according to individual experience, including memories (Tolia-Kelly, 2004, 2007), as well as being dictated by our innate need for contact with nature.

The same phenomenon, that landscapes are polysemic and have multiple meanings, is a well-recognized theme, but referred to in different terms, covering a wide range of landscape types (Table 17.1). For example, Crook (1989) and Van Eck (2000) use the term "associationist aesthetics" to describe the idea that a (visual) landscape can conjure associations in the mind of the viewer, including memories of other places and events, both real and imagined. Kaplan and Kaplan (1989) refer to this as the "subjective approach," identifying how the individual constructs their own perception of the landscape based on their experiences and emotions, also introducing the notion of "compatibility" where people's relationships with their environment is interactive and that perception is determined by a range of personal and environmental factors described by the concept:

> Compatibility is established by an environment that is conducive to meeting your personal goals; that is, in a compatible environment, what you want to do and are inclined to attempt are needed and feasible.
>
> Kaplan and Kaplan (1989)

Gibson (1979) introduced a similar concept of "affordance," whereby ". . . affordances of the environment are what it offers for the animal or human being and what it provides or drives towards good or ill."

Gibson considered that each individual experiencing the landscape will have slightly different expectations dependent on their needs and their prior experiences. The existence of an affordance requires harmony between the individual and the environment but the factors that cause accord are wide ranging and diverse.

Sensory Engagement

In introducing aspects of sensory engagement I have used two examples of images related to specific environmental encounters. The first, Figure 17.1, shows "Ellie's tree," in which Ellie depicts, in a drawing and words, the

Figure 17.1. Ellie's Tree. For explanation see text.

nature of her interaction with the environment and the associated sensory experience. The mechanism that elicited the process was that she was invited to draw a picture following a group session on tree planting, but what is particularly interesting is the language used in the poem, which describes in highly evocative and eloquent terms the sensory experience that is both cued by the drawing and associated with it. In this example Ellie expresses the sensory cues and the natural aspects associated with the tree. Ellie refers to a complex of sensory inputs: light/vision ("the colours of nature"), sound ("the birds that sing like parrots"), and tactile ("the sun that shines in hot on your back"). In the picture she communicates very effectively the positivity of the experience. Ellie both verbalizes her experience and invites others to share it. The use of this example referring to a tree is selected on purpose as trees are such a common feature in urban environments, easily planted, and can have deep significance in terms of their associated meaning. This is an aspect that will be returned to later on.

Figure 17.2. Sensory Engagement, a Total Body Experience. In this case a photograph of the feet was the appropriate way to recall and explain the sensory experience and the associated memory. For explanation see text.

The second picture (Figure 17.2) features a photograph of a person's feet in a pool. It is perhaps a little more elusive but was taken in response of a request to take a picture, make a drawing, or write about the memory of a place (the sea frontage of a town) and what it meant. This participant described the memory of walking on hot, uncomfortable, pebbles on the beach and the contrast of the cooling pools and felt that the best way to communicate the totality of the experience was to photograph his feet in a pool. For this person, the way that his feet touched the ground was fundamental to the past and present experience of his surroundings (for example, see Wylie, 2005; Millman, 2012).

These two examples are given as they represent real expressions of encounters, meaning, and symbolism expressed by individuals who wish to share their experience in the best way that will be meaningful to another. They were obtained as a result of a simple intervention asking the participant to express the meaning associated with a place (the waterfront) or a particular type of vegetation (the tree). Each invites the recipient to share the experience, demonstrating both the emotional attachment that the individuals have, including the depth of memory, and its associated meaning. As such it is easy to move into/share the same moment of reverie that is associated with the experience. However, in the wider context of urban living there has been considerable debate on the importance of the different senses in environmental encounters and in establishing the identity of places.

Much of this debate centers around what some consider an overemphasis on the visual to the exclusion of the other senses; that is, largely ignoring such factors as sound, smell, and touch, especially when designing the environment. For example, Adams and Guy (2007) argue that architectural

practice in particular, as well as scholarship in the arts, humanities, and social sciences in general, are underpinned by ocularcentricity in that much of the language of these practice areas, and their resultant designs and methodologies, are based in the stronghold that the visual has over the way humans perceive their surroundings (Millman, 2012). This concern and greater understanding of the sensorial experience in the perception and design of the built environment has led some to a call for "an architecture of the senses . . . " (Adams & Guy, 2007), which emphasizes the need to consider a wider range of sensory inputs. In particular, a greater emphasis on sound is suggested (Arkette, 2004; Schafer, 1973). Millman (2012) suggests that there is now a tendency towards sound studies in place of the visual, citing Woodiwiss (2001), who states that:

> to privilege vision over the other senses and intellect (ocularcentrism) as both the chief provider of reliable sense data and the best mode of checking its accuracy is mistaken, since what we see is as much affected by the positions in time, space and social life in which we look . . . as any other activity.
>
> Woodiwiss (2001), cited in Millman (2012)

However, the Woodiwiss quote is important not just in trying to balance the totality of sensory inputs but in that it recognizes the importance of the individual regarding their position in relation to time and space and social life or activity. The indication is that there needs to be congruency between all these factors to maximize the level of interaction and thus to initiate a strong meaningful response, which, if positive, is to be embraced as part of wellbeing or, if negative, avoided for the same reason.

Two studies exploring the interaction between visual and acoustic stimuli (Yang & Kang, 2005) found that there exists a general preference for natural and rural rather than urban and human-made images and sounds (Carles, Lopez Barrio, & de Lucio, 1999). Both approaches employed the use of quantitative data and high-specification sound equipment. Yang and Kang's experiments took place in urban squares in Sheffield, but those of Carles and colleagues were laboratory-based, involving the use of combinations of recorded sounds and landscape images of rural places and urban green spaces. Sounds were regarded more positively when they were congruent with the image—for example, the sounds of children playing alongside the image of an urban park are regarded as pleasant because participants expected to see images and hear sounds that supported one another—whereas unexpected sounds can be deleterious to the landscape (Carles et al., 1999). Such studies suggest that visual and acoustic congruency is crucial for positive cognition.

Other authors comment on the need to consider the totality of the senses in relation to the process of cognition, the way that the sensory inputs are given meaning. For example, Pink suggests that the senses are not distinct activities; rather, they are all different facets of the same activity: similar to the whole organism in its environment (Pink, 2010). Sainsbury and George (2006) emphasize that all the senses feed cognition. Pink, supporting many of the strands of this inquiry and adopting similar approaches to investigation, also stresses the importance of considering all the senses, or multimodality, in addition to the faculties of memory and imagination (Pink, 2010). In further support of the use of multimodality, Pink (see also Millman, 2012) also cites the work of neurobiologists who discovered through brain scanning that:

> cross-modal interactions are the rule and not the exception in perception, and that the cortical pathways previously thought to be sensory-specific are modulated by signals from other modalities.
>
> Pink (2010)

In other words, the sense organs and their respective sensory faculties do not operate alone, but rather are single aspects of a holistic sensory perception. In light of this finding, Pink suggests that we should think of "our perception of social, material and intangible elements of our environments as being dominated by no one sensory modality" (Pink, 2010).

Pink also emphasizes the importance of walking in relation to sensory experiences, suggesting that we need to consider where people walk in relation to the sensory experiences that they encounter. The indications are that walking facilitates sensory engagement and wherever walking is practiced the walker is subject to his or her own bodily experiences framed through the subjectivities of his or her personal understanding (Gray, 2003; Millman, 2012; Tolia-Kelly, 2007; Wylie, 2005). She also comments further, emphasizing that "the practice of walking is generally situated in the urban context" (Pink, 2010).

These authors point towards a total body experience where material and intangible aspects of the environment are experienced together and processed to give meaning, emphasizing the experience gathered when walking. Aspects of memory (and past sensory inputs) as well as imagination are indicated in feeding cognition through the subjectivity of personal understanding to give the new experience specific relevance and meaning. In addition, when recounting an experience a similar process is indicated that allows the recipient to fully engage with the depth of the encounter.

Accordingly, as we move through an environment an holistic process of sensory input and its processing occurs by the individual to interpret the new experience with an impact on personal wellbeing.

Case Study 1: The Sound Quality of the Urban Environment

As indicated in the two initial examples, the evocation of remembered or programmed associations via sensory triggers and the way that we make sense of encounters is an important aspect of environmental engagement. For example, Millman (2012), in studying the urban environment, suggests a process of encounter–sensory engagement–participation–feedback as the pathway that occurs as sensory inputs metamorphose into meaningful encounters which then have the capability to support wellbeing. In the context of this, here we consider the soundscape of the urban environment, which has been studied by Millman and colleagues in some depth (Millman, Coles, & Millar, 2008). This study draws upon the work of the World Soundscape Project (WSP), which pioneered the idea of "soundscapes" and brought to light the effect that sounds have on individuals (Schafer, 1973). The subject of the study was the regenerated canal environment of central Birmingham in the United Kingdom embracing an extensive sequence of spaces and associated buildings. Together they form a distinctive pedestrian route, an important part of Birmingham's public realm and modern identity. The area includes distinctive human-made features as well as reference to natural components in the water, trees, and wildlife. Several images of the area are shown in Figure 17.3. There is much emphasis on the historic qualities of the location, with characteristic canal architecture, bridges, tunnels, and locks, in combination with modern dining, leisure, and entertainment. The area is maintained to a high standard with associated security (Figure 17.3).

The sensory experience involved walking; indeed, the area is only accessible by foot (or boat), although there are a range of access points originating from surrounding roads. The initial supposition was that the route has the potential for a rich variety of sensory cues, and thus have a sound signature that is unique to that place. This being why the location was selected. For example, the expectation was of the noise of footsteps on the brick-paved towpath, echoes in the tunnels, water, and wildlife. Accordingly, the walk was held over the selected route lasting about 35 min, the group walking together as one might do as an everyday experience, but being instructed to

Figure 17.3. The Various Canal Environments Featured in the Sound Study. These promised a rich diversity of sound associations; for explanation see text.

observe the sounds that they encountered. This was facilitated by recording the walk and by stopping at previously agreed locations to discuss what sounds were significant. A follow-up focus-group interview was held to obtain feedback on the walk.

The results were surprising in that few of the expected dramatic sound qualities were revealed. The main noises recalled by the group in the follow-up session were related to external sources; for example, the noise of traffic as the group encountered a road bridge, the sound of air conditioning from nearby buildings, and the sound of recorded bird song from the nearby Sealife Centre. While initially disappointing, during feedback it became clear that for many of the group they had their own sound expectations of a canal which were based on a rural canal. They complained that they would have expected the noise of sheep and cattle, wind, and strong sounds of associated wildlife, which were absent. Accordingly, their response was that the space was negative. Others participants talked about trying to find sounds that they expected to be present; for example "looking for the sound of water," an interesting visual reference to noise explained by the recollection of an enjoyable canal holiday and the working of the locks with the inherent noise

of the paddle gear and the consequent rushing of water. In other words, many of the participants had sound expectations derived from previous experiences of rural canals and they could not reconcile the urban canal with these expectations. These did not accord with the reality of this walk, and thus the consequence was largely a negative response.

Importantly, the study indicated that people come to a place with expectations of what they will encounter generated from prior experience. Perhaps even more critical is the inference that people use prior experience to give meaning to/rationalize the new sensory experience. While the sensory engagement is the starting point and the body assimilates the various aspects, these sensory encounters are processed where cognition occurs through the evaluation of the sensory engagement in the light of past experience or expectations. For wellbeing this is important as it is the cognitive process that gives meaning and which can lead to a negative response, a positive response, or no response at all, depending on the relevance of the environmental/sensory cues to the individual. These results seem to support the ideas of congruence and compatibility referred to earlier; for these participants there was an incongruence between sound expectation and reality.

This was only one small part of Millman's studies, in this case looking at sound as a component of sensory engagement, but it did demonstrate that people have sensory (sound) expectations which are derived from previous experience. This seems to be a culturally determined response, but the reference to the sounds of nature can also be interpreted as being preferential. Also indicated was the danger of predicating any one sensory element in isolation from others. Follow-up work involving walking which allowed free and full sensory engagement revealed the high potential of this environment in supporting wellbeing and is considered later in this chapter.

Nature's Constants

Earlier in this chapter we briefly reviewed a range of literature regarding the ways that people interact with the environment, which suggested that we are genetically disposed for both being attracted to nature and needing nature; that is, there is an innate response to the natural elements of the landscape, as well as having a learned or cultural response. The literature referred to natural environments of forests being particularly well liked but some concern was expressed that the environments contained in urban areas do not conform to true ideas of wilderness. Accordingly, here we consider

the response to nature, or more specifically the natural elements that are contained in urban conurbations, In doing so we can explore what it is useful to term "nature's constants."

Nature's constants is used to signify those elements of the natural world, or derived from the natural world, which endure beyond the lifespan of people, giving them specific qualities or showing specific features of natural interaction. For example, they typically appear to remain constant over several generations, often reaching back to the past and surviving long into the future. Accordingly, nature's constants are elements which seem to root individuals to the natural world, reaching beyond the human condition. They include trees, one of the most familiar aspects of the environment, forming easily identifiable features which remain over many generations, their presence often being venerated as they age and become more rugged (Figure 17.4). However, we can include other basic natural elements,

Figure 17.4. Trees, One of Nature's Constants. Trees are a venerated part of the environment, significant in urban and rural areas. Age and ruggedness are a significant positive factor. Seen here are roots which appear to cling to the very substance of nature. This type of tree is particularly associated with memories and events spanning long periods of time, across generations; thus they have particular importance in underpinning wellbeing, having characteristics that express great age, grandeur, and seasonal change.

especially water, the view of the horizon, the night sky, natural stone, and other natural materials, such as wood, which continue to express their natural origins, and particularly when they show the impact of nature or natural processes.

Few of these elements have been investigated in any depth regarding their association with wellbeing but trees form a useful subject for discussion as there are studies which suggest that in-depth investigation is helpful in understanding how wellbeing is underpinned. Trees, as introduced in Ellie's picture (Figure 17.1), have always been recognized as important natural constants that become more significant with age. The age of trees is frequently hugely overestimated and would seem to indicate their importance as a constant in a changing world and the significance that people attach to them. In addition, trees are easily identifiable landscape features where ancient examples are celebrated (in rural situations at least) as boundary markers, or given names to identify their significance (Figure 17.4).

As indicated by Ellie, trees can form important symbols associated with higher levels of meaning and we would expect that an exploration of their physical and sensory attributes in relation to wellbeing would reveal positive connections in the personal responses of those who live with them. Such work is summarized here to demonstrate a range of aspects: the specific importance of trees as a positive component of the urban environment in relation to wellbeing, and the multiple and deep meanings that they signify to different individuals, going far beyond their physicality. The extent to which urban trees have been investigated as positive facets of wellbeing is limited, and it is even less so for other aspects—for example, the impact of building materials—and thus the studies are presented in some detail.

Two studies are considered. The first reveals and confirms the deep significance of everyday contact with street trees. These are not exceptional examples of ancient trees; rather, they are typical of the more "rough and ready" trees, examples of which are found everywhere, but which have imbued meaning and thus deep significance. In the manner of Gibson's affordances, what these trees afford or represent is highly significant. The second example looks at the more conventional aspect of urban woodlands which form part of a purpose-designed urban landscape complex in Redditch in the United Kingdom. The Redditch study, in particular, confirms the wellbeing attributes but also relates it to strict requirements of access and how woodlands are seen as a powerful constant in which individuals place and review their life events.

Case Study 2: The Role of Street Trees in Forming a Supportive Residential Environment

As indicated, this case study looks at some of the factors that contribute to wellbeing in a residential environment and the role of trees in the wider context of a street, trying to understand more fully the connections that are made (or can be made). The study was located in a major city in southwest England (Flannigan, 2011). From the earlier discussion and in the context of the wider literature the suggestion is that streets form one of nature's constants and the ways that people relate to them are likely to be significant. While trees are recognized as significant natural features in urban landscapes (constituting a key component of the *biophysical surroundings* to which individuals and families are exposed), it is only relatively recently that researchers have sought to investigate people's relationship with them, and the consequences that they may have in respect of underpinning well-being; that is, understanding their aesthetic qualities as part of a wellbeing relationship (for example, see Heimlich, Sydnor, Bumgardner, & O'Brien, 2008; Schroeder & Ruffolo, 1996; Sommer, Guenther, & Barker, 1990), which may come from a deeper understanding of the sensory engagement that occurs (e.g., McLean, Jensen, & Hurd, 2007; Sommer et al., 1990).

Several aspects need to be highlighted in this example: that the environment considered is a residential area (that is, there is a specific activity associated with living in the street, everyday home life, relaxation, a home environment) and that the trees exist within the context of this activity and the wider biophysical surroundings, the houses, the greenery, and other aspects of urban life such as cars and the residents themselves. Accordingly, it is necessary to consider the wider aspect of the street before the specifics of the trees themselves. The approach used was to encourage residents to verbalize their relationship with the street and the trees through the initial use of a questionnaire with follow-up interviews. This is a process referred to earlier where the importance of eliciting narratives or stories related to everyday experience was emphasized in understanding the detail of the interaction between individuals and their local surroundings as well as the need to consider the subjective responses of the individuals in informing how wellbeing might be influenced. These responses are reported in some detail in Tables 17.2 and 17.3 where the reader is invited to consider the totality of the "social, material and intangible elements of the environment" (as identified by Pink, 2010).

Table 17.2. Biophysical Components and Interactions within Residential Streets of a City in Southwest England. The responses can be considered as factors that equate with a positive environmental association, underpinning wellbeing (adapted from Flannigan 2011).

Description	Indicative quotations
Area feels spacious/wide roads	"The street is wide."
	"It's a fairly wide road."
	"Nice wide street."
	"Good wide road."
Little noise and peaceful	"It's fairly quiet, its pretty and peaceful."
	"It is quiet."
	"It is a quiet residential road."
Adequate road space to park the car	"Plenty of street parking."
	"Relatively easy parking."
	"Wide street with easy parking."
	"Normally sufficient on street parking."
Low traffic levels/not a rat run	"Not cut through—at present."
	"It is quiet (on the whole) with little through traffic."
	"Not too busy with cars."
Attractive gardens	"Gardens are attractive, though many have now put hard-standing areas for cars in the front gardens."
	"There are interesting front gardens."

(*continued overleaf*)

Table 17.2. (*Continued*)

Description	Indicative quotations
	"I also love to enjoy other people's front gardens—I would be sorry of they were lost to parking, *but* parking is becoming a bit of a problem."
	"Everyone has nice front gardens, which I like."
Good/interesting view from the house	"Good view."
	"We have great views over Redland from our flat, road is on a hill."
	"The view over Bristol from the back of the house is beautiful and I can often see fireworks and balloons and beautiful sunsets."
Street trees in the road	"Many large trees—mainly limes. Very good but in reality too large for scale of road."
	"Good, mature substantial trees."
	"Many attractive trees on both sides of the street."
	"The road is wide with trees all down it on either side—it really makes a difference."
	"You can hardly see the houses for the trees."
Friendly neighbors/street party/children playing/mixed age range	"This is a nice area—quiet, residential, nice peaceable neighbours—a middle class area."
	"Nice people."
	"Good neighbours, annual street party."
Denotes nonspecific approval of vegetation	"Lots of greenery to look out on even though it's in town."
	"Typical 'leafy suburbia.'"
	"Leafy."
Good access to local shops/facilities/parks/public transport	"Close to all amenities."
	"The house is convenient to my work, the local shops."
	"Convenient for shops and social facilities and GP surgery."

The street is beautiful	"I'm lucky because I live in a beautiful street."
	"It is an aesthetically pleasing view up the street as you turn in from either end."
Upbeat positive comment	"Great and fab."
	"I love living in my street!"
	"It is a pleasant street."
Streets are litter-/dog-mess-free	"There are very few dogs around (one guide dog next door) so the pavements are usually clear."
Low levels of crime and antisocial behavior/feels safe	"It feels safe."
Specific street tree outside their home	"I like the plane tree outside my house."
	"The tree outside my house is lovely and is a deep red all year round."
Properties are well maintained	"Most gardens and houses well kept."
Attractive houses/pleasing architecture	"Nice old-fashioned architecture."
Good access to city center	"Close access to central city."
Specifically described/bird song	"Nice to hear birdsong outside the window."
Like their own house	"The houses are spacious with good-sized gardens."
Council provides good services	"Council services good."
Denotes nonspecific wildlife benefits	"There is plenty of wildlife (birds, foxes, etc.)."
Greenness brings countryside into the city	"I chose this flat partly because we have a big sycamore tree outside the bedroom window—at eye level—makes it feel pleasant and natural and 'countryfied.'"

(*Continued overleaf*)

Table 17.3. Wellbeing Factors Associated With the Deeper Meaning Of Street Trees in a Residential Environment. Note the range of references to such aspects as past events, lifestyle, nature, and personal benefits which indicate that a loop exists between the tree as a profound indicator of the environment and the residents' wider values. For further explanation see text. Adapted from Flannigan (2011).

Factor	Brief definition	Indicative quotations
Environment	Contribute to the environment/add variety	"They add variety to the environment." "Environmentally desirable." "They are better for the environment." "Improves the environment."
Shade: positive	Cast welcome shade onto cars/property/garden	"Provides shade." "The trees provide shadows for cars (keeping them cool)."
Color	Add color to the street	". . . and produce colour and interest all year round." "Trees add colour to a street—all year round." "Adds colour throughout the seasons." "Greener look to street."
Habitat	Trees provide a habitat for wildlife in general	"It is essential to live in harmony with nature and to provide habitat for wildlife." "Also trees provide habitats for birds."
Smell	Trees provide a nice smell for the street	"We have lime trees and plane trees; the scent of both is beautiful." "Smell nice on street." "Smell of the pollen in summer."

Nature	Trees bring nature to the street	"They provide greenery, something natural, in a very densely populated area."
		"City streets need trees to bring a feeling of nature into the city."
		"They add nature to a street."
Enhance look		"They make the place look more welcoming."
	Trees enhance the look of the street/houses/gardens	"A natural aesthetic, generally making the street more attractive."
		"Trees add a great deal to the scenic attraction of our road."
		"They just look more interesting than continuous footways."
Seasons	Mark the changing seasons	"Trees are very important, giving us colour through the seasons."
		"You can feel the changing seasons."
		"Change through seasons."
		"Trees change with the seasons, thus continuously changing the appearance of the street."
Light	Enhance the light	"Enhance light and shade."
		"In the summer the light that comes into rooms is dappled and moving."
Sound	Trees make an interesting sound	"The other day I was lying in bed listening to the rain and wondered why summer rain sounded different to winter rain and my boyfriend pointed out that in summer you hear it pattering on the leaves."
		". . . and rustle of the leaves when the wind blows."
		"They make a great sound when windy."

(*Continued overleaf*)

Table 17.3. (*Continued*)

Factor	Brief definition	Indicative quotations
Countryside	Trees are associated with rural living	"Give impression of countryside." "It brings a bit of countryside into the city."
Wildlife	Attracts non-specified wildlife	"Encourage wildlife." "Attract wildlife." "Attract wildlife—we have a reasonable number of birds (too many pigeons and magpies) and squirrels."
Urban heat island	Trees contribute to cooling the area	"Trees help to prevent urban heat island effect."
Intercept rain	Trees intercept the rain	"Trees help to prevent flooding by intercepting rainfall."
Aesthetic	Trees look good/are beautiful in their own right	"Provides visual interest." "Tall trees—attractive." ". . . are nice to look at." ". . . they look nice."
Affluence	Make the area look affluent	"They make the place look more welcoming and more affluent."
Privacy	Afford privacy by obscuring property	"Privacy for houses." "Gives privacy." "Screen you from neighbours—v important in crowded city." ". . . and also they help with privacy."
Pollution	Ameliorate pollution	"Give fresh air." "Trees keep the air clean and suck up the urban pollution." "They act as the lungs of the city."
Carbon sequestration	Take up carbon	"Also, helps combat climate change by soaking up CO_2 from cars."
History	Offer a historical context for the street	"When fully mature they give a real sense of continuity; i.e., I'm truly grateful to our Victorian and Edwardian forebears for all the tree planting they did here in Bristol."

I love trees	A general statement of approval	"Keen gardener so fond of plants and trees." "I like trees in general." "They are a constant reminder of my happy youth growing up in semirural village in Gloucester."
Shelter	From sun, wind, rain	"Even the canopy of leaves provide shelter in order that I can get out of the car and stay relatively dry even in a downpour."
Leaves: positive	Exercise in raking them up	"Sweeping up the leaves gives us all a bit of exercise!"
Establishment	Makes the area appear established	"I prefer/really like the very large avenue of trees which can be found up the road between Redland Girls School and Redland train station."
Enhance feel	Enhances the feel of the street	"Trees simply make the street look more pleasant and cared for. They give the residents something to enjoy and care about together."
Birds	Birds mentioned specifically, e.g., song, species	"Trees provide homes for birds." ". . . the birds that perch in them to sing are a welcome sight (except the magpies)." "The trees provide nesting and perching areas for birds." "Attract wildlife—we have a reasonable number of birds (too many pigeons and magpies)."
Psychological	Improve frame of mind	"A pleasant leafy road in the suburbs can be uplifting in the urban environment." "Makes you feel positive, happy, calm. Green a very calming colour." "Overall trees are beneficial—they have a calming effect on the neighbourhood and make it a pleasanter place to live."
Oxygen	Provide oxygen	"Trees provide oxygen."

The initial detail in Table 17.2 appears to largely define the biophysical qualities of the local environment identified by the residents where they have gone through the task of examining their relationship with the street, articulating those aspects which are key in making the street a positive place to live. While the entries are not remarkable in themselves they need to be considered as part of the holistic loop that exists between the sensory engagement, physicality, meaning, and cognition discussed earlier in this chapter. Quiet and peacefulness are key features and appear to be complemented by nature and greenery; these two characteristics appear to offer congruence with the area being a residential environment and combine with the modest levels of traffic noise. The list of factors includes physical and social aspects, as well as broader expressions of quality.

Further information regarding the trees is presented in Table 17.3, exploring the more specific relationship with the street trees, and demonstrates their key role in helping to induce positivity. Like Ellie's tree, they are associated with a range of sensory aspects regarding environmental encounters. The positive attitude to trees is not surprising in the context of the literature, in that this suggests that trees form a subset of woodlands and forests. However, the more detailed inquiry into the attributes of the street places the tree as a wider subset of other aspects which define the positivity of the street in the reality of the everyday experience of the environment and also serves to define the attributes that operate in making this positive. Within these initial findings the deeper meaning of trees is integrated with other values, but further enquiry brings to the fore the specific meanings that the trees have. These are identified by the individual comments which express the nature of the sensory engagement in the residents' own terms. Many of these can be described as intangible (not easily defined), important to the individual but sometimes difficult to express or measure. These associations are diverse; they include wider reference to the environment and contact with nature, or remembered contact with wider nature ("Give impression of countryside," "It brings a bit of countryside into the city"). Specific reference is made to health and wellbeing, as well as individual reference to sensory engagement—for example, the noise of rain on the leaves, light, and the noise of the wind (see Table 17.3)—involving specific sensory engagement, remembered events, or representing nature.

This deeper level of engagement exemplifies the human dimension with a range of references to other experiences which support the individual in making life in this area of the city a highly positive experience. In terms of

supporting wellbeing, this can be further explained by considering the link that has been made between the physical attributes of the trees, the sensory engagement, life experience, and environmental constants such as wildlife and seasonal change. In addition, this is further amplified by reference to current environmental concerns, such as ameliorating the heat island effect, pollution, or carbon sequestration.

There is a strong indication that for most of the residents these trees are representative of a wider range of values than their physicality might suggest, values that are normally associated with wilder aspects of nature. The street trees appear to be a reminder or symbol of a deeper level of engagement constituting a constant positive (and welcomed) reminder of environmental and other values. Thus the trees are an essential part of a loop that connects the residents to these values and which, in turn, allows them to focus their values upon a significant constant of nature. Identifying and managing this loop is thus likely to help sustain high levels of personal wellbeing. Conversely its destruction, for example the removal of trees, destroys it and is far more damaging than the physical action would suggest. In fact our more generally superficial understanding of street tree situations seems to indicate that if more deeper enquiry into local values was a regular part of environmental management we would understand much more clearly how the environment performs and how to specifically help support wellbeing.

Case Study 3: Redditch New Town

This second example serves as an adjunct to that previously discussed and similarly explores the complex of factors that contribute to wellbeing in an environment that was specifically designed to contain industrial and residential activities. Like the previous study it looks at the experience of the individual, in particular how the experience is verbalized and given meaning. The relevance of the woodland experience in the context of individual life events is emphasized throughout rather than the nature conservation aspects which informed much of the landscape development (Bussey, 1996; Coles & Bussey, 2000). This was recognized at an early stage of the work, where the associations that local people had with their new woodlands were articulated in a set of social criteria (Coles & Caserio, 2001) that underpinned positive interaction, but which in fact were better related to the underpinning of wellbeing. Several points related to the achievement of effective social interaction and wellbeing are emphasized in this study

- the overall (anticipated) positive effect of woodland environments in an urban setting;
- that access to this experience is highly dependent upon the physical location of the resource being determined by easy walking distance from the home;
- the enduring nature of the woodlands where they exist as perpetual aspects of the environment which exceed the human dimension, especially in time;
- the associated intergenerational experience that facilitates the establishment of values and connections to personal wellbeing that goes beyond the simple physicality of the woodlands;
- that simple definitions of nature as nonurban (defined by the sensory experience) suffice to describe woodland quality and are not dependent upon specific nature conservation status;
- the verbalization of encounters that identify the deep level of sensory engagement and the significance of the encounter in terms of their positive effect on personal wellbeing in the context of their everyday lives and life events;
- that these results were not dependent on specific woodland types unlike nature conservation.

User reactions to the experience are illustrated in Figure 17.5 and may be expressed in a range of positive terms: happy, relaxed, uplifted, and close to nature. Essentially these relate to and serve to define the wellbeing experience. However, the ability to access this experience and level of positivity needs qualification in that strict parameters need to be in place. These relate to the quality of the woodland experience and in particular to the ease of access, in that there are distinct preferences for walking to the woods and in accessing the most local or convenient areas providing that they meet the quality requirements (Figure 17.6). By quality users meant the quality of their 'lightness' or structure, in that the woodlands should not be too dense, but other demands were modest. In this study walking was the preferred mode of access with the ideal walking time being around 5 min, a distance of less than 500 m. Thus the conditions that needed to be met to secure a positive relationship with the landscape were defined for this particular area, Redditch, and this particular population. Here we can be fairly secure of these findings in that there was a choice of over 300 woodlands within easy walking distance from the home, thus offering choice, where access to these environments is immediate, occurs every day, and can

Figure 17.5. The Qualities of Urban Woodland Environments Contributing to Wellbeing. Note the presence of the mature trees, dappled shade, seclusion away from urban noise, and ease of walking. Also notice the surfaced path which allows access for all without the need to change into specific outdoor wear. Narratives associated with use and obtained through the keeping of diaries further confirmed the sensory engagement, the presence of memories, and in particular relaxation which combined to create a loop of positivity.

be considered an extension of the home environment. How to optimize positive engagement becomes clearer when details of access patterns are examined. For example, residents preferred circular walks for recreation purposes, but also used wooded locations by preference when walking to the local shops or the town center. Some of the most popular routes expressed the desired environmental qualities, in particular the importance of easy access. Access formed the primary determinant and included the location of the woodlands from the home but also the quality of the paths. Modest street lighting was a feature of the most popular walking route but this route also offered the grandeur of mature trees and strong sensory engagement; for example, regarding the noise of the leaves, the smell of the flowers, and the quality of the light. Highly implicated was the fact that the woodland venues formed locations for social gathering, essentially being an extension of the home environment, a favored walking route to the shops and the school where casual encounters were anticipated and realized.

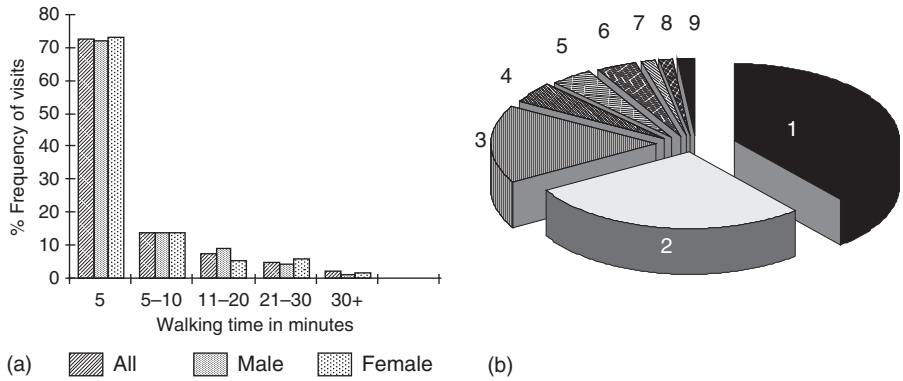

Figure 17.6. Some of the Key Parameters and Responses Associated with Urban Woodlands that Underpin the Achievement of High Levels of Positive Interaction and thus move People into a Wellbeing Loop. (a) Histogram showing the influence of woodland location and frequency of access; (b) pie chart showing the emotional responses associated with the use of preferred woodlands. (1) Close to nature; (2) relaxed; (3) happy; (4) uplifted; (5) explore; (6) insecure/uneasy; (7) memories; (8) bored; (9) other. Modified from Bussey (1996); Coles and Bussey (2000).

The study also indicated the ease with which negative factors can quickly creep in to destroy the interactive loop, such as the presence of litter, dumped supermarket trollies and other items, fear of crime, or even the mere presence of strangers.

Thus studies point to the importance of tree-type environments as an essential element of urban life and verify the significance of tree-planting schemes that usually accompany urban improvement in a variety of locations from urban parks to city centers and residential environments. The potential for tree-planting initiatives to underpin wellbeing is thus wide and remains to be more clearly defined in terms of ideal woodland or tree typologies which give the required level of sensory input. Noise, smell, light, and stature (age) are identified as important considerations, as are location and the ability of treed/woodland environments to isolate the individual from the negative aspects of urban life, noise, and traffic and to maintain a link with nature. The connections that trees can make to nature and the environment are key in that trees represent a tangible natural artifact which is representational of more elusive aspects of the natural environment assuming substantially more significance than their physical presence would suggest.

The longevity of trees remains a significant factor. In the Redditch study, evidence of intergenerational values and exploration of life events, and change, were set against the permanency of the woodland environment.

Narratives associated with use and obtained through the keeping of diaries further confirmed the sensory engagement, the presence of memories, the nature of the interaction, and in particular relaxation, which combined to create a loop of positivity. For example, little Katie played with her dolls in her local woodland, another local resident would go to his nearest woodland to remember his mother, whereas a grandfather used the woodland at the back of the house to hold a party for his grandchildren.

Combining the two case studies indicates the types of loops and relationships that can occur with just one urban component—trees—how they can influence the urban resident to elicit a sequence of interaction. Assessing tree performance in terms of wellbeing indicates the way forward, in that there are a multitude of urban components that needs specific attention. The significance for the design, spatial organization, and management of urban centers in supporting wellbeing through just this one, easily achievable, element becomes more obvious as it is investigated. Moving away from the biological aspects to the cultural significance and in particular the affordances provided by trees in their various forms is likely to be extremely useful in the development of wellbeing tree strategies (Zhang, Hussian, Deng, & Letson, 2007). Such is proposed, for example in the development of health-improvement zones by one local authority in the United Kingdom, which is to be achieved through planting strategies that link components together. These can be defined in various ways but essentially constitute wellbeing retrofit strategies where planting is optimized so that it can be as effective as possible in supporting wellbeing. Such strategies would implicitly recognize the sensory engagement offered, the qualities of light and sound, the permanence of one of the most profound of nature's constants, the affordances generated, and the ability to access, or ease of access, to generate a loop of positive interaction.

Wellbeing Loops and Performativity

In earlier discussion reference has been made to individuals moving into loops of positivity where sensory engagement elicited a positive response and led to a meaningful interpretation of that experience. In this section the discussion is continued, looking at the notion of a *wellbeing loop*, which describes the process by which an environmental encounter is interpreted by the individual and rationalized in terms of past experiences, places, and memories to give it particular personal meaning. The idea of the wellbeing

loop conforms to the initial discussions regarding perception of the landscape (Table 17.1) but is based upon a dynamic interaction being part of a process that can be described as a flow that occurs between the qualities of the encounter and the individual. The strength of this flow can be so great that the recipient is moved into a position of reverie where past encounters and memories combine and where the individual can express a certain level of euphoria, describing the moment as "a little bit of therapy" or "being on a high."

The presence of wellbeing loops is derived from a range of walking studies involving, in particular, self-narrated walking where the meaning of the encounter is verbalized. The act of verbalization appears to facilitate the formation of a loop in that it helps the process of cognition; that is, the task of narration forces the individual to explain the experience. The idea of wellbeing loops recognizes and amplifies the subjective approach to landscape perception, explored in the introduction to this chapter, and emphasizes the importance of individual identity as part of the process. It also emphasizes that we do not approach an environment in a neutral way but use past experiences to rationalize what we experience and that each new experience builds upon the past. For example, the sound studies of the canal suggested just that: a sound expectation associated with the urban canal. Again earlier on, reference was made to congruences in the landscape, in that what we see and hear, or expect, need to equate to create a positive association (in the sound walk sounds and expectations did not align). It also seems likely that we actually look for congruency in our encounters; we draw upon and look for positive past experiences or associations as a means of rationalizing and understanding a new encounter. If they are found it moves us further into a positive loop, if they are not found the encounter has little relevance. Performativity, or a "showing of doing," is an inherent part of the loop in that there is a strong dialogue between the individual and the environment through a combination of sensory stimuli (e.g., the sound of water, the sight of a tree) and cognitive processes (the meaning the individual attributes to what they sense): this is a two-way process. The narrative is the story that unfolds in response to the interaction, and can be either dialogic (told to the interviewer or another, such as a friend or visitor) or in the form of a monologue (speaking aloud to oneself) as with the self-narrated walking technique (Millman, 2012; Pink, 2010). The act of narration would seem to increase the development of a loop as it requires the participant to consciously explain the encounter.

Accordingly, as an individual moves through an environment there is a continuous flow of information that is capable of initiating wellbeing loops but the higher level of cognition is not necessarily achieved due to the lack of stimulus, or by being overridden by other aspects, for example fear of crime, the mechanics of navigating the route, a fear of getting lost, the concentration involved in avoiding the crowds, or crossing a busy road. Thus there is a complex dynamic of interaction which takes into account the purpose of the journey (e.g., if it is planned relaxation the individual is already programmed to experience positivity and will have chosen the location accordingly), its compatibility with that purpose, the congruency between the sights and sounds and purpose, and the quality of the sensory cues plus the cultural identity and experience. When all align a positive wellbeing loop should be capable of being formed.

Examples of walking techniques help illustrate the process. The first involves Millman's (2012) canal study, where she examined the dynamics of interaction recording a lone journey along the urban canal. The purpose of the journey was relaxation but she experienced a range of emotions which moved her from relaxation to communing with nature, reverie, and reflection but also fear (Millman, 2012). Millman's codification of the engagement, shown here, is interesting. Several extracts and an indication of the technique follow:

> Going through the notes from the walk, I codify the main components in terms of sensory experience including memories; sight, sound, touch, smell, taste, memory, musing, feeling (and) action.
>
> Another bridge. Dry, dripping, then wet. In the distance blurry human shapes (I'm not wearing my glasses). Scared—start to turn back. A bike is coming in my direction, yellow jacket—a man. I walk past him, then turn back around and walk towards the shapes; his presence has strengthened me.
>
> Birds singing—lots of them—I am surprised. There is so much nature around me in the middle of the city. I side-step some puddles, big ones with milky gravel-water in them. I pass the couple and say "alright" and smile—the man frowns, the woman smiles. I wonder what they are doing. What do they think I am doing? To the left the backs of houses with cute little jetties behind their back fences—some have seats and planters. They look old and well used, I am reminded of Welshpool and then Tipton where I have seen this before.
>
> Millman (2012)

Other aspects can be quite unexpected and impossible to predict. For example, another walk but in a different location, a botanical gardens, has similar attributes where the walker encounters various facets of the garden

and related these to past experiences and memories, for example the alpine garden reminds her of the mountains at home (she is a mountaineer) thus placing a personal layer on this environment.

In a further example, a couple walking along the central canal of Birmingham recall the Grand Canal in Kashmir. The linkage to this past positive experience is interesting in that the response to the Birmingham canal was mixed, described as "dirty not like the Grand Canal," but the couple then talk about the Grand Canal, swimming in the water and move into a positive loop and a brief moment of reverie, despite these initial negative feelings. The memory of the Grand Canal is emplaced on the U.K. canal experience to create a wellbeing loop that now moves these two walkers into a positive state.

As individuals walk through the environment, encounter different landscapes involving a range of sensory inputs and rationalize these, it is possible to consider a series of loops being initiated and moving the individual to states of positivity or indeed negativity. Associations formed which underpin wellbeing are likely to form favorite places, places that are revisited, where meetings are planned, or to which visitors were taken. These places are experienced in relation to a function (how they are used or wish to be used), a structure (their physicality), and the way that they relate to the individual (psychological component). If any of these components are changed, perhaps through urban regeneration, it is not just the physicality of the environment that is changed but the whole perceptual process and with it the wellbeing loop. This situation was examined in detail by Caserio (2005), who recognized these key aspects of environmental performance and modeled them in a Three Component Model (Figure 17.7) recognizing the key interaction of physical structure, the function of the environment, and the psychological component concerning cognition. These factors interact in a dynamic according to the value reference of the individual which results in a flow of information to the individual. Caserio's model is appropriate since it was developed in the context of what were thought to be relatively modest changes to the landscape of the Val Fontanabuona, Italy, caused by economic regeneration but which were accompanied by dissatisfaction by the local population. While recognized landscapes had been protected, the professionals developing the proposals had been unable to appreciate the close cultural connection between the population and their local landscape. These were revealed through the collection of narratives when walking through the villages and were associated with what was called "a visual tradition," a way of seeing things and organizing local relationships: the environment, scenery, and traditional relationships.

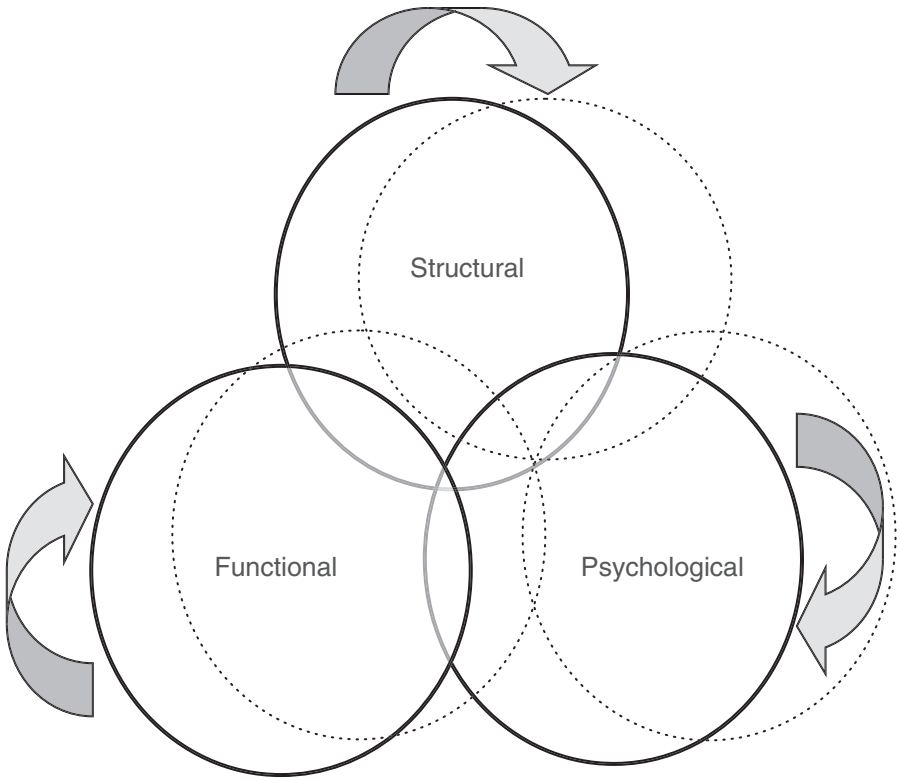

Figure 17.7. Caserio's Three Component Model. This recognizes the key aspects of the landscape in relation to its interpretation which can be examined in terms of wellbeing and environmental interaction. The components are considered to be in a state of constant change but must be considered holistically in that if one component changes (e.g., the function of the landscape) the others will also be affected. For further information, see text. Adapted from Caserio (2005).

Caserio further considered the flows that occur, conceptualized in the form of perceptual loops, which are formed as a consequence of the flow of information between the user and the environment (Figure 17.8). The loop expresses the dynamic of a continuous exploration which is also appraised in relation to remembered events and associated reference points. Rapid change will destroy the loop, but gradual change, or change that assimilates the value references, will maintain the loop (Figure 17.8). In the study and in the face of modest but not fully informed changes, the changes could not be assimilated in the loops; rather than evolving, the loops already existing were destroyed.

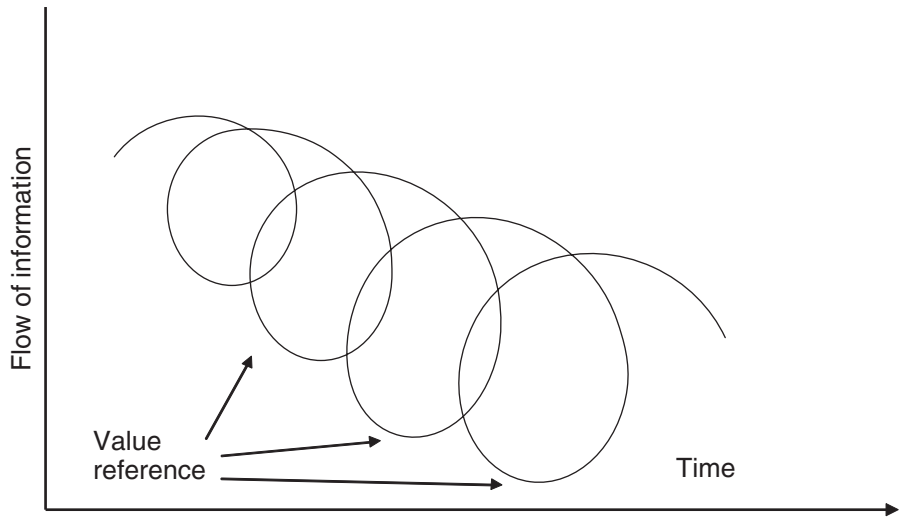

Figure 17.8. Perceptual Loops. A notional diagram for the formation of perceptual loops that involve placing or maintaining the cultural value of the landscape. The qualities of the landscape are continuously assessed and reassessed in relation to desired reference points. Key interactions are retained through the layering of memories, maintaining views, etc., and need to be identified if wellbeing is not to suffer. Modified from Caserio (2005).

In Caserio's study the local population had a close association with the landscape that was not readily recognized by the professionals. A change in the function of the landscape from farming to business units without considering the stewardship of the landscape affected the flow of information in a negative way. The impact on wellbeing was dramatic with disapproval being shown by the local population. In this example the well-established wellbeing loop was broken. The issue was firstly to recognize the loop and secondly how to ensure that it was maintained or even amplified. On an individual level this process occurs continuously in that cherished places are associated with a wellbeing loop which can be destroyed by change to the physical structure of that place, denied by a change in function; for example, the change of building use and a different dynamic of engagement, or not relevant to another individual who finds no connection. The challenge for those charged with the design and management of the environment is to recognize that these aspects exist and to maintain, enhance, or introduce them.

The professional challenges identified are recognized in the education of architects and related professions encouraging students to examine their

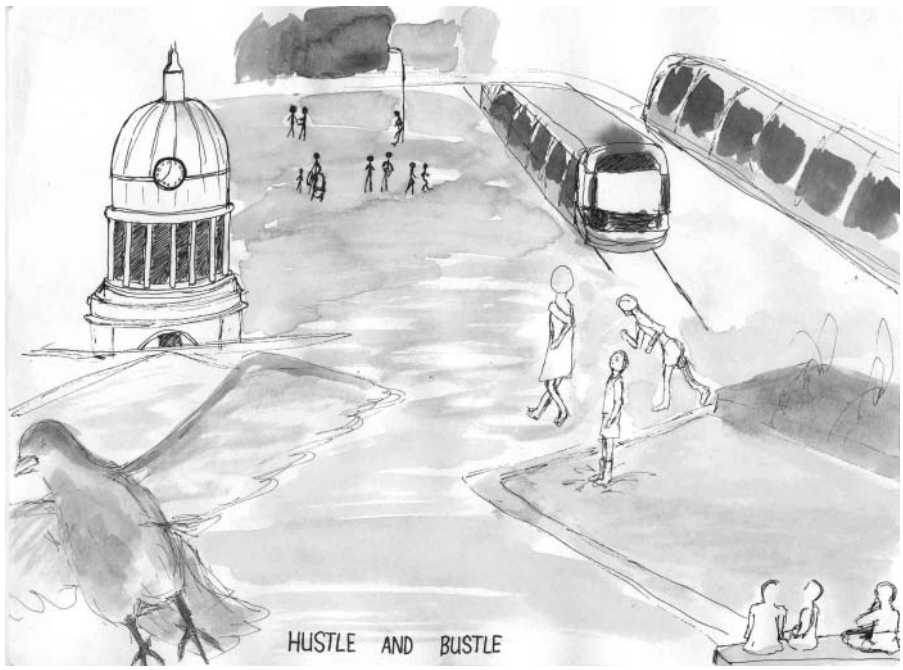

Figure 17.9. Observation through Drawing as a Means of Understanding more fully the User Perspective on the use of the Environment. Used with permission from Lindsay Purssord.

cultural/environment identity and to look at the ways that people interact with the environment. For example, Purssord got her architecture students to explore the narratives associated with the use of and possible regeneration of Old Market Square in Nottingham, United Kingdom, through drawings that explored how they used the space, what they were doing in it (why they were there), and the sensory engagement involved (Figure 17.9). Such approaches are much more likely to result in places where the design is connected to the wellbeing associations that the users have established or might be able to establish.

Case Study 4: Wellbeing Walks

The subject of this case study is the approaches used to investigate how individuals perceive the urban environment, returning to Millman's broader study of the canal, in order to look more closely at the wellbeing loops. The

Figure 17.10. Birmingham Central Canal. Note the overall architectural qualities, the dominance of water, the materials, bridges, and actual and potential use of the area. Access is only by walking or boating.

study is located in central Birmingham and forms a major pedestrian area, free from cars, dominated by several canals coming together and of a high quality with a variety of materials, many bridges, and the presence of diverse architecture embracing leisure, recreation, dining, entertainment, business, and music performance, together with the original heritage of canal basins, boats, and wharves (Figure 17.10).

This study had a range of phases, some already referred to, including encouraging students to explore their individual personal cultural context so that they could more easily appreciate the dimensions of the canal similar to Purssord's work (Figure 17.11). Within the students' explorations several aspects are worth emphasizing in relation to the visual narratives developed, the way that they were explained and the implications for understanding wellbeing.

- The narratives explored positive associations and clearly demonstrated that the location was being interpreted by reference to past experiences including other canals, water bodies, and boating holidays, but also

Figure 17.11. Student Representation of Birmingham Central Canal. Note the key indicators of water emphasized by the presence of boats and the bridge, and the trees. These components are exaggerated while others are reduced in impact. Compare with Figure 17.10, a photograph of the same location. Used with permission from Zoe Millman.

considered in terms of the function, vibrancy (lots of people), and opportunities for leisure, which could be both positive and negative.

- All the students' drawings were different but water and vegetation tended to be exaggerated as important components.
- The majority had positive associations but some had negative ones.
- When questioned, students explained the rationale behind their drawings and thinking, which emphasized the memory of different places with which they had linked their current experience.
- It was clear that they were assessing the qualities of the environment in the context of past environmental encounters.
- Those students who had a positive association had emplaced a previous positive encounter on this new environment; those with a negative experienced had done the opposite.

This type of investigation and the others described briefly elsewhere in this chapter confirm that we do not encounter the environment in a neutral way; as adults we continually assess the attributes of new encounters in the light of past experience. However, the emphasis on natural elements also seems to indicate an innate response to nature, as already explored. It further confirms that in trying to understand how environmental encounters impact on wellbeing the nature of the individual's past knowledge and the nature of that interaction are key.

The second aspect of the study involved a visual preference survey using postcards featuring selected images (Millman, 2012). The act of using a postcard to elicit landscape responses was a carefully chosen one in that it invites the participant to respond to a visual stimulus by "posting" a personal written narrative, a familiar performative act (Biggs & Blowen, 2009; Millman, 2012), redolent of choosing a holiday postcard based on its cover image and sending it to a friend with a holiday story on the reverse; that is, instigating a loop of interaction through a purposeful act of choice and description. Postcards showing six images of the canal area (Figure 17.12) were distributed to a wide group of participants via a network of contacts. Participants were asked to select the image they would send to a friend, together with a short explanation of the rationale for their selection. Brief personal details were requested on the reverse of the card.

The images provoked strong response, even to the extent that some people sent their own photos to demonstrate "better" scene depictions. The preferences for two images are shown in Table 17.4. The most favored images were images 3 and 4 (80% preferred these images). These are the most complex images, containing a wide range of cues and accordingly elicited the most diverse responses. It was also clear that respondents targeted the images that they associated with, almost regardless of content. The images had been selected for the survey on the basis that they contained what can be considered iconic landscape components (e.g., prominent trees, expanses of water, significant buildings, bridges, heritage) but the presence of these aspects alone were insufficient, since context and personal viewpoint were found to be important aspects of respondents' comments. In addition, other unexpected links were made by respondents, in particular making more abstract reference to the dominance of water and its iconic importance.

However, importantly, one in five respondents perceived the canalscape differently to the majority, with less focus on heritage, commercial leisure, and green space. Responses were often elicited by both the image itself and the memory associated with components therein; for example, image 4 does

Figure 17.12. Postcards of Birmingham. Tables 17.4 summarizes the respondents' comments for two of the images: image 2, Birmingham Skyline, dominated by water, and image 4, Brindleyplace, the most complex image, which also contains large trees, and favored by many. Used with permission from Zoe Millman.

not show the many nearby restaurants, but elicited many comments on this theme. The postcard technique represented a fairly simple but effective way of investigating the loops that occur between environment and individual, providing qualitative and quantitative data that is associated with the analysis of subjective wellbeing. The themes associated with two of the images in Table 17.4 are indicative of the wellbeing loop associated with the memory or sending of the postcard.

The final part of this study to be considered here relates to the compilation and analysis of self-narrations to the experience of the environmental encounter involving a particularly strong flow elicited through physical presence in the landscape, the opportunity for multimodal sensorial or total body experience, and the requirement to verbalize the experience (Evans & Jones, 2011; Millman, 2012). It is in these approaches where we see the deepest representations of meanings associated with personal wellbeing, where individuals explain their emotional response, the physical features, and the sensory engagement, including the degree of attachment. All these

Table 17.4. Factors Indicated in the Postcard Technique for Images 2 and 4 and which are Linked to Wellbeing. The images are shown in Figure 17.12. Notice the reference to a range of sensory qualities, physical components, and emotional responses that are elicited through this technique and linked to positive interaction. Used with permission from Zoe Millman.

Themes (image 2)	Frequency of comments	Themes (image 4)	Frequency of comments
Composition	3	Greenery	20
Reflections	3	Composition	14
The city	3	Sunshine/summer	13
Beauty	2	Water/canal	11
Tall buildings	2	Balance, old + new	10
Nature	2	Boats/boating	10
Peace	2	Modernity	9
Modernity	1	Iconic	8
Light quality	1	Tourism	7
Water/canal	1	Colors	6
Tourism	1	Positivity	6
		People/vibrancy	5
		Inviting	5
		The city	5
		Buildings	5
		Bridge	5
		Good development	4
		Peace	4
		Cafés/continental	4
		Heritage/tradition	3
		Pleasure	2
		Walking	1
		Fresh air	1
		Sky	1
		Business	1
		Space	1
		Reflections	1
		Freedom	1
		Beaches	1

are indicators of movement into a wellbeing loop which was verified in a follow-up group feedback interview session.

Although commonalities are apparent when considering the broad trends in responses, the differences between responses become apparent when narratives are analysed at an individual level. It is evident that although

participants sometimes arrive at similar, general perceptions, their associations with the landscape are more complex and individual. Interviewees expressed feelings of like or dislike of the regenerated canal but crucially their reasons for this preference differ. For example, one participant disliking the regenerated Brindleyplace and Gas Street Basin areas because they viewed them as commercial pastiches, a sort of residential theme park; that is, they represented exclusion, in that accessing the landscape here for leisure and yet residential use implies a high financial status that is potentially exclusionary to many local residents. Another respondent disliked the same buildings because she did not recognize the landscapes of her past in the regenerated landscape; they were now incongruous with the retained/selected/remembered heritage component, which related to her past. During her visit she became displaced when she could not trace the routes of her childhood memories of the area. Sensory experiences instigated the sudden recall of memories; for example, one participant walking across cobblestones in the Gas Street Basin area recalled the associated landscape of Turkey, where the paving is similar and where she had been on holiday. For another, the sight and sound of water moving through a lock caused him to recall a "vision" of the seaside near his home in Italy. Neither outcome could have been predicted. Significantly, some individuals also consciously emplaced memories in the landscape for later retrieval during visits. These included one participant talking about how she takes her visitors to the Brindleyplace area to tell them stories about the city and about herself. For her this area has become a "repository of memory;" for another, she visits in order to recollect and also share her memories. In these cases the sensory stimuli, in the form of the buildings and wider environment experienced as she walked, provoked the recollection of the memories she associated with those buildings. Since landscape perceptions are founded in experiences and associations, it follows that individuals' identities, which are also based on experiences and associations, are implicated in the landscape and the activities they engage in there (Gray, 2003). All these cases demonstrate the complex of connections associated with wellbeing for each of the individuals.

Participants narrated such evocative landscape perceptions relating to associated landscapes that they demonstrate the very strong importance of memory. In such cases participants seem to be engaged in a confluence of the past and present (and sometimes the future), in which they are momentarily caught in a self-reflective cycle of remembering an absent landscape while experiencing the current one, so that the boundaries between both are blurred. The example where two walkers in particular displayed such

momentary "transformations," wherein they were effectively transported across time and space to the landscape of Kashmir in response to the qualities and sensory engagement elicited by the canal, referred to earlier, was a feature of this study.

Evidence suggests that certain places are commonly linked with the expressive evocation of memories. These include the Gas Street Basin area (featured in the postcards, Figure 17.12) and the Cambrian Wharf/Farmer's Bridge locks area, both eliciting more memories and landscape associations than any other places on the route (walking interviews). A similar effect was observed in the postcards study, in which the images of Gas Street Basin and the central bridge at Brindleyplace elicited far more memory-based responses than any other image on the postcards.

The reasons for the concentration of emplaced memories and involuntary memories at these "memory hotspots" is unclear, but both are high traffic destinations: Gas Street Basin possesses the potential to attract more visitors to emplace memories there, but this does not explain the high number of instances of memory recall at the Cambrian Wharf/Farmer's Bridge area, which is less well known. Another explanation is that water is particularly conducive to the emplacement of memories; participants were drawn to the water to the extent that they disliked leaving the sight of it when directed to it. There were strong instances of memory recall within the sight of water. Two "memory hotspots" were based around the two basins, large bodies of water that are redolent of lakes and are referred to as having "the potential for life."

Despite the concentration of memories at these sites, the memories participants recalled differed according to their personal identities. For instance, the same sensory stimuli trigger different memories in individuals so that for one participant the sight of the colored boats in Gas Street Basin caused her to recall familiar African boats, whereas the same boats caused another to recall his own boat and, by association, a specific instance of boating with his daughter.

In these walks the level of performativity is high as the walker actively seeks out meaning when experiencing cues, actively engaging in loops of experience and memory facilitated by the process of self-narration; that is, they are required to consider these aspects in the performative act of narration (Millman, 2012). This has implications for understanding how we might try to underpin positive wellbeing. However, it is not entirely clear what is driving the process: the past positive experience of environment by which we interpret the encounter, the specific sensory cues, or the specific qualities

of the current environmental encounter. In all probability it is a mixture of these, in that participants construct meanings that are related to experiences that have been identified by the individual as positive (or negative) through a combination of physical experiences (sensory perception) and through cognition (understanding based on associations with previous experiences, or memories). Also indicated is that within this process sits our innate response to nature: positivity occurs through the integration of past encounters with new encounters.

These aspects are thought to be particularly crucial in urban situations where the biophysical environment is complex and where we spend much of our time. However, as indicated, the process is an integrated one involving natural elements, especially water and trees as well as built aspects. In this study the reference to water as having "the potential for life" or trees forming "a natural aesthetic" suggest that the innate need for nature greatly facilitates the formation of loops in highly urbanized situations. Hence, the results suggest that we should be looking more critically at all urban environments to understand more fully how they perform in relation to human interaction, and how we can better understand them and manage them as *supportive environments.*

Concluding Remarks

The intention behind this chapter was to consider perspectives relating to the ways that we interact with the environment in order to shed some light on the interactive process that needs to be established to move individuals into a state that is associated with higher levels of wellbeing. A range of aspects have been considered which suggest that we have an innate need for contact with nature, but, as adults, much of our interaction is based upon our past experiences, which we use as a basis for the interpretation of new environmental encounters. The extent to which this moves us into a more positive state can be identified by the collection of the narratives, descriptions, or stories that accompany the environmental encounter. In fact the act of self-narration when walking through the environment is thought to aid the movement into a higher state of wellbeing as it facilitates the cognitive process.

The formation of wellbeing loops is conceptualized. These are formed via a process of engagement and involve the structure of the environment and the function of the journey; individuals constantly gather information as part of everyday activities but for such loops to fully form there needs to

be congruency between the environmental cues and the desired action. As might be expected environments that invite relaxation appear to be a critical cue to moving into a higher state of positivity, thus supporting wellbeing.

In studies wellbeing is rarely referred to, but is inherent/implicated in the language used by individuals in describing the encounter which consider the physicality of it as well as the associated flow. Understanding and recognizing these flows presents a range of challenges to those involved in the design and management of human-centered environments, in terms of understanding how their own identity will bias their actions and identifying existing aspects that are important. In relation to the modern urban environment these aspects are recognized in the design of high-quality environments, emphasizing walking and aspects of walkability and a design quality which offers greatest scope for multimodal sensory engagement with good prospects for the initiation of loops.

In urban environments some of the determinants that predispose towards the formation of wellbeing loops (for example see Gehl, 1987, 2010) include places that

- are safe;
- are accessible;
- give dominance to the walker;
- link to other places;
- are multifunctional/allow interpretation;
- are inspiring, encouraging sensory engagement;
- encourage exploration;
- are empowering, giving ownership;
- are iconic in meaning;
- have changes in level;
- contain views and vistas;
- show opportunities for relaxation and socializing;
- have calm areas;
- provide a refuge;
- engage/contact with nature's constants;
- contain artifacts/sculpture/to increase aspects of performativity.

As individuals move through the urban environment they move through a range of states which are induced by their encounters with the environment and their contact with others. The interactions involved are capable of moving people into a more positive or negative state in respect of their

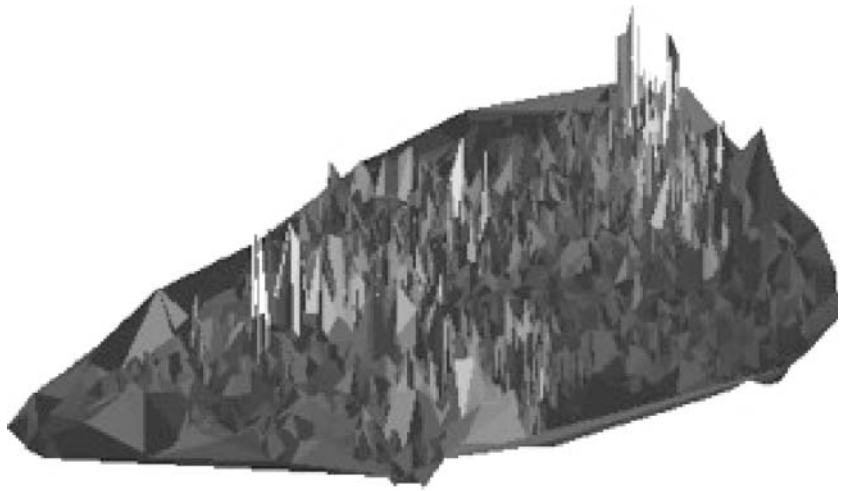

Figure 17.13. Computer Simulation of Environmental Interaction Involving 20 min of Walking in the Location of Castle Vale. The peaks and troughs represent high and low levels of wellbeing; the peaks representing wellbeing increase as different interactions occur. The model used actual population profiles to give the users identities, memories, and levels of confidence which reflect that interaction relates to the individual.

wellbeing and can be modeled (Figure 17.13). Importantly, such models need to take into account the characteristics of the individuals using the environment to consider the flows that occur, in that different individuals will react differently. Figure 17.13 features an image based on a generated video sequence associated with such a model, does this in considering a well-defined, local environment that has a distinct identity and structure, Castle Vale in Birmingham. The model uses local, already published, statistical information to give walkers in the environment specific properties that will affect how they respond to environmental encounters and other individuals (such as age, gender, income, confidence, purpose, and memory). The result is that there are certain places which induce high levels of wellbeing and that repeat running of the model causes consistent results. These are shown as peaks in Figure 17.13. The model allows all parameters to be varied, for example testing the impact of a new urban extension on the population or looking at a specific user group with defined characteristics, together with a trace of the routes taken.

Much investigation remains to be done in translating existing design practice and recommendations more specifically into the remit of wellbeing

Figure 17.14. Urban Regeneration and Urban Flows. This location had particular significance for the author in terms of having a range of positive factors, visited and enjoyed as part of his personal wellbeing experience. These include the presence of a mature tree, the gravestones (natural stone and indicating age and past events), the area as a refuge from the hustle and bustle of the busy and changing city, and the view of the Selfridges building with its organic shape and biological cell-like surface. These all combine to form a wellbeing link reinforced by memories of other places, a fascination for churchyards, and remembered schooldays including the structure of the Selfridges building. The range of components are associated with strong personal flows, as are other examples discussed in this chapter.

through understanding of the nature of environmental encounters. This can be regarded as an evolution of our understanding of how urban environments function in the support of wellbeing, to help us understand the flows that occur, how they can be instigated, and their relevance to the user. It is the hope that this chapter will help in this process (Figure 17.14).

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Part 4

Wellbeing and the Environment

Other Factors and the Future

18

Crime and the Urban Environment

The Implications for Wellbeing

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Introduction

Crime is considered in the literature on wellbeing, and crime and security-related criteria have been directly incorporated into a number of the wellbeing measures that have emerged.

First implemented in the United States in the 1990s, the Genuine Progress Indicator (GPI) measure includes the "cost of crime" as a potential harmful effect of economic activity (Talberth, Cobb & Slattery, 2007). This is in contrast to the purely economic measurement of gross domestic product (GDP), which is actually boosted by crime.

> Each year, Americans incur nearly $40 billion in crime related costs in the form of lost and damaged property and expenditures on locks, alarms, and security systems. GDP counts these needless expenditures as an economic gain, implying that crime is good for economic growth.
>
> Talberth et al. (2007)

In 2006, the International Institute of Management proposed a Gross National Happiness (GNH) metric to monitor socioeconomic development: a measure to act as an alternative to the narrower gross national product (GNP) metric. The GNH 2.0 metric tracks seven socioeconomic

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development areas. "Social satisfaction" is indicated by direct survey and statistical measurement of social factors including discrimination, safety, complaints of domestic conflicts, lawsuits, and crime rates (http://www.iim-edu.org/polls/grossnationalhappinesssurvey.htm).

In the United Kingdom, research into wellbeing conducted by the Office of National Statistics also includes crime as a factor (www.ons.gov.uk/about-ons/consultations/closed-consultations/measuring-national-well-being/index.html). Crime and security are key components of conceptual frameworks such as quality of life, sustainability, and the liveability of the urban environment. In this chapter we investigate the relationship between crime, feelings of insecurity and the urban environment, and the implications for wellbeing.

Research shows that crime is not evenly distributed geographically, but that incidents are concentrated in particular locations. Crime Prevention Through Environmental Design (CPTED) seeks to understand the relationship between crime and the environment, and to use this knowledge to prevent crimes from occurring. Evidence shows that crime levels have declined significantly, and this is attributed in part to improvement in policing, security, and design. However, researchers and policy makers are concerned that citizens' fear of crime and feelings of anxiety remain high. In the United Kingdom the problem of fear of crime has fuelled concerns about incivilities, such as young people's antisocial behavior. We raise issues about the social consequences of U.K. attitudes and practices in relation to young people, arguing that an overly negative and punitive attitude toward young people undermines wellbeing. We also draw attention to limitations with research into fear of crime and insecurity, presenting a new model that links fear of crime more closely to wellbeing and quality of life: the "Insecurity Lifecycle."

Crime and Wellbeing

A key element in determining crime is whether an action results in "harm" (Henry, 2001). Officially, crimes are defined as breaches of rules or laws, for which a governing authority—usually the legal system—can prescribe a conviction or caution. Modern society generally differentiates between crime or offences against the public or state, and offences against a private individual. The latter are usually dealt with under civil law. In England and Wales, broadly speaking, crime is classified as vandalism, theft, vehicle-related

theft, bicycle theft, burglary, violence, sexual crimes, and murder. These classifications have varied over time, as measurement tools have developed and different offence types have emerged. In the 1990s, a wider range of behaviors began to be considered by authorities and less serious incivilities were criminalized by the legal adoption of the term "antisocial" (Home Office, 2011). Antisocial behavior was defined in the 1998 Crime and Disorder Act as acting in "a manner that caused or was likely to cause harassment, alarm or distress to one or more persons not of the same household as the perpetrator" (Great Britain, 1998).

Crime has an impact on the wellbeing of individuals, business, and societies, both economically and socially. For crimes such as assault and robbery, victimization results in psychological and potentially physical harm, and may have longer-term consequences, generating fear and anxiety among victims and their families. Burglary can lead to victims and their neighbors feeling unsafe in their own homes (Gibbons, 2004). Following the initial shock, victims may experience a range of emotions, such as anger, frustration, helplessness, and even depression. Fear of repeat victimization may lead to changes in routines and avoidance of certain locations. Although there are tangible, financial costs to crime, there are also wider, less tangible impacts on victims, local environments, and wider society. These two sides of the cost of crime are shown in the Ripple Model illustrated in Figure 18.1.

In 2000, Brand and Price published a briefing document for the U.K. Home Office outlining a methodology for determining the cost of different types of crime. In June 2005, Dubourg, Hamed, and Thorns (2005) updated the data and methodology, focusing on three broad categories of cost

- costs incurred in anticipation of crime, such as defensive expenditure;
- costs incurred as a consequence of crime: these include the physical and emotional impact on the victim and the value of any property stolen;
- costs incurred in response to crime, including the costs to the criminal justice system.

The reports showed that the most costly crimes are those with a large estimated emotional and physical impact: homicide, wounding, robbery, and sexual offences. The most costly violent crime was judged to be rape. Violent crime, due to its high emotional and physical impact, accounts for a large proportion of the total cost of crime against individuals and households.

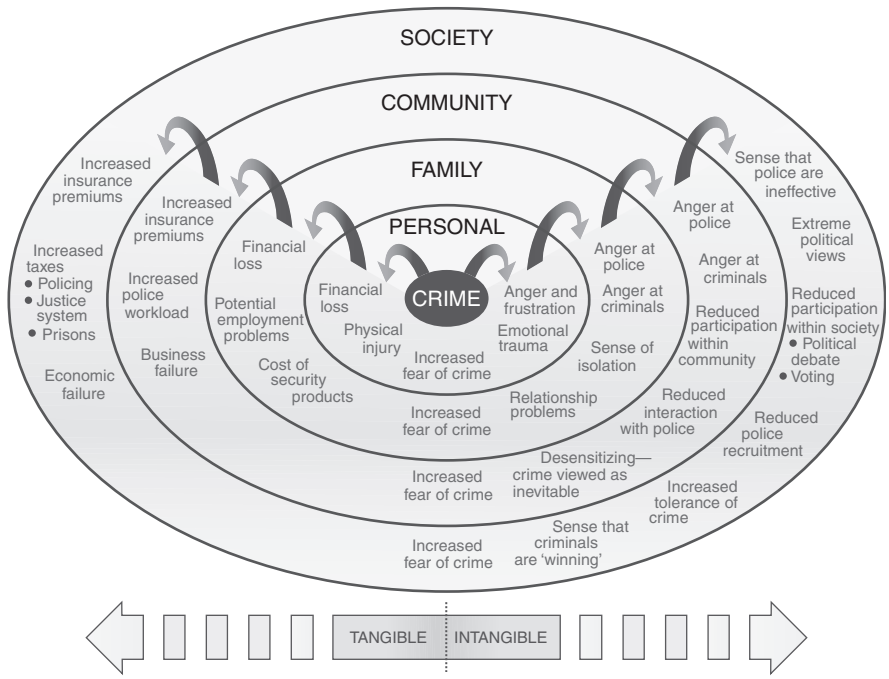

Figure 18.1. The Ripple Model. The tangible and intangible costs of crime. Source: Wootton and Davey (2003).

The total burden cost of crime against individuals and households in 2003/2004 was around £36.2 billion. Compared to 2000, the cost of crime had decreased by around 9% due to a significant reduction in crime levels (Dubourg et al., 2005).

Understanding Crime and the Urban Environment

Crime is not evenly distributed across the population. Increased risk of victimization is experienced by men, younger people, single people, and those living in disadvantaged communities (Crime Survey for England and Wales [CSEW], 2012). Levels of crime also vary significantly across different types of environment.

In the 1970s, criminologists started to investigate the immediate conditions and choices confronting offenders and the relationship of these with the geographical distribution of crime. This represented a shift away from

a focus on wider social conditions, such as poverty. Drawing on the work by Shaw and McKay (1942) in the U.S. city of Chicago, the new field of environmental criminology emerged. Environmental criminology drew attention to the rational choices made by offenders. It highlighted the fact that offences such as burglary and robbery are typically committed close to an offender's home; but not too close, as offenders fear being recognized. In addition, as offenders travel around (visiting shops, work, school, leisure facilities, etc.) they develop useful knowledge of their environment and how it is being used and are therefore more likely to commit offences there (Brantingham & Brantingham, 1975; Brown & Bently, 1993). These ideas are encapsulated in rational choice theory (Cohen & Felson, 1979) and routine activity theory (Garland, 2000).

In Canada, the United States, and Australia the discipline of CPTED was developed. Inspired by C. Ray Jeffrey, CPTED brought together concepts related to the psychology of the individual and the form of the physical environment. CPTED draws on the work of Jane Jacobs (1961), author of *The Death and Life of Great American Cities* (1961), who criticized planning practices for creating exclusive centers that lacked clarity of use and provided opportunities for crime. Jacobs highlighted the need for a clear demarcation between private and public space, more "eyes on the street," and for neighborhoods to contain a mix of social groups and building uses. CPTED was also influenced by the sociologist Elizabeth Wood (1961; cited in Colquhoun, 2004), who argued for managers of housing projects to work with residents and for crime prevention to be considered when designing neighborhoods (Colquhoun, 2004).

CPTED is founded on the idea that crime arises not simply from the individual's motivation or "criminality," but due to the offender being presented with opportunities to act on these motivations. The offender's final decision to act is influenced by other factors: the degree of effort required to offend; the risk of being detected and, if detected, being caught; and the likely consequences; that is, the balance of rewards against potential punishments (Ekblom, 2001). This model of criminality is known as opportunity theory, and is explained in the seminal work *Opportunity makes the thief* by Felson and Clarke (1998).

Offending is also affected by whether offending behavior may be observed and by environmental cues. Derelict buildings that have been vandalized, litter, and graffiti all give the impression that the area is uncared for and that offending will be tolerated: this is known as the broken windows theory. The image of a broken window is used to explain how neighborhoods

descend into incivility, disorder, and criminality, without sufficient attention to management of maintenance (McLaughlin, 2001). Interestingly, broken windows is not strongly supported by the the empirical evidence, but nevertheless continues to guide CPTED practice.

Opportunities to offend can be reduced by changing the physical and social environment. "Natural surveillance"—achieved by, for example, housing layouts and appropriate locations of windows—facilitate neighbors surveying other properties and additionally observing potential intruders. Access control, where boundaries and entry points deny access to crime targets, acts to prevent crime by physically impeding accesses (e.g., doors, fences, and gates) and/or psychologically deterring intruders from entering an area (e.g., symbolic gateposts, changes in road surface texture or color). Creating a sense of ownership of an area—"defensible space"—has the potential to empower residents to respond to threats of intrusion (Newman, 1973, 1995). A well-maintained area suggests that the environment is well cared for and that any damage will be noted and repaired (Town, Davey, & Wootton, 2003). Since the late 1990s, CPTED approaches to the built environment have turned their attentions to the role of social factors and communities in helping to reduce crime (Saville, 2003).

In the United Kingdom, Ron Clarke developed Situational Crime Prevention while working for the Home Office (Clarke, 1983, 1995, 1999; Felson & Clarke, 1998). Situational Crime Prevention seeks to intervene in the design of products, services, environments, or systems to make them crime-resistant. It alters situations that the offender encounters, or seeks out, in the immediate circumstances of the criminal event (Ekblom, 2001). According to Clarke (1995), targets, victims, and facilitators combine to create a "criminal opportunity structure" (p. 102). Concerted efforts have been made to identify and reduce the vulnerability of products to crime.

Tackling Crime through Design, Planning, and Management

Police Geographic Information Systems (GIS) reveal geographical areas or locations where crime is concentrated: classified by police and criminologists as "crime hotspots." The use of GIS to plot the location of crime incidents has become common practice. In the United Kingdom street-level data on the occurrence of crime is made available to citizens via the Internet (www.police.uk) (CSEW, 2012).

GIS are not simply used to target police resources, but also to provide data that helps target, design, and evaluate interventions. In addition to taking steps to address problems of crime and insecurity that already exist (crime reduction) effort may be directed at reducing the likelihood of crime occurring in the first place (crime prevention). Crime issues may be addressed through strategic urban development projects and plans, the planning-control procedures, and/or design processes (Davey & Wootton, 2012).

There is the possibility for performance to be recognized or accredited; that is, compliance with an accepted standard recognized by an official agency, which operates independently of commercial considerations. Buildings are generally assessed against compliance with CPTED criteria and may be accredited for security.

In the United Kingdom, Secured by Design is operated by the Association of Chief Police Officers (http://www.securedbydesign.com/). Police Label Secure Housing was established by the Dutch police and is now operated by local municipalities across the Netherlands (Van Soomeren & Woldendorp, 1996) and has recently started to operate in Germany (Schubert & Schnittger, 2003, 2005). In addition, a European Standard has been developed to promote crime prevention through urban design and planning (Comite Europeen de Normalisation [CEN], 2007).

In some forces in England and Wales, new developments and building renovations are assessed in terms of their potential effect on crime and the findings taken into account in the planning process (Wootton, Marselle, Davey, Armitage, & Monchuk, 2009). Police Architectural Liaison Officers are employed by police forces to provide architects and developers with relevant information about local crime conditions, CPTED principles, and building products that meet security standards. The Architectural Liaison Officers assess designs submitted to local authority planning departments against crime prevention criteria, drawing planners' attention to designs that increase vulnerability to crime. As a result, local authority planners may ask the architect/developer to make changes to the design before awarding planning permission.

Evaluations have demonstrated the ability of Secured by Design schemes to prevent crime (Armitage, 2000; Brown, 1999; Pascoe, 1999; Poyner & Webb, 1991). In addition, in-depth research conducted over a 10-year period found that Secured by Design significantly reduced both crime rates and fear of crime (Armitage & Monchuck, 2011). The findings support the value of continuing to promote Secured by Design principles:

> The findings are presented alongside caveats regarding sample size and, in many cases, the reader is urged to treat the findings are indicative. It is hoped, that limitations aside, the findings of the study can be used to support the continued use of the [Secured by Design] scheme and to highlight areas for improvement.
>
> Armitage and Monchuck (2011), p. 338

Studies have also examined specific CPTED principles such as access, surveillance, and territoriality. These have shown crime-prevention benefits of reducing access, increasing surveillance, and supporting residents' sense of territoriality (Armitage, 2007).

Research into the link between housing quality and crime suggests that crime must be actively considered during the design process, if residents' quality of life is not to be compromised by high crime rates (Armitage, Rogerson & Pease, 2013). The national standard—Building for Life—aims to promote functional, attractive, and sustainable housing and addresses issues related to the environment and community, character, streets, parking, and pedestrianization (www.buildingforlife.org). Despite purporting to promote sustainable housing, Building for Life standards do not ensure that crime is considered by architects and, as a result, designs were found to be vulnerable to crime (Armitage et al., 2013).

The Situational Crime Prevention and CPTED literatures have also highlighted the value of product design in reducing crime. The design of products can significantly increase levels of crime: these have been referred to as "hot products" (Clarke, 1999). Measures have been taken to improve the security of some products and services, especially vehicles (Armitage, 2012). The Motor Insurance Repair Research Centre, or Thatcham as it is widely known (http://www.thatcham.org/about), was established in 1969 by British Insurers. Its main aim is:

> to carry out research targeted at containing or reducing the cost of motor insurance claims, whilst maintaining safety and quality standards.

Thatcham conducts research and produce data to assist in the efficient, safe, and cost effective repair of motor vehicles. It also works closely with vehicle manufacturers to influence the design of new vehicles in order to improve safety and security (http://www.thatcham.org/about/). It is recommended that crime prevention is embedded into the design process (Design Council, 2011; Wootton & Davey, 2012).

Evidence of Reductions in Crime

Data on crime comes from the International Crime Victims Survey (ICVS) of 30 industrialized countries, including Australasia, Europe, and North America as well as Japan and Mexico. Initiated in 1987, the survey is conducted every 4 years. The ICVS asks a sample of the population about their experiences of ten "common" crimes, broadly defined as vehicle-related, burglary, theft of personal property, and contact crime (robbery, sexual offences, and assault and threat; Van Dijk, Manchin, Van Kesteren, Nevala, & Hideg, 2007, p. 11). The survey—which is conducted by telephone—provides a measure of "victimization" (i.e., direct experience of crime) over the previous 12 months. Adoption of a standard methodology allows comparisons to be drawn internationally, and for trends to be identified. ICVS results are available from http://rechten.uvt.nl/icvs/.

Building on the experience of conducting the ICVS, the European Crime and Safety Survey (EU ICS) was developed to inform policy makers about the volume and nature of crime in Europe (http://www.europeansafetyobservatory.eu/default.htm). In England and Wales, crime figures are available from both police records and national victimization surveys: the CSEW is used (formerly known as the British Crime Survey).

Worldwide

Evidence suggests that steps to minimalize opportunities have helped reduce crime levels worldwide. North America, Australia, and most European Union countries suffered a "crime epidemic" lasting for three (1970s to 1990s) or even four decades. Since 2000, most countries have managed to significantly reduce levels of crime (Manchin, Van Dijk, Kury, & Schaber, 2005, p. 2). According to the ICVS:

> The level of victimisation peaked halfway through the 1990s and has since shown a slow but steady decline.
>
> Van Dijk et al. (2007), p. 16

The authors of the ICVS consider the near universal drop in crime "arguably the most striking result of the fifth round of the ICVS." Better design and security are credited with bringing about reductions in instances of property-related crimes such as burglary and vehicle crime (including

thefts from cars, joyriding, and bicycle theft). It would appear that design and security effectively "raise the bar," making crime harder to commit. Only the more determined individuals continue to offend:

> Reductions in levels of burglary might well be the result of improved security among households previously most at risk. Improved security among sufficiently large proportions of vulnerable households may have dissuaded potential burglars from committing burglaries by increasing efforts and risks.
>
> Van Dijk et al. (2007), p. 68

Across Europe

Conducted in 2005, the EU ICS groups countries in terms of crime levels—high, medium to high, and low (Van Dijk et al., 2007, p. 2)

- high (significantly higher than the average): Ireland, United Kingdom, Estonia, the Netherlands, Denmark, and Belgium;
- medium to high (but not significantly different from the mean): includes Poland, Sweden, Germany, and Luxembourg;
- low (significantly lower than the average): Spain, Hungary, Portugal, France, Austria, and Greece.

Researchers wish to explain the differences between countries. Interestingly, affluence does not appear to explain the differences, because high crime levels are not concentrated in less-affluent countries (Van Dijk et al., 2007). The degree of urbanization strongly affects crime rates (Hideg & Manchin, 2005–2007). In main cities in developed countries, overall victimization rates are about one fourth higher than surrounding areas (the average is 19.9% according to the ICVS (Van Dijk et al., 2007, p. 12). With the exception of Ireland, the countries with high crime levels are all relatively urbanized (Van Dijk et al., 2007, p. 43). The proportion of young people in the population is another common factor associated with crime (Van Dijk et al., 2007). Young people are more likely to offend compared to older age groups, although the relationship to age varies depending on the offence: some offences actually peak later in life (McVie, 2005).

Risk of being assaulted were found to be highest in the United Kingdom, Ireland, the Netherlands, Belgium, Sweden, and Denmark. Violent crime is linked with the consumption of alcohol (Manchin et al., 2005).

Concerns about Levels of Insecurity

The EU ICS shows a reduction in the number of residents in most countries that are concerned that their houses will be burgled, which is in line with actual decreases in rates of burglary. However, feelings of unsafety in the street have not declined significantly, despite reductions in violent crime in many European countries (Manchin et al., 2005). Policy makers are concerned that reductions in crime have not resulted in significant declines in feelings of insecurity.

The victimization surveys show that feelings of security and safety are not necessarily related to a country's actual crime levels. The Eurobarometer data shows the proportion of respondents reporting that they felt unsafe (either a bit unsafe or very unsafe) over time. Respondents in Scandinavian countries, Denmark, Finland, and Sweden were most likely to report the greatest feeling of security. This was especially strong in Denmark, where the majority of respondents (60%) felt very safe. At the other end of the scale, respondents in Greece, the United Kingdom, and Italy reported the greatest feelings of insecurity: feeling either a bit unsafe or very unsafe (42% in the United Kingdom and Italy, 43% in Greece). Nearly one in five respondents in the United Kingdom (19%) and over one in five Greek respondents (22%) said that they felt very unsafe (Eurobarometer, 2003, p. 3) (See CrimPrev report at http://lodel.irevues.inist.fr/crimprev/index.php?id=330).

Authors of the victimization studies suggest that feelings of unsafety may be fostered less by actual crime rates and more by environmental factors, such as public drunkenness and drug dealing on the street. Surveys have been conducted into people's personal contact with drug-related problems (such as drug dealing and syringes left in parks). Such experiences are common in Greece, Portugal, Luxembourg, Spain, and Italy, where feelings of insecurity are high, and least common in Finland, Sweden, Hungary, and Denmark, where insecurity is low (Van Dijk et al., 2007).

Further surveys are being conducted in Europe to help identify environmental factors that generate fear and insecurity. Results suggest that young people—simply by being present—may induce fear and anxiety, especially among some groups. Older people express more anxiety about young people. However, it should be noted that older people tend to express more worries about personal safety on the street, but this might be due to a range of factors including being bumped into by other users and knocked over. Women also tend to express more anxiety about crime.

Research shows that fear of crime may be the result of design aspects of the built environment. In relation to public space, Blöbaum and Hunecke (2005) highlight three physical features associated with danger. These are

- entrapment: where people perceive possibilities for escape as limited;
- concealment: where the environment cannot be fully surveyed and people may believe that it provides opportunities for attackers to hide;
- lighting: where the people feel less able to survey the environment.

The empirical study and questionnaire methodology used by Blöbaum and Hunecke found that ability to escape is the most important factor. In situations with little opportunity for escape, ability to survey the environment becomes important: reducing perceptions of danger. If escape is considered possible, lighting reduces perceived danger. While other studies show that lighting can reduce fear of crime, Blöbaum and Hunecke (2005) found that only places offering possibilities for escape may benefit from lighting (p. 481). However, the role of context should be taken into account. It may be that people pay less attention to environmental features or react differently if they generally feel safe or enjoy the environment. In this respect, trees, street furniture, etc. may all help to generate positive feelings about the environment. In the study by Blöbaum and Hunecke we note that students were asked to walk around a university campus, after dark, in winter. Environments used predominantly in the day can be fairly bleak and lonely places in the evening, which may have helped generate feelings of unease and increased attentiveness.

Some researchers and social commentators have expressed concern about developments in security, arguing that these are detrimental to wellbeing. In the United States a comparison of gated and nongated communities found that residents of gated high-income communities reported significantly lower levels of a sense of community. The author concludes that residents were feeling safer (even though crime rates were not lower than the control) but suffered from an erosion of the social fabric (Wilson-Doenges, 2000).

Anna Minton (2009), in her thought-provoking book *Ground control: Fear and happiness in the twenty-first-century city*, argues that security issues have been prioritized over other desired outcomes in the design and planning of cities. As a result, citizens are increasingly living in gated communities and being protected by security guards. Minton suggests that, although physically safer when within the walls of the community, residents may feel unsafe when venturing out of the protected area.

Minton is certainly right to point out that certain aspects of CPTED, such as access control, potentially foster insecurity if not applied thoughtfully. In addition, identification of crime risks later in the design and planning process may lead to security measures being "bolted on," in the form of security fencing, CCTV cameras, etc., creating the impression that the area is unsafe. In reality, however, the extent to which crime issues are considered within design and planning processes varies significantly across difference police forces. Many police forces simply lack the resources to be able to consult with architects, check designs for new developments and renovations, or to engage with planners regarding their proposals for developing and managing the urban environment.

Minton does highlight a number of factors promoting a security-oriented approach to the management—and to some extent design—of the urban environment. These include privatization of public space, the priority afforded to commercial interests, and role of the security industry in managing city centers. However, CPTED does aim to reduce both crime and fear of crime. Furthermore, a more critical examination of the focus on antisocial behavior and research into fear of crime and insecurity highlights significant limitations with subjective measures.

Tackling Insecurity through Design, Planning, and Management

Design, planning, and urban management may be used to tackle issues of insecurity, including those related to young people. The CPTED guidance highlights the importance of considering subjective feelings about crime, and suggests that environments should be made safer without increasing fear of crime, or other undesirable outcomes. The importance of addressing both crime and fear of crime is illustrated by the U.K. Secured by Design principles (Cozens, Saville, & Hillier, 2005), which state that urban environments should

- be of a high environmental quality, and free from factors that increase fear of crime, such as heavy security;
- be clearly understood by users;
- promote a sense of ownership by ensuring that there is a clear separation between private and public space;
- enable natural surveillance to ensure that potential criminals risk being seen, but without infringing privacy;

- have good lighting;
- have carefully designed access routes and footpaths that are safe and well used, and do not facilitate criminal activity;
- have well-designed and -managed open space to ensure that it is used for legitimate purposes, and does not invite crime nor disturb local residents;
- provide for their long-term management in terms of rubbish removal, grass cutting, etc.

In Vienna, Austria, insecurity itself—rather than crime—is addressed in the urban design and planning processes. CPTED principles have been transplanted from the "crime, policing, and security" context and incorporated into the city authority's "Gender Mainstreaming" strategy (Stummvoll, 2004).

In light of more recent concerns about fear of crime at a political level, crime-prevention practitioners have turned their attention more directly to insecurity. Guidelines have been developed focusing specifically the reduction of insecurity through design, planning, and urban management (see U.S. Center for Problem-Oriented Policing, http://www.popcenter.org).

Engaging Young People in Design and Planning

The CPTED literature highlights the importance of developing facilities that meet the needs of young people; for example, age-appropriate play areas, sports facilities, or areas for teenagers to simply "hang out." Such facilities should provide opportunities for young people to meet in safety without generating insecurity among other users or residents (Hampshire & Wilkinson, 2002).

Governments across Europe are being urged to engage young people in design, planning, and regeneration (Day, Sutton, & Jenkins, 2011). The quality of the participation is considered in terms of contribution to decision making by young people. This ranges from being consulted to being actively involved in decision making and making decisions themselves, or in partnership with others, as appropriate (Hart, 1992). The positive impact on participants, relationships with stakeholders, and the physical environment are considered (Day et al., 2011).

Engagement is generally considered as giving young people "a voice" and an opportunity to exercise their right to participate in democratic processes (Day et al., 2011; Frank, 2006; Hart, 1992). In some instances it

is being used to turn young people away from crime and antisocial behavior. The Youth Design Against Crime (YDAC) programme engages young people considered "at risk of offending" in addressing community safety issues in their neighborhood, with support from youth workers and police mentors. Participants are supported through a process of research, creative idea generation, consultation, design validation, design development, and communication. The process of addressing community safety issues, in collaboration with others, develops young people's skills, self-confidence, and sense of self-actualization. YDAC helps generate innovative solutions and transforms relationships between participants and stakeholders including police, Community Safety Partnerships, and local residents (Davey, Wootton, & Marselle, 2012a, 2012b).

Antisocial Behavior and Insecurity in England and Wales

In the 1990s, a wider range of behaviors started to be considered by authorities and less serious incivilities were criminalized in the United Kingdom by the formal legal adoption of the term "antisocial" within the Crime and Disorder Act 1998. With the Act came the Anti-social Behaviour Order (ASBO), a civil sanction, effective for a minimum of 2 years. An ASBO does not result in a criminal record, but sets conditions prohibiting the offender from specific antisocial acts or entering into defined areas. Breach of an ASBO is, however, a criminal offence that can result in a jail sentence of up to 5 years. Behaviors identified as being antisocial include

- substance misuse, drinking alcohol on the streets, and drunken behavior;
- problems related to animals such as not properly restraining animals in public places;
- begging, prostitution-related activity;
- abandoned vehicles, vehicle nuisance;
- noise coming from business or industry, alarms, or pubs and clubs;
- environmental damage such as graffiti and littering;
- inappropriate use of public space such as disputes among neighbors, or rowdy or inconsiderate behavior.

Significant resources have been dedicated to addressing antisocial behavior, with progress in relation to this issue a key component for measuring performance of local authorities. In 2007 crimes being used to measure local authorities and partnerships were as follows

- serious crimes: serious violent crime rate and serious acquisitive crime rate; assault with injury crime rate; specialist support to victims of a serious sexual offence; serious knife crime rate; and gun crime rate;
- antisocial behavior: perceptions of antisocial behavior; dealing with local concerns about antisocial behavior and crime by the local council and police; perceptions of parents taking responsibility for the behavior of their children in the area; perceptions that people in the area treat one another with respect and dignity; satisfaction with the way the police and local council dealt with antisocial behavior; satisfaction of different groups with the way the police and local council dealt with antisocial behavior; and understanding of local concerns about antisocial behavior (see http://www.communities.gov.uk/documents/localgovernment/pdf/505713.pdf).

ASBOs have been widely used to exclude individuals from environments. Amid fear that the ASBO had become a "badge of honor" among young people the Crime Prevention Injunction was introduced in June 2012.

Crime prevention also seek to expel young people from the public domain. The "mosquito" device (listed in the Home Office's 2006 Respect Action Plan to tackle antisocial behavior) and so-called Manilow method employ sonic techniques (in the latter case, "uncool" music) as a means to encourage young people away from public area (http://www.independent.co.uk/news/uk/crime/cliff-vs-the-asbo-kids-481920.html).

The CSEW conducts interviews to gauge perceptions of antisocial behavior and police effectiveness at addressing this issue. Findings from a recent survey showed that the proportion of people who perceived a high level of antisocial behavior in their local area remained at 14%. Of the seven indicators that make up the composite measure, one showed a statistically significant decrease compared with the previous year: "teenagers hanging around" (from 26 to 25%). The rest showed no statistically significant changes (CSEW, 2012, p. 17).

The Politics of Security in the United Kingdom

We would suggest that the focus on antisocial behavior is supporting a preoccupation with the behavior of young people, with moral panics becoming the foundation for key legislative and policy changes. The negative consequences of changing political attitudes to crime have been highlighted.

Political Focus on Crime

Crime became a key political issue for governments in the 1970s, when the Conservative government identified itself as the party of law and order. Initially, this stance was rejected by the left, which argued that the focus should be on the social problems thought to underlie crime. However, crime remained a central theme, and was increasingly linked to wider social issues in the mind of the public: permissiveness, youth cultures, demonstrations, public disorder, black immigration, student unrest, and trade union militancy. For the Conservatives, these social issues were linked to Labour's concern for "social democracy and welfare." When referring to petty crime among children, fault was often apportioned to the soft liberal attitudes of parents and teachers, and increasingly the public and other stakeholders were positioned as having a role in preventing crime (Waiton, 2006).

Between 1993 and 1995, this rhetoric took a new turn with increasing numbers of people imprisoned. Indeed, England and Wales have higher levels of young people in custody than all other European countries, except Turkey (Civitas, 2010, p. 2). The focus was now firmly on the behavior of individuals and groups, with the emergence of the concept of antisocial behavior and a preoccupation with "hooligans," "lager louts," and "yob culture": young people have been associated with an alien, and often criminal, culture. Through these shifts, crime has come to be seen as a problem of and for individuals (Waiton, 2006).

Media Coverage of Crime

The British press devote considerable coverage to crime issues, and references to antisocial behavior—often linked to young people—have reflected political changes in attitudes and policies. The starting point of most articles about antisocial behavior is that the problem exists, and that the "problem" is linked to the "collapse of communities," giving rise to antisocial behavior and a "culture of fear" (Waiton, 2006). Crime and disorder events, such as riots in cities in the United Kingdom, are seized upon by politicians and the media to reiterate concerns about the behavior of young people and communities.

Public Misperceptions of Crime

The CSEW published in 2012 continues to reveal significant reductions in crime. However, U.K. citizens report fear of crime. This may be because the

media devote considerable coverage to incidents of crime and that people are unaware of reductions in crime in their neighborhood or country. In 2011, around 40% believed that crime had actually increased in their local area, and around 60% thought that this was the case in England and Wales (CSEW, 2012). However, it may be that measures of "fear of crime" and antisocial behavior are inaccurate and misleading.

Critical Review of the Measures: Antisocial Behavior and Insecurity

Crime rates from across the world have been collected over many decades using victimization surveys, a methodology designed to address differences between countries in terms of reporting, categorizing, and recording incidents of crime (Manchin et al., 2005; Van Dijk et al., 2007). The methodology provides a reliable measure of changes in crime levels, and the limitations with the methodology are openly discussed. However, this is not the case with measures on antisocial behavior or insecurity. Antisocial behavior is difficult to measure because it is not a criminal offence. As a result, quantitive surveys and interview methods are being used in Britain and across Europe to measure individuals' perceptions of "antisocial behavior." The authors believe that there are significant shortcomings with the surveys.

For example, in the CSEW (2012), interviewees are asked about "teenagers hanging around," and this is cited as evidence of "perceptions of anti-social behaviour" (CSEW, 2012, p. 17). We would suggest, however, that simply "hanging around" does not constitute antisocial behavior, not unless it is accompanied by conflict or disturbance.

Similarly, the EU ICS measure of feelings of insecurity refers to "unsupervised youths." The word "youth" in this context conjures up a different image to that of "young people." More worryingly, the phrase infers that "unsupervised" young people are by default a problem, suggesting an imperative to keep "youths" under constant observation. It is worth remembering that these are not infants that are being discussed, but young people between the ages of 12 and 18. We suggest that such loaded terminology may promote anxiety in the minds of survey respondents and so bias responses.

Serious concerns have been raised about the measures of "fear of crime." Farrell, Gray, and Jackson (2007) and Farrell, Jackson, and Gray (2006)

suggest that standard methods of measuring feelings of insecurity may actually be constructing fear of crime as a significant social problem for a large proportion of the population rather than accurately measuring a real quality-of-life issue. While various forms of question are used, a number of "industry-standard" questions dominate the field (Farrell et al., 2007, p.19). One typical question asks about feelings of safety when walking: "How safe do you feel walking alone in the area where you live (very safe, fairly safe, a bit unsafe, very unsafe)" (http://lodel.irevues.inist.fr/crimprev/index.php?id=330). Another asks about worry of victimization, which is worded as follows:

> Most of us worry at some time or other about being a victim of crime. Using one of the phrases on this card, could you tell me how worried you are about the following.
>
> The following crimes were then asked of in turn: "having your home broken into and something stolen?," "being mugged and robbed?," "having your car stolen?," "having things from your car stolen?," "being raped?," "being physically attacked by strangers?," "being insulted or pestered by anybody, while in the street or any other public place?," and, finally, "being subject to a physical attack because of your skin colour, ethnic origin or religion?"
>
> The codes offered to respondents were very worried, fairly worried, not very worried, not at all worried.
>
> Farrell et al. (2007), p. 19

As the first sentence shows, before the survey question is even asked, respondents are invited to admit to being worried. Indeed, the state of worry is positioned as a social norm by the survey. Such questions could at the least be considered leading.

Research by Farrell et al. (2007) into methods of measuring so-called fear of crime suggests that the standard question "Are you worried about crime?" is not really measuring "fear of crime," as we might commonly understand the term. Rather, the question relates to a range of different feelings and views about crime. Qualitative interviews show that a respondent may answer in the affirmative to the question about "worry" because he or she has personally experienced fears or anxieties generated by actual experiences of crime; feels angry about having been a victim or the prospect of becoming a victim; considers the prospect of being a victim frightening; believes that crime is an important social issue that should be addressed; or takes steps to improve his or her own personal security. Farrell et al. (2006) propose that "fear of crime," as a lived experience refers to a range of emotions reactions and cognitive processes, listed in decreasing order of impact on qualify of life

- real moments of fear of victimization, arising prior to or post-victimization or threat of victimization;
- the puncturing of mundane thoughts about security by sudden shock events that alert one to the possibility of crime; for example, arising from actual victimization, hearing about family or friends that have been victimized, or knowledge that an area is a crime hotspot;
- nagging doubts about the security of one's home and property, when left unattended;
- the awareness of the crime as a possibility and the need for added precautions;
- a set of feelings and attitudes about crime as a problem or issue for society.

The authors suggest that the impact on quality of life depends on the intensity and type of feeling and on its frequency. Interestingly, they found that 60% of survey respondents who purported to be "very worried" about being mugged or robbed also stated that they had not actually worried over the previous 12 months. Similarly, 72% of those who reported being "fairly worried" had also not actually worried (Farrell et al., 2006, p. 25). The authors liken the findings to that of the "worried well" in health-care research (p. 25): these people report being worried about their health, but actually don't suffer from health problems.

The authors conducted further research into people who report being worried about crime but don't actually worry, focusing specifically on quality of life. For this purpose, they looked at data from the British Crime Survey (2003–2004) asking: "on a scale of 0 to 10, how much would you say your quality of life is affected by crime/fear of crime?" A split ballot was conducted, where half the respondents were asked about crime and half were asked about fear of crime. The authors compared worriers who worry with worriers who hadn't actually worried over the last 12 months, considered analogous to the "worried well." They found that the impact on quality of life is far greater among those who actually worried about crime or fear of crime. Farrell et al. (2006) conclude:

> All of which presents early evidence that standard measures of the fear of crime (How worried are you about being . . . ?) tap into something above and beyond the frequency of worry, and importantly, the aspect that they tap into is somewhat removed from anything that erodes individual quality of life.
>
> Farrell et al. (2006), p. 27

Methodological issues about measuring and understanding fear of crime are far from "academic," as the findings about this issue are being used to guide and formulate national government policy:

> Consider evidence that one-third of the British population is worried about being physically attacked in the street by a stranger. Does this mean that a full one-third of the population regularly worry about this prospect and that their quality-of-life is damaged as a result? Remember, the significance of fear of crime ultimately rests on its status as a social problem. People have anxieties about all sorts of things—their family, their job situation, their health. The reason why the fear of crime has attracted such interest—aside from the political significance of public opinion about crime—is that it has acquired the status of serious social problem.
>
> Farrell et al. (2006), p. 2

Any kind of unhappiness is evidence of a "social problem" to be tackled by government. In the case of crime, this tendency may be focusing attention on low-level concerns among the general population at the expense of significant problems for individuals living in high crime areas (Waiton, 2006).

An Alternative Model of Fear of Crime: the Insecurity Lifecycle

In response to failings of current conceptual formulations of fear of crime, the authors have developed a model that they believe better operationalizes the different aspects of worry, anxiety, fear, and feelings of insecurity that relate to crime.

As illustrated in Figure 18.2, the Insecurity Lifecycle model embodies two dimensions: the temporal and the situational, while also being divided into two levels: the social/societal and the individual. Furthermore, by adopting the form of a life cycle the model illustrates the relationship between an individual's anxiety or fear (especially that based on experience of victimization), feelings of insecurity shared by family, friends, or neighborhood, and wider societal anxieties.

Around the model, and relating to each of its elements, are mediating factors. These are aspects that have the potential to either increase fear and anxiety (i.e., negative mediating factors) or reduce fear and anxiety (i.e., positive mediating factors). Mediating factors will impact on the activities, processes, and results of each stage in the model. Their form may be

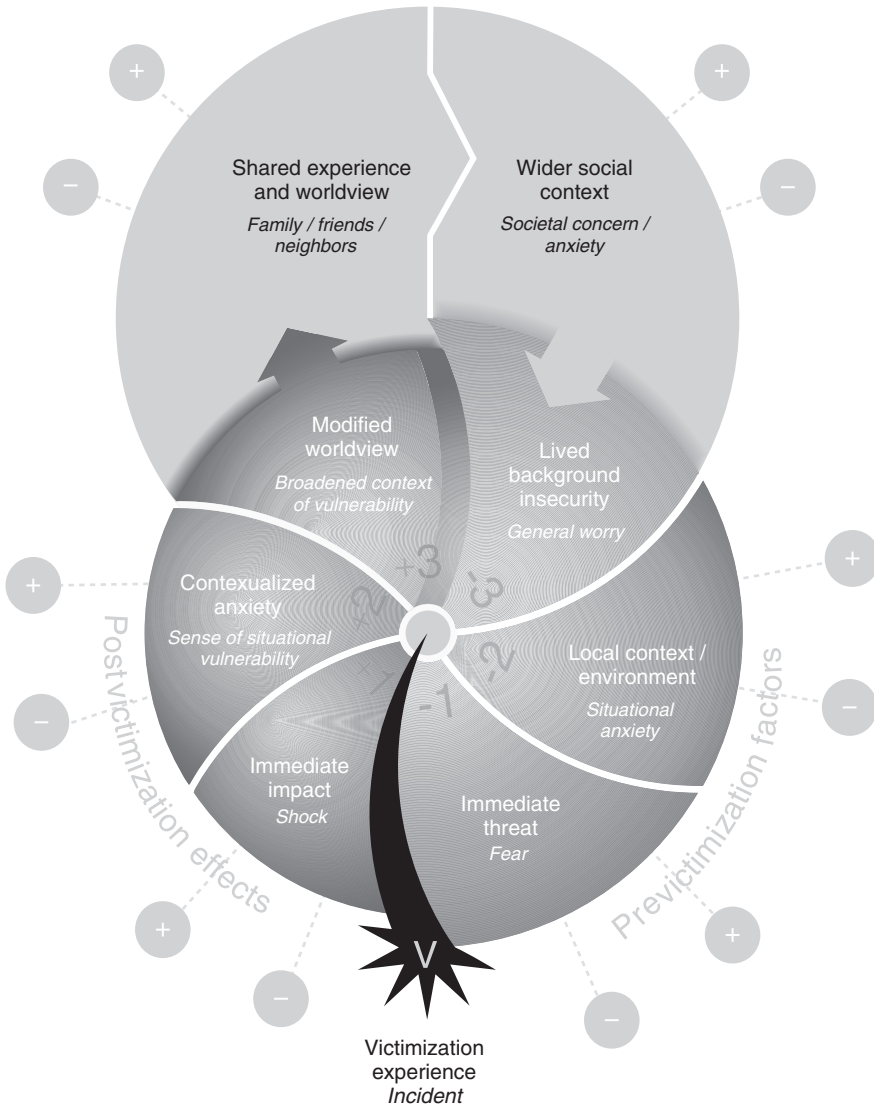

Figure 18.2. The Insecurity Lifecycle. © Copyright 2012 A. B. Wootton & C. L. Davey. All rights reserved.

various; from physical technologies to social attitudes; from systems of communication to social and political policies. The authors suggest that, at different stages in the life cycle, these mediating factors can play an important role in both amplifying and reducing anxiety and feelings of insecurity, for both the individual and wider society.

The model is split into two realms: the upper "shared/societal norms" realm and the lower "individual experience" realm. By doing this the model seeks to differentiate between these very different interpretations of "fear" as well as demonstrate their interrelationship: the link between societal concerns or anxieties and the lived experience of the individual.

Individual Experience of Insecurity

This part of the model is divided into six stages: three previctimization factors and three postvictimization effects. These are numbered −3 to −1 and +1 to +3 respectively.

Previctimization factors.

−3 Lived background insecurity: general worry. This relates to the baseline of general worry that is experienced by the individual. As indicated in the model, it is fed in part by previous experience—especially by previous victimization—as well as by the nature of the wider social context to which the individual belongs. Mediating factors may include the editorial style of national media (e.g., sensationalist approaches to reporting crime and security issues), as well as lifestyle and sociodemographic factors relating to the individual. Ideally, lived background insecurity will be negligible and have no real day-to-day impact on an individual's wellbeing. Clearly, however, this will sometimes not be the case.

−2 Local context/environment: situational anxiety. This relates to the nature and quality of the environment in which the individual is situated at any moment in time. Clearly there are mediating factors here that may exacerbate or alleviate such anxiety. For example, poorly managed environments that contain visible evidence of antisocial behavior (e.g., litter, graffiti, broken windows, vandalized street furniture, and so on) are likely to raise anxiety for the individual, especially if they are alone. Broken or poor-quality street lighting can also create situational anxiety. Generally, such environments come to be avoided, which then leads to a lack of natural surveillance ("eyes on the street") and further raises the anxiety level of potential users.

−1 Immediate threat: fear. This relates to the immediate period prior to an individual being victimized. While the term "fear" is used in a rather general way in the fear of crime literature, we have reserved the term fear for this stage of the model alone. This is the period exactly prior to the

individual becoming victimized. For example, it may be the moment during which they are challenged, or even chased, by a mugger. In some cases, the victim may be aware that something is wrong, that they are in danger. For example, an offender may attempt to intimidate by invading the personal space of their potential victim, acting aggressively, or otherwise breaking social norms. This threatening situation may trigger a "fight or flight" response in the victim.

V Victimization experience: crime incident. This is the actual crime being committed. In personal crime such as theft, robbery or violence, this may involve a face-to-face encounter with the criminal. While crimes such as burglary or theft from motor vehicle may not involve direct confrontation between victim and offender, they may be felt by the victim to be no less personal.

Postvictimization effects.

+1 Immediate impact: shock. The immediate response to victimization is identified in the model as shock. This immediate impact can be very serious for victims; for older individuals, even life-threatening. Positive and negative mediating factors include the response of other people (e.g., coming to the victim's aid, or offering help), as well as the speed and quality of response of the police.

+2 Contextualized anxiety: sense of situational vulnerability. This facet of the model concerns heightened anxiety relating to a particular context or location that may arise in victims of crime. This may give rise to avoidance strategies or, in extreme cases, complete lifestyle changes. For example, an individual victimized at a bus stop may avoid using the bus network. Alternatively, an individual may avoid certain temporal contexts as a result of a specific victimization experience; for example, not leaving home when it is dark. Such responses to victimization can seriously inhibit an individual's quality of life, limiting their use of local amenities and services and their participation in their community.

+3 Modified worldview: broadened context of vulnerability. This aspect of the model concerns broader shifts in worldview and sense of vulnerability arising from victimization. For example, a reluctance to travel by bus may grow to become the feeling that all public transport is inherently unsafe. Thus, specific instances of victimization grow to become a broader sense of vulnerability or helplessness. The impact on the individual may range from a reduced participation in civil society (e.g., not voting) to clinical depression.

Shared/Societal Perceptions of Insecurity

This part of the model is divided into two parts, the first feeding the second, and in turn informs the first stage of the individual experience of insecurity, lived background insecurity.

Shared experience and worldview: family/friends/neighbors.
Feelings of vulnerability emerging from +3 (modified worldview), above, are shared with family, friends, and neighbors through narratives relating to actual victimization experience. This can result in a relatively local shared perspective and worldview regarding to risk of victimization, and shared anxieties.

Wider social context: societal concerns/anxiety.
Such shared experience are themselves aggregated to give form to a wider societal context. This contains the fears that a society may be having at any particular time. For example, in the West there is currently fear of terrorism, and specifically of suicide bombers. However, in the United Kingdom negative perceptions about crime among the general population have become a key social issue for the government.

Positive and negative mediating factors may impact on both aspects of the shared/societal perceptions of insecurity. Positive factors may alleviate feelings of insecurity, while negative factors my increase them. An important new mediating factor at this societal level is the Internet.

Humans, as Aristotle noted, are social animals. As such, the communication of "stories" is used to share knowledge, build and strengthen social ties, and to earn status. The rise of Internet services such as YouTube, Facebook, and Twitter has greatly increased the ability of stories to be shared very quickly, extremely widely, and often anonymously. Thus, sharing of "stories" of (sometimes extreme) criminal victimization has become much easier. In addition, the rise of 24-h news services has left professional broadcasters searching for content to fill their schedules. This has resulted in sensational stories that become popular on the Internet being regurgitated by traditional news broadcasters. Negative and sensationalist stories are "sticky:" more easily communicated and more easily remembered than positive ones.

A constant background noise of negative stories can skew perceptions. According to research by the organization Women in Journalism published in U.K. newspaper *The Independent* (Garner, 2009), over half of the stories about teenage boys in U.K. national and regional newspapers in 2009

were about crime. The most-used term to describe them was "yobs" (591 times) followed by "thugs" (254 times), "sick" (119 times), and "feral" (96 times). Other words used included "hoodie," "louts," "heartless," "evil," "frightening," "scum," "monsters," "inhuman," and "threatening."

> The best chance a teenager had of receiving sympathetic coverage was if they died.
>
> Garner (2009)

The research found that as a result of the negative press some 80% of the nearly 1,000 teenage boys interviewed felt adults were now more wary of them than they had been a year ago. Most worryingly, the survey also found that many were now more wary of boys their own age: they had become more frightened of each other.

Using the Model

By considering the different levels of fear of crime, reflecting on the stages in the Insecurity Lifecycle that relate to both the pre- and postvictimization factors and effects, a more precise understanding of what is meant by fear of crime and feelings of insecurity can be developed. By then considering potential positive and negative mediating factors it is possible to develop targeted intervention concepts to reduce feelings of insecurity and so improve wellbeing.

Furthermore, the model may be used to develop more survey questions to enable the more precise measurement of a richer conception of feelings of insecurity.

Creating a more positive social context.

While the role of agencies like the police and criminal justice can impact on the individual experience of insecurity, the government might tackle misperceptions about crime that exist in the shared/societal context. This includes communicating not just the fact that crime levels have decreased, but presenting alternative "sticky" stories about society: citing examples where communities have become safer and/worked together to solve problems. In addition, the role of the media in shaping perceptions of crime might be investigated, and steps taken to promote a more accurate and balanced representation of society. In the United Kingdom, Lord Justice Leveson's inquiry into "the culture, practice and ethics of the press" touched on some

of these issues. The Leveson Inquiry report was published in November 2012 (see http://www.levesoninquiry.org.uk/about/the-report/).

Conclusion

This chapter has discussed the relationship between crime and the urban environment. Broadly speaking, crime is associated with more urban contexts, where more alcohol is consumed and young people form a higher percentage of the population (Manchin et al., 2005; Van Dijk et al., 2007;). Evidence suggests that the urban environment impacts on crime levels to the extent that it affords opportunities for offending behavior, in the form of places, services, and products vulnerable to crime. Places can become susceptible to crime due ease of access, low levels of surveillance, and possibly lack of sense of ownership by residents and users. When measures are taken to reduce vulnerability to crime, such as through Secured by Design in the United Kingdom, then crime levels are significantly reduced (Armitage & Monchuck, 2011). The design of a product affects offender perceptions, in terms of its attractiveness as a target, the effort required to obtain it, and the rewards it offers (Clarke, 1995).

Wellbeing has become a focus for measurement by governments across Europe, and in the United Kingdom is being examined by the Office of National Statistics (http://www.statistics.gov.uk/hub/people-places/communities/societal-wellbeing). Assessments of wellbeing measure objective factors (e.g., demographics and longevity) as well as subjective factors (e.g., perceptions of quality of life). Crime is often included as a component of objective wellbeing, with crime rates being measured in relation to particular crimes. As an ingredient in such wellbeing measures, the crime component has improved markedly across Europe, as crime levels have decreased significantly over the last decade (CSEW, 2012; Van Dijk et al., 2007). Using figures from the Home Office, we can also calculate the savings in terms of economic and emotional costs of crime in the United Kingdom (http://webarchive.nationalarchives.gov.uk/20110220105210/http://rds.homeoffice.gov.uk/rds/ecom_soc_cost.html).

For policy makers charged with improving the quality of life of their citizens, the reductions in crime rates experienced across the developed world could be considered a cause for celebration. Furthermore, results of the ICVS support the view that good design and improved security and policing can effectively tackle crime problems. Taken together this suggests that governments might best continue their efforts to improve the design

and security of products and places at risk of crime. However, the attention of policy makers seems to simply have shifted to a new "problem"—namely, "fear of crime" among the general population—and the apparent mismatch between fear of crime and actual risk of victimization (Manchin et al., 2005).

Victimization surveys collect information on perceptions of crime using standardized questions such as "how safe do you feel?" and "how worried are you about . . . ?" Researchers have highlighted the shortcomings of such questions (Farrell et al., 2007), asking whether such worries and fears reported in surveys really demonstrate impact on quality of life. In view of the methodological shortcomings it is questionable whether the findings of such surveys should be informing European policy or be the basis of so much attention by national governments.

Victimization surveys suggest that environmental and contextual factors influence feelings of safety, such as contact with drug users or alcohol consumption (Manchin et al., 2005). Surveys are being developed to measure perceptions of the environment and context across Europe. However, these uncritically adopt a discourse biased against young people and are likely to suffer the same shortcoming as questions on worry about and fear of crime. If used, we would suggest that terms such as "unsupervised youths" are not appropriate and that frequency of fear/concern must be considered. Therefore, it would be beneficial to develop further the literature on the environment and fear of crime by undertaking research using alternative approaches and measures, such as empirical studies or daily diaries. Research might also usefully evaluate whether security measures effect feelings of safety and security. Applied research might explore—perhaps through design—methods to increase positive feelings about homes, communities, and public places.

Political attention have shifted from less serious crimes and to the widespread "problem" of fear of crime. The popular concerns of the general population about the behavior of neighbors and young people seems to be accepted uncritically, and considered an appropriate focus for government. Waiton (2006) points out that this is achieved at the expense of other social issues. In the case of crime we are concerned that individuals and communities directly affected by crime and community safety issues are being neglected. We are also concerned that government policy is encouraging an unhealthy focus on the behavior of young people, who are widely blamed for crime and other societal problems without real evidence. Such an approach would appear contrary to the espoused concerns about wellbeing, which is supposed to promote sense of belonging and social cohesion.

We believe that the design industry might address public concerns about young people "hanging around," noisy neighbors, and drunken behavior. The concerns might be addressed by improvements in housing quality, facilities for young people, and the design and management of public space. Designers are well placed to understand the needs and emotions of users, to address potential conflicts between stakeholders, and to develop designs that foster a sense of security and community. In our experience the design process can also be used to engage young people, including those at risk of offending, in the creative process of addressing community safety (Davey et al., 2012a, 2012b; Wootton, Davey, & Marselle, 2011).

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http://www.iim-edu.org/polls/grossnationalhappinesssurvey.htm International Institute of Management, Gross National Happiness (GNH) survey.

http://www.legislation.gov.uk/ukpga/1998/37/contents The Crime and Disorder Act can be downloaded from the U.K. Government legislation website.

19

Transport and Wellbeing

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To begin thinking about how transport affects and is affected by wellbeing we have to think first about why we have transport at all: what does transport do for us? Only then we can start to think about how to make a transport system work to achieve the outcomes we desire. In particular, this chapter examines the engineering, rather than the planning, of such a transport system but of course the link between planning and engineering is symbiotic so there is a need to include at least some aspects of the interfaces between planning and engineering and how they work.

This chapter starts by exploring what we mean by wellbeing in this context and how that translates into mobility needs. This naturally raises the question of how we should design and implement a mobility system and what transport opportunities arise. This leads naturally into a discussion about the wellbeing implications for transport and how we design transport systems to maximize wellbeing. In the course of this discussion we will be raising issues of accessibility and capabilities, energy and emissions, health impacts, the importance of activities as drivers for the design of transport systems, what we really mean by capacity, the importance of information, and the integration of transport subsystems into a system that can be integrated with the other great systems of modern life: financial, political, technological, cultural, environmental, health, and education.

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What is Wellbeing?

For the purposes of the following discussion, we consider wellbeing to be the achievement of reasonable health, economic stability, freedom to be able to choose the activities one wishes to pursue, access to sufficient resources, including water and food, availability of educational opportunities, and a life in which social justice prevails. The link with transport arises because many of these require travel to obtain them or to provide them: either I have to go somewhere to obtain them or someone supplies them to where I happen to be. The route between wellbeing and transport is not so simple though. First of all it is essential to realize that the whole edifice is built upon the basic principle that we are dealing with people. People wish, or need,

to carry out certain activities—employment, attending to health-care visits, education, leisure activities, and so on—and it is from the participation in and enjoyment of these activities that wellbeing is derived. The fact that most activities are not located where a person happens to be means that there needs to be some system in place to enable a person to travel to the activity in order to achieve the desired wellbeing. The whole system is represented by the edifice in Figure 19.1.

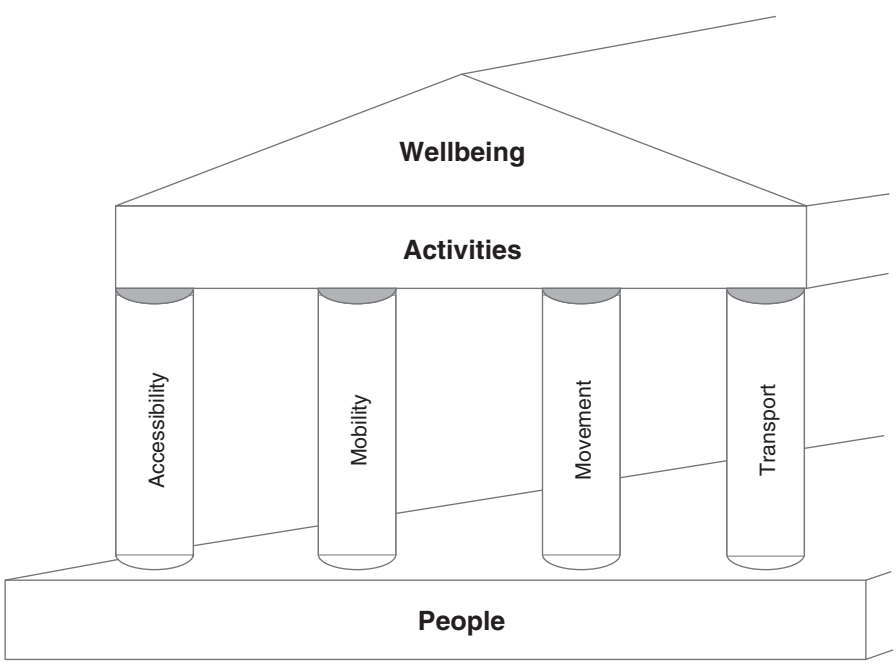

Figure 19.1. The Relationship Between Wellbeing and Transport.

What Does Transport Do For Us?

For the last 10,000 years or so, people have aggregated in cities because of the enhanced supply of resources and security. The city nourishes its inhabitants by providing activities and resources for the people. However, it is inevitable that, particularly as cities grow, these resources will become increasingly distant from most of the population and thus it becomes necessary to travel to reach these resources and activities. The availability of the activities and resources indicate the richness of the city but can only be accessed if they can be reached. The ability to reach them is a sign of the mobility being offered by the city's transport systems. The better the mobility provision, the better the quality of life of the population. Mobility implies movement of people or goods between activities. If the transport system is not accessible, neither movement nor mobility can be delivered. Accessibility is therefore the key definer of whether or not a city can provide a satisfactory sense of wellbeing: if a person cannot reach the health care they need, the employment, the education, or the social activities that mark a civilized society, they will not be able to achieve the level of wellbeing to which they could aspire. As transport is the means by which movement—and therefore mobility and accessibility—are delivered, it is the umbilical cord between what the city provides and what the individual inhabitants need.

It is worth thinking about the four concepts—accessibility, mobility, movement, and transport—in a little more detail.

Accessibility

Accessibility is the beginning of the process of giving meaning to mobility. Accessibility is the actual availability of the mobility system: how possible is it for the population to realize the mobility on offer? Is it truly available to disabled people, older people, and younger people? This determines aspects of design planning and operation and without these details being secured—that is, without accessibility—the mobility required to establish a reasonable quality of life for the city's inhabitants is merely an illusion.

Mobility

As indicated above, mobility is the conceptual linkage between the provision of activities, goods, and services and the people who need or wish to

consume them. To promote wellbeing a city should promote mobility as a principle which guides its design, planning, and operation. It is essential that the mobility of goods as well as people are taken together as a fundamental need of a city system.

Movement

Movement is the act of overcoming displacement. Physical movement from one place to another might be required for a person to reach a resource (or vice versa), but this comes with a variety of disadvantages: the expenditure of time, money, and other resources; the emission of noxious chemicals; the use of energy, etc. are examples of negative consequences of movement. Mobility, being the conceptual linkage between the provision of activities and resources and the people, could be achieved with or without movement. It is therefore necessary to maximize mobility of both people and goods (to improve the quality of life and wellbeing) but to minimize movement (to reduce the negative impacts of the movement process).

Transport

The transport system is the means by which movement is delivered. Just as without accessibility equitable mobility is unachievable, so without transport we cannot achieve movement. The transport system therefore needs to be able to deliver as much movement as is necessary to deliver the required mobility in a way that minimizes the negative impacts of movement so that activities are accessible and wellbeing can be achieved for the whole population.

I like to call the whole set—accessibility, mobility, movement, transport—the accessibility system. This is to emphasize that what the whole system is about is achieving accessibility, not just the provision or easing of movement.

It is also important to include the concept of time when considering the development of a city/country/society. Brundtland (1987) recognized this when she declared that sustainable development was meeting the needs of the present without compromising the needs of future generations. The problem with the Brundtland definition of sustainability is that we simply do not know what the future needs of future generations will be. We only have to look back 100 years—only four generations ago—to see transport decisions taken, for example about the routes and design of the London

Underground system, which have yielded impossible-to-breach capacity problems for the present generation. Indeed, the task of meeting the "needs of the future generations" as perceived in the first decade of the twentieth century has certainly been compromised by the design of deep tubes and small-cross-section trains which preclude the sort of capacity that is required by these systems in the early decades of the twenty-first century. How do we know that decisions we take now will not compromise the needs of future generations in a similar way? Indeed, some of the people who will constitute the "future generations" of 100 years hence have already been born so this difficult-to-predict future is really not that far off. The wellbeing of the future is therefore at least to some extent already enshrined in the transport systems we are developing today so present decisions really do need to take time into account to try to ensure that it is not unduly reduced by the decisions we take now.

The trick for enabling transport to improve quality of life and wellbeing is therefore how we intertwine these four elements over time; these elements range from the purely conceptual to the purely practical and achieving optimal outcomes in any one of them in denial of the others will mean a poor outcome for the population. Transport is such a complex system with axions providing connections to the resources and activities, the people, the environment, and the economy, fired by advances or gaps in technology. Making the "right" decisions about transport is therefore a highly complex business, requiring views to be taken about what is needed, what can be done, what needs to be done, and what new technologies/methods might be required and all this in a context of permitting/encouraging change in mobility over a period of several lifetimes. It is therefore highly important to devise a decision-making system which includes these elements so that a decision made today will be positively pertinent in the time of a few generations hence. The question then arises: "How can we make decisions that would make possible the delivery of wellbeing in the future?"

Outcome-Based Decision Making

To analyze the issues and the needs required for a transport system, it is important to have a clear strategy in mind that can provide a way for the problem to become resolved. An outcomes-based strategy starts by defining the desired outcomes from a decision so that the decision is driven by the need to attain those defined outcomes. The tool to develop this strategy

is called the outcome-based decision model. This method is particularly apposite where the problem in question is likely to be intractable to a single solution and/or where compromises will be required.

The outcome-based model enables leaders to design a more thought-through plan that will formulate a clear strategy to tackle specific problems. It will enable leaders to identify a long-term vision and, based on that vision, determine the steps to get there.

An example of how the outcomes-based decision model works is shown in Figure 19.2, where the process starts with defining the overarching desired outcome; for example, improving the quality of life. Then it is necessary to define the success factors that are necessary to attain the desired outcome (e.g., good health, an improvement in the access to activities so that people can have a realistic choice about the activities they wish to follow, a reduction in air pollution, etc.). Next it is necessary to define the limitations which would work to prevent or limit the attainment of the desired outcome. These could include lack of political will, high cost, lack of community support, etc. Then actions are devised which offset or eliminate the limitations and encourage the take up and achievement of the success factors so that the

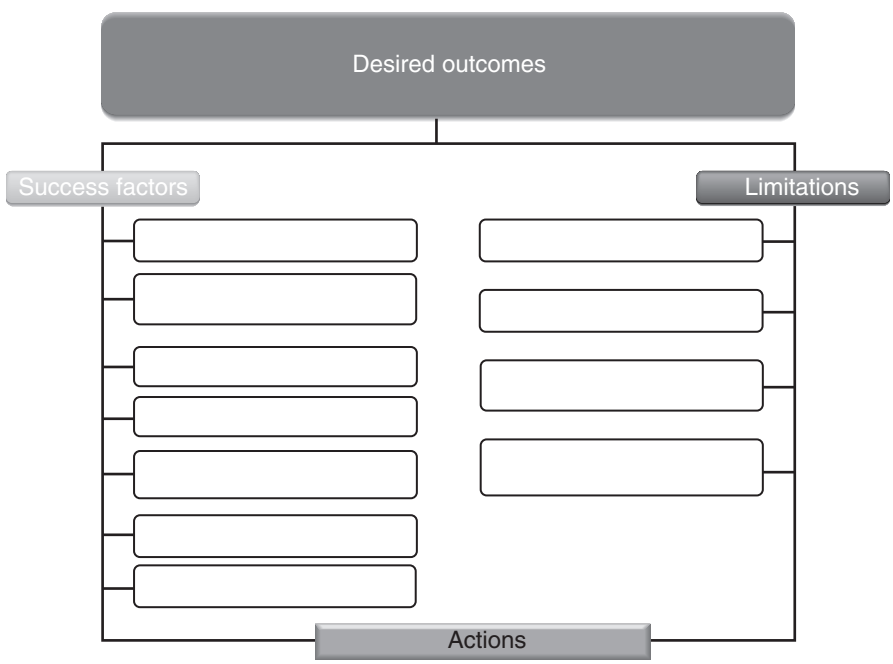

Figure 19.2. Outcomes-Based Decision Model.

desired outcome can be reached. The model can be cascaded: achievement of a success factor or the successful elimination of a limitation could each be a desired outcome for a subsequent outcomes-based decision model. An example of such a cascaded set of outcomes-based decisions can be seen in Figure 19.3.

The embedded nature of the outcome-based decision model means that even in the development of the integrated mobility system (for example), the original desired outcome—the improvement in the quality of life—is still the key goal to be attained. The strategic actions are therefore progressed further in stage 3 but the original high-level desired outcome remains. This is important so that focus is applied correctly and difficult choices are made on the basis of achievement of the higher level goals rather than to satisfy particular low-level problems.

The key to good decision making is the incorporation of an evidence base. However this is not without its problems. There is a sense of an assumption that "evidence" is somehow incontrovertible: it is "pure" fact and not open to discussion so a decision (or a policy which is in effect a programmed series of decisions) based on "evidence" must be "a good thing." However, different people understand different things from the same evidence. This can arise because of differing levels of knowledge, background philosophy, or culture. It is therefore crucial to ensure that the meaning of evidence is understood when determining how to use the evidence to support a decision. This more anthropological side of engineering decision making is often ignored in favor of the "hard" numbers and facts that engineers (and planners) derive, but it is the understanding of a proposed system by the people that will determine whether or not it will work.

Is evidence incontrovertible? Even without the added burden of interpretation of the evidence, most evidence beyond the basic laws of physics is highly contestable, so the purity and "goodness" of evidence-based decisions are not quite as perfect as might be thought at first. What we have to consider is the sense of "meaning" which envelops evidence. One person's "hard truth" evidence may be contested by another person's understanding. Priorities, relevance, and importance of facts and interpretations yield an ambiguity. Suddenly an incontrovertible fact has become ambiguous: the concrete availability of a bus service is meaningless to a person who cannot use it. The evidence of the existence of the bus service is incontrovertible—the bus follows its route and arrives at bus stops—but this has no meaning to me if I cannot use it. Another example could be the consideration of a bus fare.

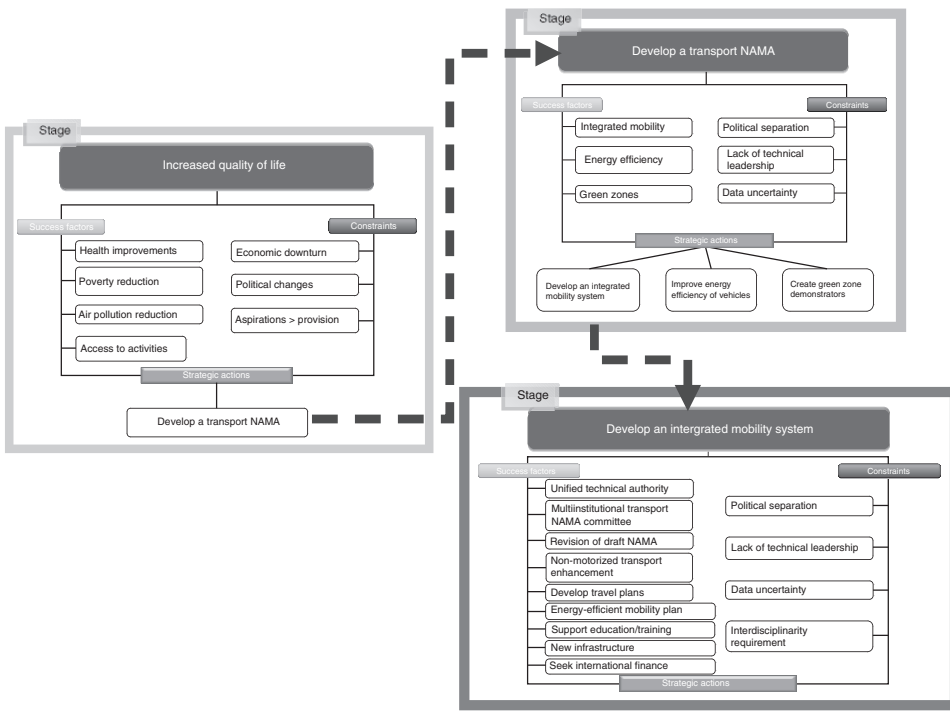

Figure 19.3. An Example of a Cascaded Outcomes-Based Decision Model.

Although this seems simple, it is illusory: "evidence," however factual and incontrovertible, can still mean different things to different people; the more sophisticated the issue and its associated evidence, the more the evidence is enveloped by a whole layer of meaning. A bus fare in a particular case might be stated quite simply as $1 and in evidence towards a decision this is an incontrovertible fact. However, this might be seen as "too low" fare for the bus operator, "too high" for certain passenger groups, and "appropriate" by a government wishing to stay clear of the argument. The evidence of the bus fare is therefore factual—nobody disputes the figure itself—but also shrouded with meanings which differ according to the perspective of the person examining the evidence: "evidence-based policy" is thus a mirage, at once beguiling and meaningless; the latter paradoxically because of the meaning surrounding the facts. This makes implementation really difficult.

We must therefore develop our decision model on the basis of the meaning, rather than the mere existence, of evidence. This makes it much more difficult. Or does it? Engineering, for example, is concerned with developing solutions that work—a bridge, a train, a road system—but which are unambiguous. Solutions for these installations exist and are substantive: decisions have been made and implemented. The consideration of meaning in the decision process suggests that the evidence used to support a substantive engineering solution might be less solid than would have been thought if only the engineering issues had been considered.

It might be more important for a certain community to reach a hospital than for the wider population to have a faster journey through the neighbourhood. This could affect the way in which a traffic signal network is configured: closing junctions to improve speed along a major road benefits the wider population but disbenefits the local community, who now find it harder to cross that road and thus have poorer access to the local hospital. Rawls' Difference Principle (Rawls, 1973) is an interesting way of looking at such meaning-heavy issues: nobody should be worse off than they were before a decision has been implemented. Even though this puts into sharp relief the deficiencies of optimum-seeking decision algorithms, it still requires interpretation of meaning: what is "worse off"? Really, we should be seeking to learn how to make engineering decisions which are "ambiguous," that can be changed as circumstances are better understood or as they change in the future. Ambiguity and implementation are uneasy bedfellows, yet that is precisely what society needs to progress, especially into a future where the only certainty is that the nature of that future is going to change increasingly rapidly. Transport planners and engineers need to

embrace ambiguity and to work out how to design and implement transport systems that will be sustainable when the underpinning evidence for their decisions is essentially ambiguous.

I have therefore amended the outcomes-based decision model to become a meaning-based decision model. This takes the outcomes-based decision model and inserts the consideration of meaning because it seeks the desired outcome, not simply the taking of a decision; indeed, we may talk about "making" rather than "taking" a decision, with the sense of constructing the decision, putting the relevant pieces together to arrive at an outcome, rather than the decision becoming obvious as a result of some mechanical calculation. Decisions become emergent rather than precalculated and this characteristic becomes hugely important when considering the question of the accessibility system, especially when we consider the need for this to be able to adapt over time. A guideline on how to design a transport system for the attainment or improvement of wellbeing is therefore a matter of creating a suitable decision model and then using it to create the emergence of an accessibility-enhancing system.

How do we Determine the Desired Outcome, Success Factors, and Limitations?

It is therefore necessary to establish the meaning of the issue at stake before determining the desired outcome. Sustainable transport could mean having a sufficient amount of movement with low impacts on the environment, but this could mean insufficiency for some groups of the population, thus rendering the outcome inequitable; and inequitable outcomes are not sustainable. The process should therefore start with discussions with the people who will be concerned with the outcomes because those people will be affected by the outcomes in one way or another. This means dealing with cultural issues as well as gender, aspirations, and political and technical requirements. Understanding what different outcomes would mean for these groups is an important stage in the process of defining the desired outcomes.

Having determined the desired outcomes, we need to define what evidence would be necessary to enable us to know whether or not they have been achieved. This in turn sets out the success factors and limitations that we will have to address to achieve the desired outcomes, and to know that we have done so because the evidence shows us the extent to which they have been attained. As before, the success factors and limitations give rise to

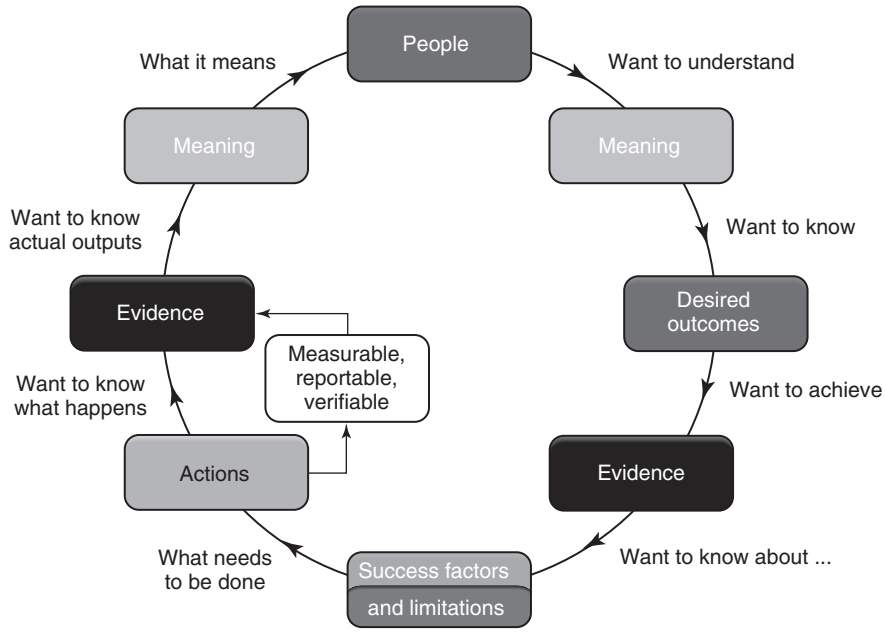

Figure 19.4. Meanings-Based Decision Model, Incorporating the Outcomes-Based Model shown in Figure 19.1.

the set of actions. The results of the actions are tested against the evidential criteria and these results then have to be interpreted in terms of the meaning they provide for the people. This more complete meanings-based decision model (MBDM) is shown in Figure 19.4.

Of course, one decision leads to another and so the loop shown in Figure 19.4 can be made into a more helical structure, as shown in Figure 19.5, where the meanings obtained from one set of decisions lead into the definition of outcomes for the next. The reason why the helical structure is important is that, although viewing the process in one direction shows it to be circular, looking at it in the other shows that although the process is repeating itself the actual position in terms of progress towards the overarching desired outcomes is always moving forwards.

Mention was made above about the insufficiency of an optimum-seeking decision process. One way of trying to represent the richness of a decision process involving people is to consider each of the issues separately and then combine them into a single picture so that decisions can be supported in a more comprehensive way. One way of doing this is multicriteria analysis.

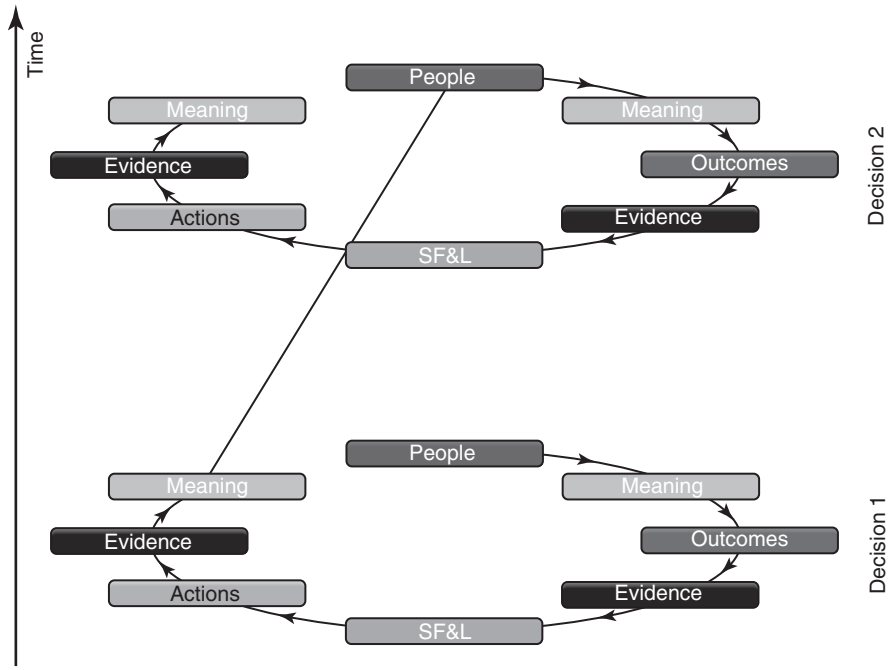

Figure 19.5. Phased MBDM. SF&L, success factors and limitations.

Using Multicriteria Analysis

An example of how the multicriteria analysis would be carried out by the decision makers is as follows. First, the desired outcome is commonly agreed and defined by all stakeholders. This is followed by the consideration of success factors and limitations, ending with the possible strategic actions to attain the desired outcome. Once that list is ready, the multicriteria analysis will help the decision maker decide what the best/more appropriate actions should be. To illustrate this process, we can take a simple example. For this example, it has been decided that as part of the achievement of an improvement in wellbeing, one of the desired outcomes in relation to the transport system is to reduce carbon dioxide emissions by 10% in the transport sector by 2018. We hold a meeting with all stakeholders to define possible actions and select some for further analysis. The actions selected by all stakeholders in this example are

- action A: renew 15% of the bus fleet;

- action B: build 300 km of cycle lanes and develop an information program to incentivize walking;
- action C: provide cleaner fuel.

Following the selection of actions, the criteria that might be affected in one way or another by these actions—and thus constitute the means for evaluating success—are defined. This is done by a group of people representing the stakeholders. In this example we have defined seven criteria: health, the environment, the economy, social issues, capacity, time, and transport (there could of course be other criteria if agreed by the stakeholders). Then, each action is analyzed against each criterion; for instance, health.

For the health criterion, the factors that might improve as a result of these actions could be related, for example, to the change in the number of people dying from pollution-related causes, the number of people with respiratory illnesses, and/or the change in life expectancy, to name a few. In the case of the social criterion, the actions might reduce the number of accidents, improve accessibility, and reduce stress levels. The equivalent process is undertaken for all seven areas. Then all the stakeholders will agree on how much each action will improve/affect each indicator and will give it a score. We can use any sensible scoring system, but for this example a simple scale of 0–5 will serve as an illustration. We could allow 0 to refer to a negative impact and 5 to a positive impact.

Continuing with the health example, if action A were implemented, we could expect it to reduce the number of people dying from pollution-related causes but the question would remain: by how much? Assuming that data is available and reliable, we could predict the impact of the renewal of 15% of the vehicle fleet and therefore decide whether it would score, say, a 5 (highly positive) if a large reduction is expected or less if the change were smaller. The same is done for illnesses and life expectancy. All the scores should be worked out with all the stakeholders using supportive evidence (research or factual) for their decisions and taking into account the meaning that such evidence yields to all the stakeholder representatives. Table 19.1 shows the results of the analysis for this simple example, made of all the actions in the health criterion.

The change in the proportion of people dying from pollution due to action A is significant. However it depends on the age of the vehicles targeted to achieve better results, so it will therefore be necessary to know the quality of the new vehicles, the type of emissions that might be reduced, etc. It has

Table 19.1. Impact Scores on Health from Actions. For this example, a score of 0 represents a large negative impact and a score of 5 represents a large positive impact.

	Percentage of people dying from pollution	Change in the number of respiratory illnesses	Change in life expectancy
Action A	3	2	2
Action B	2	1	4
Action C	5	5	4

been assumed for this example that the action will virtually eliminate NO_x and therefore it has been assigned a value of 3.

Action B relates to building cycle lanes. Increasing nonmotorized transport might have a direct effect on improving health as there might be a modal shift. However, if the vehicles continue to pollute in the same way, the positive impact might not be very high. Assuming data is available to support this assumption the allocated score is 2.

Finally action C (changing the fuel to a cleaner variety) will have a high impact on the number of people dying. The overall analysis is shown graphically in Figure 19.6.

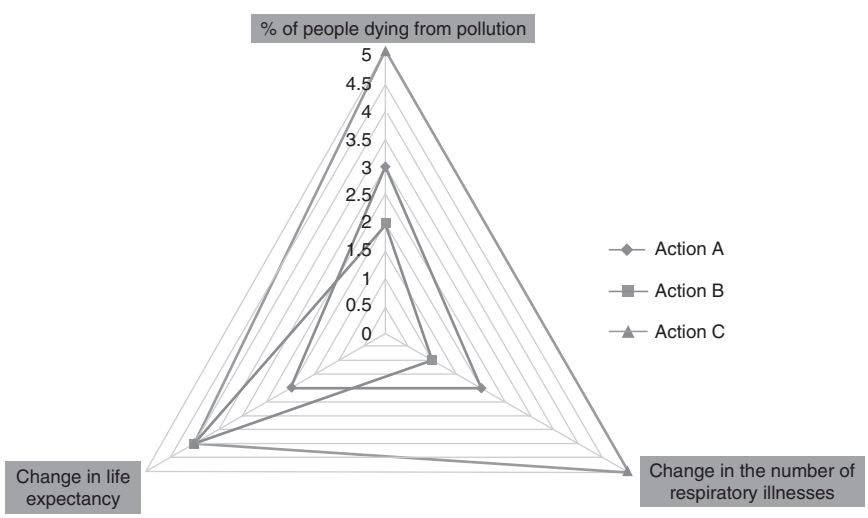

Figure 19.6. Measurement of Health Impacts Arising from Different Actions.

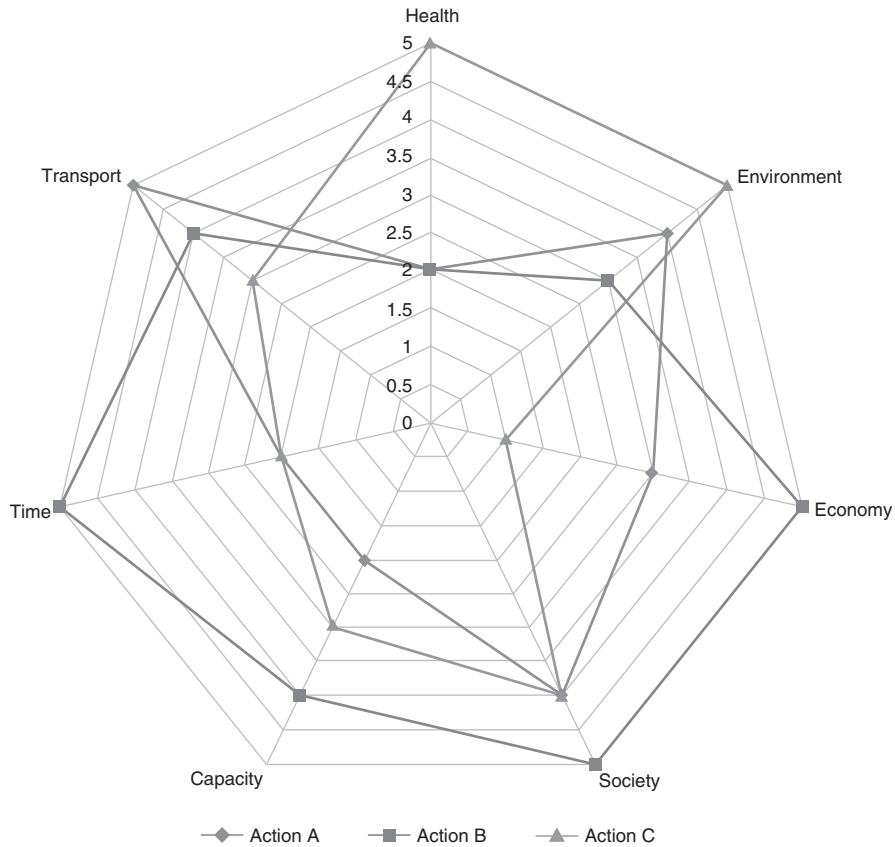

Figure 19.7. Multicriteria Analysis of Transport Actions Before Changes.

Figure 19.6 shows the impact analysis of the three actions within the health criterion for our simple example. The action that covers the largest area is the one that suits best all factors considered and in this case action C is the most positive in terms of health. The stakeholders then allocate a value to this outcome according to their evaluation of its impact. The equivalent analysis should be done for the rest of the criteria.

Once the seven criteria have been analyzed individually they are analyzed together to show the overall action that should be implemented. This results in a set of scores for each action and its impact on each criterion. Figure 19.7 shows the three action scores for all criteria. In this case it can be seen that the action with the greatest area, and therefore the one that should be chosen, is action B.

However, in this analysis it is likely that we would want to differentiate between, for example, the number of people dying as a result of respiratory diseases brought on by pollution and the travel-time savings brought about by the actions under consideration: one is a major health impact and the other is a matter of convenience. Therefore we have to consider their relative values in relation to the different criteria by means of weighting the scores for each criterion. The stakeholders can consider how they wish to weigh the impact scores for each criterion to produce an overall multicriteria outcome.

Figure 19.8 shows such a holistic analysis, in which the action scores have been adjusted by weights agreed by the stakeholders. For example, it can be seen that the score for action B in relation to time is reduced to 2 in Figure 19.8 from its high value of 5 in Figure 19.7. This, together with other changes, means that the action with the largest area has changed and is now action C.

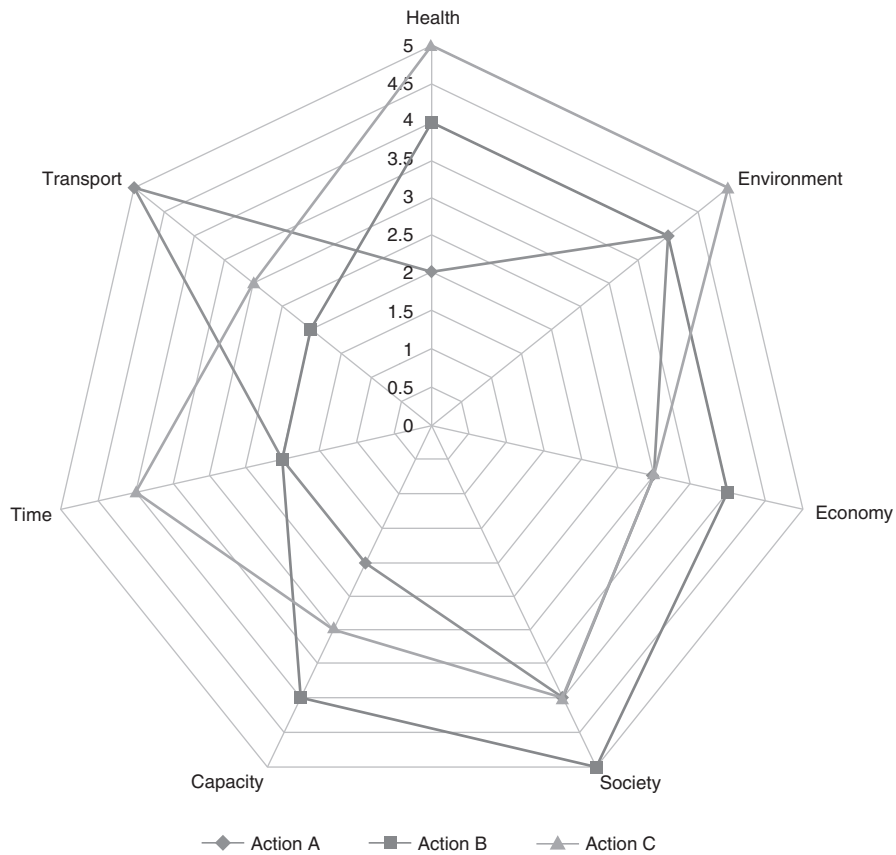

Figure 19.8. Multicriteria Analysis of Impacts After Changes.

The essence of multicriteria analysis is the scientific evaluation of the assessments within each criterion and the agreement of the weights (obviously only described sketchily here): these processes need to be the result of stakeholder inputs and there are several techniques for ensuring that these weights are both credible and supported by scientific evidence.

Mobility and Wellbeing

The link between mobility and wellbeing is related to the availability of resources—material and ephemeral—to the members of society. As noted, these are not always—or even often—located in the same place as the person desiring to make use of them and thus mobility is required to bring the resources and the person together. We have to consider this at an individual level to ensure that everyone has an equitable opportunity of enjoying the use of the resources. Using a population-wide measure will lead to the exclusion of some members of society, which will not enhance the overall wellbeing of society.

It follows that we need to think in terms of the more problematic cases of providing mobility; for example, older people or those with some form of disability are likely to find it more difficult to provide their own mobility to an extent sufficient for the easy provision of availability of resources in a "normal" city (but a city provides many more such opportunities than a rural area). This leads us to think in terms of societal provision of a means of providing mobility. This is usually conceived as the provision of a hierarchy of mobility which includes easier walking and public transport systems before providing capacity for private cars.

The Hierarchy of Mobility

An elementary principle when considering mobility is the understanding of its hierarchy (Figure 19.9), which is defined on the basis of social fairness, democracy and equity, social inclusion, health, and economy. It is crucial that this hierarchy is understood to facilitate prioritizing actions and low-carbon objectives at a later stage. The following is the description of the mobility hierarchy, which requires essential understanding to be able to facilitate the prioritization of actions and interventions aimed at carbon reduction and improvement of quality of life.

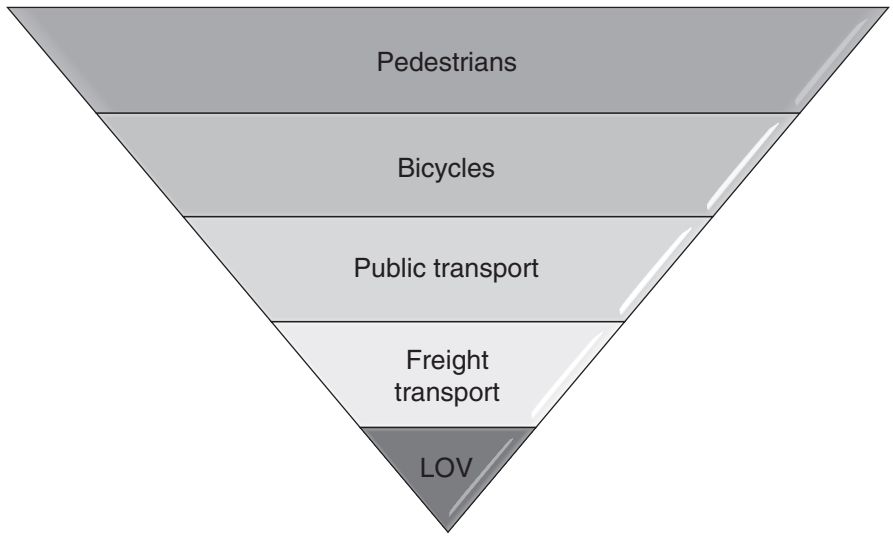

Figure 19.9. Hierarchy of Mobility. LOV, low-occupancy vehicles (e.g., private car).

Pedestrians

The cheapest vehicle that a human can acquire is *a pair of shoes*. All journeys require a pedestrian stage, irrespective of the mode used for the main displacement. Walking is thus one of the most essential and common modes of transport used in the world and the major source of accessibility to any activity by any person regardless of age, sex, or social status. Insufficiency of the pedestrian network precludes the possibility of making journeys for much of the population and a satisfactory pedestrian network is essential if public transport is to become the mode of choice to make better use of energy. With this in mind, the top priority is to design for pedestrians[1] to ensure proximity to their activities and improve their safety and satisfaction to motivate them to walk more.

Bicycles

The second priority in the hierarchy is the bicycle because it alleviates congestion, lowers air pollution, increases fitness, and reduces the risks of obesity. It is also within the economic range of the majority of the population who cannot afford to buy a car in any city in the world. Bicycles are excellent

replacements for vehicles for short trips because they do not occupy much space, provide easy access to areas that cars cannot reach, and avoid extensive and expensive searches for costly parking spaces.

Public Transport

The next best mode of transport in the hierarchy is the public transport system because of its capacity to transfer high numbers of people from one point to another as quickly and efficiently as possible. It takes two buses to transport the same amount of people that 175 vehicles can transport, with the difference that the road seems bigger and more pedestrian-friendly when buses are used. Public transport also includes the provision of trains and, in particular in the urban environment, metro trains, whether these are located on the surface or underground. The provision of a metro train is complementary to the bus system and the two systems must be integrated so that together they form a coherent public transport network.

Freight Transport

It is important to remember that one of the prime needs for mobility is that of obtaining goods: food from a shop for example. This presents an important issue for mobility because some goods might be delivered to the home rather than to the shop, thus reducing the need for a personal journey. It is also the case that some proportion at least of passenger journeys are really freight journeys because their sole purpose is to carry goods (e.g., driving home from a supermarket shopping expedition). At a larger scale, however, freight journeys are those associated with trade and industry and, in the case of a port or other major freight facility, with the access to and egress from the port. Therefore, proceeding down the inverted pyramid, the priority is given to freight to ensure goods are collected and delivered.

As urban areas become more dense, the city centers have become areas of high consumption, which has resulted in increased demand for urban freight transport. Take the city of Lima, the capital of Peru, as an example. The Lima metropolis (it is actually a contiguous urban area including the city of Lima and the Constitutional Province of Callao) is a city of some 9.5 million inhabitants with a large port on the Pacific Ocean. It is therefore important to develop a freight strategy that caters explicitly for (1) the large vehicles carrying freight to and from the port and which have little need to enter the city of Lima itself, (2) the medium-sized vehicles which might need to

enter the city in order to deliver or collect goods from businesses in the city, (3) the smaller freight vehicles making local deliveries, and (4) the freight journeys which are undertaken by people either making unique journeys for freight purposes or combining a freight journey with a passenger journey. Such a strategy needs to show how the freight system can be devised and designed to allow all of these in combination to function properly with a low-energy/carbon objective in order to sustain economic growth and facilitate the access of people to the goods they require.

Low-Occupancy Vehicles

The lowest priority transport modes are therefore the ones that provide a smaller occupancy-to-space ratio and that tend to prioritize the small proportion of high-income population in a city. There are two main forms of low-occupancy vehicle: taxis and private cars.

The utilization of a private car is very low indeed: the average occupancy of a private car in the majority of modern cities is around 1.1 person/vehicle and the actual use *in travel* is around 4% (i.e., a car spends 96% of its life parked). It therefore requires both space for the person to be able to travel during the travel time ($\approx$15 m^2/s when in motion at 18 km/h) and approximately 7.5 m^2 per vehicle (or per person if the vehicle only contains a driver) when stationary ($\approx$20 m^2 per vehicle if it is parked in a car park), for the rest of the time when it is parked. The travel time includes, of course, the time spent stationary due to congestion (which is often caused by the reduction in road capacity caused by parked cars).

Taxis work on a different basis. These are occupied by people when they are traveling and can carry more than one person in a day. Often they are conveying more than one passenger at a time. As a result, a taxi is a higher-occupancy vehicle than a private car and should be prioritized over the private car when considering energy-reduction measures. An interesting example of the potential of taxis is Lima/Callao in Peru. Lima/Callao is unusual because, relative to other cities, it has a very low proportion of private cars and a high proportion of taxis. These two facts are strongly related: the easy availability of taxis is a reason why people are less tempted to purchase or use a private car. One of the disadvantages of taxis is that they search for passengers and thus are often circulating in the traffic stream with no passengers. This needs to be managed so that empty taxis are given lower priority than occupied taxis and appropriate provision is made for them to have organized taxi ranks. There is also an issue in Lima/Callao over the

quality of both vehicles and drivers: registration of taxis and drivers should include issues of quality for both, including the fuel and safety of the vehicle. The easy availability of poor-quality vehicles and drivers is not conducive to an improvement in the quality of life, but if it were possible to deliver the easy availability of affordable taxis without reducing quality this could be a useful way to proceed.

So planning a city should include as its starting point the availability of resources within a walkable distance if possible and, if this cannot be achieved for all resources, the public transport system should be devised in a way to cover the remaining distance. In other words the design of the transport system needs to be driven by the needs of the more movement-deprived groups in society. We like to look at this in terms of how we can change the priorities related to the provision of transport. Starting by *reducing* the amount of movement we need to make in motorized transport systems to achieve the desired mobility, then, *exchanging* low-capacity motorized modes for high-capacity modes, and then *decarbonizing* those motorized modes which are still being used, to reduce adverse health impacts and promote a sustainable future for the city's inhabitants. We call this the reduce-exchange-decarbonize (RED) strategy.

Accessibility

As noted, it is essential that a city and its functions (including the mobility system) is accessible. This means that systems have to be designed to accommodate people who find normal human bipedal movement difficult: maybe due to physical issues, but also sensory and cognitive challenges. Much of the design work that is needed to improve accessibility is well documented—for example in the U.K. Department for Transport's *Inclusive mobility* report (Oxley, 2002), or in relation to the bus system (Tyler, 2002)—and will not be repeated here.

However, accessibility is another issue where meaning turns out to be very important. Once accessibility becomes an issue for someone, the consequences are in fact highly individual and it is unlikely that a single solution will suit everybody. The conflicting requirements of people with visual impairments and wheelchair users are well known, but quite difficult to resolve; for example, wheelchair users need no upstanding kerbs and visually impaired people would like high upstands, particularly in relation to kerbs between pedestrian space and vehicle space on roads. There is no

sensible compromise that can resolve this—ramps are good for wheelchair users (as long as they are not too steep) but they are poor for ambulant older people, especially those needing a stick or similar walking aid.

The MBDM advocated in this chapter addresses this point because the needs, desires, and views of these groups would be included at the initial stage of determining the desired outcomes, success factors, limitations, and actions. The reporting back on the actions and the interpretation of the resulting evidence should indicate the extent to which the issues raised by every group have been resolved by the end of the process. What is absolutely clear is that as accessibility is one of the core pillars of the wellbeing edifice (see Figure 19.1) it is essential for a satisfactory wellbeing outcome that this is addressed in full.

The RED Strategy

All of the preceding discussion suggests that there is a need for a significant shift in emphasis towards a holistic approach to the problem. The system of interest is an accessibility system, not the transport system. It has objectives about enabling people to live better lives by being able to reach and take part in the activities they need and wish, not just to facilitate moving around. So we need to think about how this can be incorporated into a simple strategic model.

We could start with the consideration of reducing the amount of travel required for people to achieve their personal goals. The land-use and person-oriented approach to reducing the need to travel at all and to reduce the amount of travel needed to carry out the chosen activities is a key starting point that changes the perspective of what land use analysis is about. It shows that decisions about what happens where can have a major influence on the accessibility outcomes and thus the design and operation of the transport system which could yield significant reductions in energy use and emissions and increases in wellbeing if we can manage to make the right decisions. This reduction in movement also requires a participatory approach to the definition of what is required—people, not transport experts, choose the activities they wish to follow—and it is therefore highly important that the methods used to establish the location of activities (and thence the land-use implications) incorporate clear processes by which the population as a whole can make their views heard.

The second element of the strategy emphasizes the shift from low-capacity modes of transport to high-capacity modes and, although the second stage of the strategy, it is a crucial aspect of the design of the accessibility system because well-designed public transport vehicles are available to everyone and should be accessible. If we can use higher-capacity vehicles we can use the vehicles in circulation to a better effect in terms of accessibility; for example, providing more spaces for wheelchair users and older people throughout the network. However, there is a pressing need for a much clearer understanding of "capacity:" the difference between static capacity and dynamic capacity is a fundamental distinction which applies to transport and clarifies important issues around the provision of transport supply.

Unlike the general sense of capacity as a fixed quantity that cannot be exceeded, in transport capacity is dynamic and changes according to the situation within the system at a given time. A common mistake is to perceive capacity as a multiple of the carrying capacity of a single vehicle multiplied by the number of vehicles in the service. To explain the difference between—and importance of—the two forms of capacity for scheduled serial systems, static capacity and dynamic capacity, it is easiest to illustrate it with a simple example.

Static capacity is basically the simple mathematical calculation of how many people it is possible to put in a vehicle and how many vehicles can be accommodated safely in the system. So if a train can carry 1,200 people and we can safely operate 30 trains per hour, the static capacity would be 36,000 passengers per hour per direction.

However, this does not take into account the time the train needs to spend stationary to pick up and set down these passengers, so the dynamic capacity, which includes this, needs to calculate the effects of the stationary time in the stations. This will deliver a maximum time for a train to be stationary in each station before it starts to affect the ability of the system to deliver the train frequency. Research in London for its new rail lines suggests that, to maintain a frequency of 30 trains per hour, the maximum stationary time is about 30 s. To achieve a 30-s maximum stationary time with 30 trains per hour given the passenger demand at those stations and with the given station, track layouts and train design in this case, to enable sufficiently high boarding/alighting rates it is necessary to have the trains operating with an internal passenger density of less than 2.5 people/m^2 and that suggests a total train occupancy of maybe 60% of its theoretical physical carrying capacity. Thus the dynamic capacity of such a system

would be nearer to 21,600 passengers per hour. This is highly system-dependent so needs to be calculated for every station on every line and every operating period. It is a feature of line-based systems and thus applies to buses as well, although it is much easier to activate the possibility of changing the provided capacity of the bus system in space or time to reflect changing needs. This might provide a possibility for mitigating the problem a little.

This understanding is badly needed so that higher capacity really is provided where and when it is needed—and will actually be delivered in operation—while energy reductions are delivered through more focused delivery of transport supply where and when it is needed. When trying to make a system accessible, capacity is important because it is how we can establish that the system is truly accessible for everyone. Wheelchair users who cannot board a peak hour train cannot travel to work so their employment opportunities—and thus their wellbeing—are reduced.

The third element of the strategy allows for attention to be paid to the source of the energy used in delivering movement. Apart from the issues around energy use, the likelihood of noxious emissions from the use of energy in transport systems is very high because of the energy density found in fuels derived from fossil sources. Thus reducing the use of carbon has important health benefits which in turn help to deliver an improvement in wellbeing. Using electricity as the energy source has the advantage of reducing the emissions at the point of use: this will help to clear the air in congested areas. However, in terms of the delivery of reduction in carbon emissions this is not sufficient, as the energy source might well be producing significant emissions at the point of production. The opportunities afforded by hydro power, renewable energy, and other noncarbon-based sources of energy to produce electricity can be encouraged where these are possible so that the electricity used in the city could actually reduce carbon emissions in its own right.

Shifting energy production away from carbon-based inputs is not without its challenges of course. Carbon-based energy is common because of the high energy density of fossil fuels and this enables energy systems to manage sharp changes in demand—the peak load—by creating sufficient peak load capacity that can be brought on line quickly and turned off when no longer required. Renewable sources of energy are much less able to deliver peak load in this way, so the reduction and exchange elements of the strategy are crucial in reducing that peak demand for energy so that the mobility system becomes much more suited to the energy production afforded by renewable

sources. It is for this reason that the decarbonization element of the strategy requires the concurrent as well as an earlier implementation of the reduction and exchange elements.

This gives us a reduce-exchange-decarbonize (RED) strategy, which places the transport system within the accessibility context because it sees the significance of reducing the need for a person to make a journey in order to reach their desired activity. If a journey is still required, then the effort must go to reducing its impact on carbon emissions by better route and service planning and improving the (carbon-based) energy efficiency of the transport system. The RED strategy allows us to define different actions which would lead to potential reductions in carbon emissions, with an increasing effect as they are combined and thus lead to improvements in wellbeing. Figure 19.10 shows how these might be envisaged.

Before we can construct a transport system to enhance wellbeing we must determine the mobility system. Following the MBDM approach, we need to have discussions with the people who are concerned with the mobility system: planners, operators, regulators, funders/sponsors/clients, users, and nonusers of the mobility system. We prefer not to use the term "stakeholder" at this stage because this places undue emphasis on the organizations and

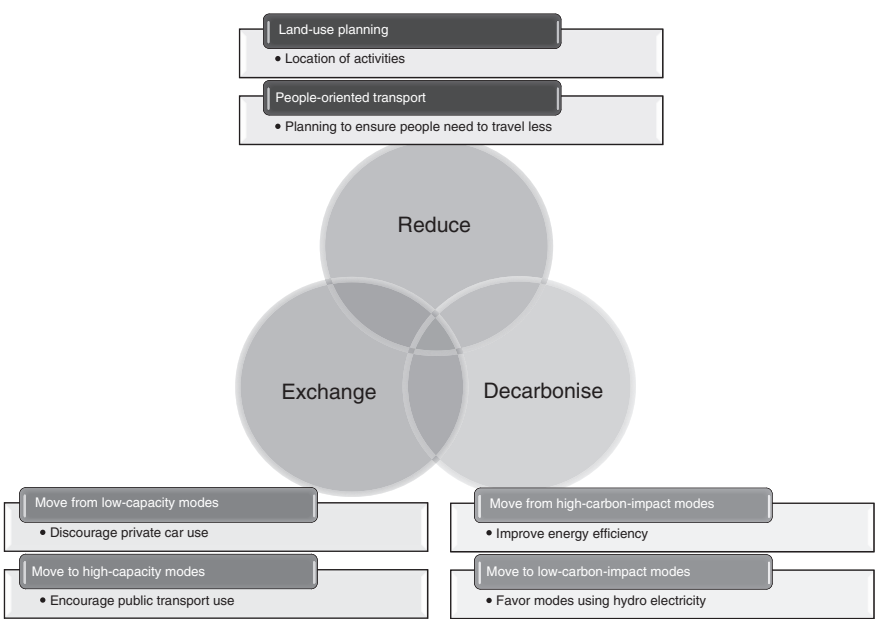

Figure 19.10. The RED Strategy.

their "stakes" in the system rather than the people and their concerns: it is people who will express their concerns whether or not they have a direct stake in the system.

Unfortunately, most people will be unable to imagine a world a few generations in the future, even if they are able to describe their current concerns or needs. This gives the mobility planner a problem. If they only take the views about current systems there will be an inevitable stasis in progress: as Henry Ford is supposed to have remarked "If I had asked the people what they want, they would say 'a faster horse'."[2] This does not mean that one should not ask the customer what they want. Ford's mistake was to believe that he had the answer. Indeed, the evidence showed that people would buy his cars in increasing numbers, until competitors entered the market with more customer-oriented products (including financing programs, closed car designs, the opportunity to trade in old cars and, crucially for the present discussion, annual changes to the models). It would appear that the desire for movement was clear; the convenience of making such movement available to a wider public was the competitive issue. Perhaps the most crucial element of this story that is pertinent to our discussion is the annual updating of model designs. These enabled manufacturers to keep up with customers' changes in need and desire in a timely way.

Whereas a car design could be changed fairly easily, the plan of a city is considerably more complex and would be difficult to change quickly. However, the sense of adaptivity is inherent in the approach of car manufacturers: they were making their company attitudes open to adapting to changes in need and in response to the technical opportunities arising from technological progress over time. This is an important lesson for planning for future cities in a world that is in a state of rapid change: the need to make frequent updates to the knowledge base and to ensure that systems are adaptive or at least adaptable enough to allow for changes that become necessary or become possible to introduce as these opportunities emerge. This is why the meaning phases of the MBDM are placed where they are in the decision model: before determining the desired outcomes and after evaluating the evidence from the actions taken in an attempt to achieve the outcomes.

The process of understanding meaning is one that continually has to be updated. Planners and implementers need to be aware that change happens—it is a natural consequence of survival in an evolutionary system—and that we need to design systems to cope with being altered to keep up with the requirements. This has profound implications for

how we think about design and engineering: making systems adaptive is one example of an approach that would be helpful in this context. The current approach of planning, designing, and engineering for as permanent a solution as we can afford is one developed during the fast expansion of movement needed in the nineteenth century and continued in the twentieth century in the form of "predict and provide." This is no longer sufficient in a world with rapid changes in climate, depleting resources, growing population, increasing urbanization, and increasing financial and political complexity in the international scene. There is no such thing as "futureproofing" in such a world. We need new ways of addressing the core problem to enable future generations to be able to survive in their world and provide a viable future for their progeny.

Brundtland's (1987) definition of sustainability, as noted, presents a set of requirements that are essentially dynamic. Maintaining the ability of future generations to meet their needs at that time means building into the present decisions the ability to be adaptive in the future. Adaptive is different from adaptable: adaptable means that something can be adapted to suit new circumstances; adaptive means that it adapts itself to the changing circumstances. Building a railway line in a way that allows for doubling of the tracks to meet future increases in capacity would be an adaptable outcome; operating a bus system so that buses adapt their headways to respond to changes in demand in real time without a positive intervention would be adaptive. At some point of course adaptivity becomes too hard to achieve without some exogenous adaptation (e.g., building a busway), but if it is designed into the system, adaptivity will enable the system to operate for longer without the need for such step changes. Adaptivity is thus a resource in the same way as the more substantive resources of fuel and materials, the difference being that building adaptivity into a system does not of itself reduce the ability to be adaptive in the future; rather the opposite: not building adaptivity into the system might yield a reduction in sustainability because additional resources would be required to maintain service under future demand conditions.

It is therefore essential to determine what the future demand for transport will be and this requires some thought to be given to future lifestyles and needs—and, crucially, where these will be found—so that we can make decisions about locating them today. What will be the future purchase model? Order online and have it delivered? Buy in the corner shop? Where will the day-to-day needs be supplied? What about future work patterns? It seems that we will all be working until an older age and that career

profiles might well change from the constant progression model of the late twentieth-century towards a spreading of tasks as experience is valued and utilized across an organization rather than the progressive honing of single skills over a life course.

The world of rapid change and the need for rapid responses to change plays well for the link between mobility and wellbeing and its impacts on the way in which we might design the transport system able to contribute to the delivery of a satisfactory level of wellbeing. The introduction and emphasis on adaptivity in planned and engineered systems is just what a wellbeing outcome requires. This is because of the complexity of wellbeing and the consequent difficulty of describing what it is and predicting what it will be in the future. We therefore need to plan, construct, and operate systems that can make adjustments as we discover better matches to the needs of the people involved in the system's outcomes. Therefore it is useful to know what we need to do to make an adaptive accessibility system.

Adaptive Accessibility Systems

The first thing that needs to be done is to ensure that everyone has access to a public transport system that can convey them usefully to and from the means of delivery of their basic needs, or vice versa. Basic needs include clean drinking water, sanitation, daily nutrition, economic basis for life, health care, and social interactions. It should be determined in discussion with all associated people how such mobility should be delivered. Water could be pumped to homes and other users via a centralized system of pipes and treatment plants, or it could be more localized if desirable. Similarly with sanitation systems: much more could be done close to source so that centralized systems are less pressured to cover the entire process. Once it is necessary to consider whether a person needs to move in order to meet these needs, it must be determined the extent to which they would be required to supply their own means of movement.

How far is it reasonable to expect someone to walk to buy their daily nutrition? At one extreme they could order this online and have it delivered to their house. This could be quite attractive for some people, but is it actually the right thing for everyone? Such a system would inevitably reduce the amount of exercise that a person would take. It could be matched by a reduction in daily calorie intake but this would not activate the locomotory and sensorimotor systems and thus some degradation in some aspects of

their medical condition might be expected (e.g., cardiovascular performance might decline). It is not uncommon to find that mental health deteriorates in such circumstances, putting more pressure on wellbeing. Evidence shows that even a small amount of daily walking provides a considerable health benefit to older people. This might suggest that we should make the daily nutrition available at a point a certain distance from the person's home. This might provide an opportunity for online ordering, with the delivery made to a point a suitable distance away from the home, from which the person collects their purchases rather than to the door. If their ability to walk diminishes over time, the distance could be adjusted. Where appropriate, the collection point could be a local shop.

At some point there might be a need to travel further, possibly to collect nutrition. We should be ensuring that some form of publicly accountable transport should be made available for this purpose. This could be in the form of a regular, suitably frequent, bus service, but, given the objectives we are trying to satisfy, it could be provided by a number of methods; for example, community transport services could be deployed for such a service, or a local system of helpers, or suitable arrangements for professional taxi drivers with suitably accessible vehicles could be devised. The point is that the service should be available to everyone who needs it in order to achieve their daily needs. The Plusbus project in Cumbria, United Kingdom, for example, showed how people would like to shop locally, with the opportunity to meet people on a daily basis more as a social than a shopping event and the provision of a daily bus service to this end provided a real benefit to the social life of the community—especially to older people and people below 17 years of age—who now had a means to visit local friends and relatives without the need to ask for a lift. We explored the possibility of using the bus to deliver goods. This had limited success (except for newspapers) but it is important to see the bus as a resource: it was scheduled to follow a route at certain times and could carry goods to local collection points without too much difficulty at certain times of day, which could be a significant addition to revenue.

Discussing these needs with the people and the possible ways of meeting them with people who might be in a position to help should be able to define a set of desired outcomes that could be feasible and which are meaningful for everyone. The rest is just a matter of taking a sensible and logical path through the process of delivering such a service.

The key here is that what we mean by the term "public transport" is rather different from the usual perception of a bus or train system. I used the expression "publicly accountable transport:" what does this mean? It is that

there should be a transport system that is openly discussed and described in public in terms of what it is being asked to do and how it proposes to achieve this. Walking to a collection point or the corner shop is part of this system. When the system needs to be adjusted for some reason, this should also be discussed: this is the "public accountability." The goal is to achieve the community's desired outcomes and to ensure that the role played by the transport system is able to deliver its share of that responsibility.

The accessibility system is thus in a good position to be made adaptive as it would shift its definitions of adequacy according to the local needs as they change. This implies that there would be a series of discussions with communities about their needs—what needs to be accessible, where, and when—and the possibilities for adapting the transport systems to help provide this. It might be thought that this would be too much—too time-consuming, too futile—to be worth the bother. If the process is organized in a suitable way it need not be so difficult to justify. The community must be given a much closer relationship to the provision of their mobility, with direct discussions with the operator and regulators so that all parties understand each other: operators understand the needs of their passengers (and, importantly, those who are not—yet—their passengers), the public understand the constraints under which the operator is working. My experience with such action in both urban and rural areas shows that understanding on both sides yields a better transport service with a more consistent passenger base: problems only emerge when the communication breaks down for some reason. In one (rural) case, there was even a discussion about the amount the community wanted to raise their council tax (by means of a precept) to provide financial support for the service, because the reason for the costs being what they were was explained—rather than defended—in an understandable way.

The way we operate our transport systems is another example of how thinking devised in an earlier time could be changed. Most serial transport systems—trams and trains for example—operate on the basis of providing capacity by sending vehicles along a fixed route at certain intervals. This is done for safety reasons—one way of keeping trains from crashing into each other is to keep them separated—but the time interval between them is a fundamental element of the system capacity: the lower the frequency of trains, the lower the capacity. Buses are not as constrained as trains in this manner because they are not constrained to operate on fixed tracks and they can therefore overtake each other. This provides an opportunity to allow operations to be more responsive to passenger demand: buses could

run closer together when demand requires this and further apart when it does not. The process of bus bunching—when one bus catches up with an earlier one—is the scourge of bus operations, but maybe it is the system regulating itself to the capacity needs of the demand at that time: one bus is travelling more slowly because it is collecting more passengers and the other is travelling faster because it is collecting fewer passengers. If the two were running as a self-organizing pair the passengers would be able to distribute themselves between the two vehicles and both would run faster. The difficulty is how to manage the service around this phenomenon so that a suitable service is provided for other passengers. This would require seeing a pair of buses as a single-but-flexible unit, allowing them to respond to the demand they encounter and scheduling the next pair to follow at a suitable interval, and being less concerned about the actual order of arrival of buses at bus stops and the final destination of the service. This is much more difficult to achieve with tracked services because the possibility of overtaking is much smaller.

Strategies for Improving Accessibility

Whatever the capacity of the service it must be accessible, or wellbeing will be denied to those who are unable to enter and use the system. This means considering how far people are able to walk to reach their desired activities or the public transport system that will take them there. In many ways the most complex problem is the interface between the fixed infrastructure of a station platform, bus stop, etc., and a vehicle such as a train or bus. In the main difficulties at this interface are currently covered by the use of a ramp: in the United Kingdom all buses are required to be fitted with a ramp for the purpose of providing access for people in wheelchairs and all stations must have ramps available. However, there are some problems with this approach.

1. Ramps only provide a solution to people whose movement is provided with the assistance of wheels. Ambulant people with movement problems, such as arthritic knee joints, find ramps very difficult to use and are thus left with the prospect of the step from the platform level to the vehicle floor.
2. Ramps are time-consuming to deploy, especially if they require manual interventions to put them in place.
3. The safety mechanisms surrounding ramp operation are not particularly welcoming: audible warnings (in some cases these are loudspeaker

announcements) make the person who wishes to use the ramp feel conspicuous.

4. Ramps, especially automated varieties, are prone to mechanical failure. This is in part due to the necessity of their location low on the vehicle where they are subject to intrusion of dirt and being knocked when cornering.

It would be far better to devise methods to avoid the need to use ramps (except in cases of emergency) by designing the static/dynamic interface so that they are not necessary. Designs exist for achieving this exist and it is not difficult to provide near-level access, even to buses.

More attention could also be paid to pedestrian facilities. Making sure that surfaces are appropriate for people who find difficulty walking and people who use wheeled vehicles to move around the pedestrian environment is more difficult than might first appear. Wheelchairs, for example, need smooth surfaces with no obstacles, clear sightlines from a relatively low eye height (including visibility of signage), and no vertical gaps. Ambulant people need places to rest, assistance in the form of objects they can use to maintain balance, to identify their location relative to road space, to have clear sightlines to the surface, and signage from "normal" head height and so on. These two sets of need are not particularly complementary: the presence of benches is good for ambulant people whereas they present an obstacle for wheelchair users, visually impaired people prefer to have kerbs because they can then detect the presence of a roadway, whereas wheelchair users find kerbs—even very small ones—to be a barrier. It is not clear that a compromise really exists between these needs: the existence of any kerb would provide problems for a wheelchair user and it is clear that the absence of any kerb presents a real problem for visually impaired people. This is an extremely good example of a situation where meaning is very important and the real approach should be to bring all parties affected by the pedestrian infrastructure to come together to discuss how to resolve the dilemmas and paradoxes thrown up by this sort of issue, but with a view to determining a solution that would suit each group. This is likely to be location-specific.

Taking all this into account, to develop a transport system that can enhance wellbeing there is a simple sequence of actions that need to be taken.

1. Discuss with all relevant people from a range of stakeholder bodies and the population in general what they perceive to be the essence of the wellbeing they seek; taking as their starting point their views of the present mobility system and their aspirations for the future.

2. Determine what would yield meaningful evidence to indicate whether or not wellbeing has been achieved.
3. Determine the desired outcomes for the particular elements of the process of achieving the mobility requirements for this objective.
4. Determine the success factors in terms of accessibility, mobility, movement, and transport that would work towards attainment of the desired outcomes.
5. Determine the limitations that work against achievement of the desired outcomes.
6. Work out the actions that will be necessary to deliver the success factors and eliminate, or mitigate if elimination is not possible, the limitations. This is likely to require a program of actions, so prioritization in terms of practical need must be determined so that the actions are undertaken in the correct order. The actions need to be designed with an adaptivity approach so that the outcomes are sustainable in an environment of continuing and accelerating change.
7. Implement the first of these actions.
8. Measure, report, and verify the outcomes arising from the action.
9. Determine the extent to which the evidence provided by the measurement of the outcomes from the actions might be indicting achievement of the desired outcomes.
10. Test the evidential outputs to ensure that the meanings required and understood by the people are sufficient for their needs and that the required approach towards the required mobility has been achieved.
11. If the test is satisfactory, proceed to the next action and repeat. If the test is unsatisfactory, repeat the process with the current action, but starting the cycle from the newly achieved point.

Given the link between wellbeing and accessibility, it is important that accessibility is available. In a world where we are trying to reduce the amount of movement in order to reduce energy use and noxious emissions there is inevitably a conflict between the wellbeing of those people for whom individual movement is really important and those for whom it is only possible if someone else provides the means. If we take measures to reduce movement for, say, car owners, we need to ensure that there is a viable opportunity for them to exercise their mobility needs. This means that the public transport system needs to be designed in part to meet their needs. Instant access to movement provided as a result of having ownership of a private car, for example, means that a replacement public transport

service needs to be provided at high frequency, with a reasonable route density and travel speed. Not providing this will simply result in a failure to transfer to the environmentally more sustainable service. This would be expensive, at least if we think in terms of the way we do about transport supply and costs. If our problem has shifted though, do we need to think about costs (and how we meet them) in the same way? The present problem is how we provide public transport and how we pay for it. The problem we are talking about in this chapter is how we ensure the wellbeing of people in the community and the role that transport plays in achieving that. How much is that wellbeing worth? The answer does not lie within the transport system, but across the whole complexity of how a community lives and thrives. We need to be thinking in terms of cross-sector benefits; that is, how investment in one sector (e.g., the transport system) can yield benefits in another (e.g., health) and how we realize these in the way in which we establish the true costs and benefits of the systems we wish to provide.

Notes

1. The term pedestrian is taken to include a person using a mobility aid such as a wheelchair, for whom all transport systems, including pedestrian infrastructure and public transport vehicles, should be designed to be accessible. However, it should be noted that wheels require different features in infrastructure compared with feet (e.g., ramps vs. stairs) but that often these conflict with each other. Some people find it very difficult to walk down a ramp, for example.
2. There is no evidence that Henry Ford actually said this, but there seems to be a general consensus that it is a sentiment that he might well have had, hence the persistence of this attribution.

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20

Air Quality and Wellbeing

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Introduction

For several decades air quality has been a key concern for urban dwellers in developed and developing nations, with plenty of evidence linking pollutants to health outcomes (Brunekreef & Holgate, 2002). Mainly this has focused on outdoor air quality and much research is based on epidemiological evidence: most results are linked to traffic related pollutants. For example, in 2006 the United Kingdom's Committee on the Medical Effects of Air Pollutants (COMEAP) report found cardiovascular disease to be linked to air pollution with different pollutants found to give similar correlation strengths: "the evidence linking daily cardiovascular deaths with concentrations of particles (measured as PM10 or as Black Smoke), nitrogen dioxide (NO_2), sulphur dioxide (SO_2), ozone (O_3) and carbon monoxide (CO) are similar" (COMEAP, 2006).

In most European countries, smoking indoors in public places is now restricted; this is an incredible achievement in reducing public exposure to a major source of pollutants that affect wellbeing. This chapter does not focus on cigarette smoking but it is recognized that this policy action has significantly improved population health in all countries where it has been implemented. For example, in the United Kingdom, following the Health Act 2006 (U.K. Government, 2006), a reduction in heart attack admissions was found (Sims, Maxwell, Bauld, & Gilmore, 2010) and a reduction in child admissions for asthma was recorded in Scotland (Mackay, Haw, Ayres, Fischbacher, & Pell, 2010).

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There are a range of pollutants that are known to affect health, and thus wellbeing. Many but not all of these pollutants are generated by the burning of fossil fuels. This chapter highlights the chief causes of poor air quality in outdoor and indoor environments and guides the reader to environmental solutions to improve wellbeing.

Individual Pollutants

The chief pollutants of concern are considered to be small particulates, oxides of nitrogen, ozone, and carbon monoxide by COMEAP, charged with considering the medical effects of air pollution (COMEAP, 2010). All of these pollutants are harmful to human health, and air quality standards have been set to reduce exposure to harmful concentrations (Department for Environment, Food and Rural Affairs [DEFRA], 2012). For the key pollutants, the limit values and the main harmful effects are listed in Table 20.1.

Exposure to Pollutants

For most of us the three key locations where significant pollutant exposure could occur are in the home, in the work place, and outdoors. Of these, we tend to spend by far the most time in the home (≈69%), then the office (≈17%), then outdoors (≈4%) (Lai et al., 2004).

However, the most attention is placed on outdoor exposure, with traffic pollution the main focus. It is true that time spent on, or near, streets with high levels of traffic has most potential for peak exposure, but as yet there is no agreement on whether being exposed to occasional peaks of high concentration or longer periods at lower concentrations is the most damaging to health and wellbeing. The most convincing evidence for health effects is made using epidemiological evidence at the macroscale of the city, suggesting it is longer-term ambient exposure that has the biggest effect (Dockery et al., 1993).

Exposure in the home can be broken into two categories: from outdoor-generated pollutants or from indoor sources. Those from outdoor sources are most apparent if the dwelling is close to a heavily trafficked street or an industrial source, or there are fumes from a local exhaust such as on a neighbor's heating system, where pollutants can enter the home via windows

Table 20.1. Major Air Pollutants, UK Standards, and Health Effects.

Pollutant	UK air quality standard (AQS) (DEFRA, 2012)	World Health Organization indoor air quality guideline (World Health Organization, 2010)	Health effects
Carbon monoxide	10 mg/m^3 8-h rolling mean	Same as UK AQS	Stops blood taking up oxygen, congenital heart disease at low levels, brain damage
Nitrogen dioxide	200 μg/m^3 1-h mean 40 μg/m^3 annual mean	Same as UK AQS	Respiratory disease, asthma, and hay fever
Ozone	100 μg/m^3, 8-h mean		Very strong oxidant, shortness of breath, respiratory problems, bronchitis, aging of lung
Small particulates	PM_{10} 50 μg/m^3, 24-h rolling average $PM_{2.5}$ 25 μg/m^3, mean		Carcinogenic, increased mortality, smaller particles absorbed deep into lung, hay fever
Sulfur dioxide	350 μg/m^3, 1-h mean 125 μg/m^3, 24-h mean		Worsens asthma, as part of a pollutant cocktail may multiply the effect, irritant to the lung
Volatile organic compounds (VOCs)			
Formaldehyde		0.1 mg/m^3, 30-min average	Irritation of eye, nose, and throat
Benzene	5 μg/m^3	No safe level	Known carcinogen

PM_{10} and $PM_{2.5}$ are measures of particulate matter in the air: both are fine particles that can travel into the lung. PM_{10}, particles of average diameter 10 μm; $PM_{2.5}$, diameter 2.5 μm. The smaller particles can travel deeper into the lung and are linked more closely to health problems.

and doors, or via infiltration through small gaps in the building fabric. The ratio of indoor to outdoor levels depends on the both the fabric and also the occupants' behavior regarding ventilation.

Exposure from indoor sources is mainly due to either the use of fossil-fueled appliances, the giving off of gas from materials within the home, or the use of paints and sprays in the home. Again, concentrations depend on occupant behavior.

Most houses in the United Kingdom have natural gas-fueled appliances for heating and cooking. Some of these appliances are unflued and emit products of combustion directly into the home (cookers, for example); in occasional cases, poorly maintained appliance installations can be a source of pollutant exposure high enough to be lethal (Croxford, Leonardi, & Kreis, 2008).

Volatile organic compounds (VOCs) such as formaldehyde and benzene are present in paints, glues, and solvent. These compounds are known irritants (benzene is a carcinogen) and as such will have an effect on health and wellbeing. New homes, newly painted homes, and homes with new flooring or furniture are likely to have the highest source concentrations, and the newest homes are likely to be the most airtight and thus occupants will experience the highest exposures. Other sources include smoking, cleaning materials, and mothballs. Sarigiannis, Karakitsios, Gotti, Liakos, and Katsoyiannis (2011) conducted a major review article identifying indoor VOC risks. They found a high variation both within countries and between countries for a range of different VOCs. Again this indicates that occupant behavior can strongly affect exposure to indoor sources, and these behaviors can have a cultural aspect; for example, celebrating religious festivals by burning joss sticks.

At work there are less likely to be sources such as fossil-fuel-burning appliances but more likely to be photocopiers and printers. New furniture or flooring is perhaps more likely, but ventilation is also more likely to be controlled.

Some health symptoms are linked to exposure to certain air pollutants indoors; sick building syndrome (SBS) is a general term encompassing symptoms including headaches, and irritation of the eyes, nose, and throat. Takigawa et al. (2011) found a particular link with formaldehydes and aldehydes in new dwellings in Japan, for example.

From the previous sections it is clear that different pollutants are present in different situations in both indoor and outdoor environments. The following

sections consider measures that can be taken to improve wellbeing by reducing exposure to pollutants.

Policy Actions to Reduce Effects of Air Quality on Wellbeing

Much exposure to pollutants is due to the background level of these pollutants in the ambient air. There is little the individual can do to avoid this and the area is under the responsibility of national governments. Already many governments have policies and regulations to reduce exposure of populations to pollutants and also to improve air quality in general.

Reducing Exposure

As the majority of our time is spent inside buildings, the regulations concerning the indoor environment are a key area for controlling our exposure to air pollutants.

Building regulations specify ventilation requirements for buildings and also emission regulations for fossil-fuel-based appliances. In the U.K. Building Regulations, parts F and J, respectively, cover these areas (U.K. Building Regulations, 2012). Also in the United Kingdom landlords are required by law to carry out regular servicing of gas appliances as set out in the Gas Safety Regulations (U.K. Government, 1998).

Governments also have a duty to inform citizens and many indicate to populations not to venture outdoors during periods of high concentrations of air pollutants of concern. For example, if you live in Scotland you now can receive emails or text alerts on days when high pollution is forecast (Scottish Air Quality, 2012).

Improving Air Quality

The governments of many countries now have laws designed to improve air quality, and in some countries these laws cover all major sources of pollution and many lesser sources. In general the United States leads the way with California the most advanced; for example, California regulated the emissions from lawn mowers in 1998 (Air Resources Board, California, 2012). In Europe, the European commission has driven much of the

legislation regarding air quality. There is a European Commission (EC) directive (1999/13/EC) aimed at reducing VOC and solvent emissions in general, with later revisions and related acts aimed at reducing VOC emissions from coatings and varnishes (EC, 2012a).

There have been significant successes: regulating sulfur dioxide emissions from power stations by a cap-and-trade system led to a dramatic reduction in concentrations of the pollutant: it has declined by 83% in the United States between 1980 and 2010 (EPA, 2012).

Road traffic is the major source of air pollution in cities and there is an ongoing effort to reduce emissions for road vehicles. European directive 98/69/EC enforces new vehicles to adhere to the current Euro 5 standard and this will be replaced by the more stringent Euro 6 standard in 2014 (EC, 2012b). For existing vehicles the United Kingdom requires an annual check including exhaust emissions testing for all vehicles over 3 years old (for latest regulations see Vehicle and Operator Services Agency [VOSA], 2012).

Local authorities and local government can enforce national planning regulations aimed at reducing pollutant exposure and can request an Air Quality Assessment when a change of air quality is expected to occur (London Councils, 2007). These regulations can affect the design of cities, neighborhoods, streets, and buildings.

Design Measures to Avoid Exposure

Cities can be designed to have more pedestrian zones, and polluting industries and sources can be kept out of airsheds. For example, Athens moved its airport in 2001 ahead of the 2004 Olympic Games and Shanghai moved many of its factories before the Shanghai World Expo in 2010.

At the finer scale, streets can be designed to keep pedestrians further from busy intersections, and to make vehicles go more slowly and smoothly, which reduces emissions. Housing and office developments can have restricted numbers of parking places, and improved public transport can reduce the need for private vehicle travel.

Buildings can be designed to be ultra low energy, exceeding the building regulations, by increasing insulation beyond that required, and thus minimizing consumption and thus emissions of fossil fuels. Also, buildings can be designed to have low concentrations of indoor pollutants; decisions regarding choice of construction materials, location, and ventilation strategy will all affect the indoor environment. Natural materials such as seasoned

wood and stone have little or no off-gassing potential, whereas carpet tiles and medium-density fiberboard have high off-gassing potential. Publications such as the BRE *Green guide to specification* can give useful information for selecting low-emission materials (Anderson, Steele, & Shiers, 2009).

It is possible to reduce the potential for exposure to outdoor sources of pollutants by locating a building further from the road, and considering the prevailing wind and the location of possible pollutant sources when designing openings. Ventilation strategy, such as top-down ventilation in polluted sites, or mechanical ventilation with filtration equipment, can also be important at reducing exposure to external sources of pollutants. Careful detailing and construction can reduce uncontrolled infiltration of external air to almost zero (Passivhaus, 2012). When this is combined with well-designed mechanical ventilation with heat recovery and air filtration, indoor pollutants can be flushed and outdoor pollutants can be minimized, thus improving air quality.

Whatever the ventilation strategy it is important that air intakes for buildings are situated away from any source of pollutants, such as car parks or exhaust flues.

Personal Measures to Avoid Exposure

We can take measures ourselves to reduce personal exposure, firstly by being aware of potential sources. These include ensuring the home is safe by regular servicing of fossil-fuel-burning appliances and by using only low-emission paints, glues, solvents, and cleaning products.

We need to ensure sufficient ventilation for our homes and offices, allowing in fresh air from a pollution-free area, or at least the side of the building with the fewest pollutant sources. Extra ventilation is required particularly after painting, the use of cleaning materials, or the installation of new flooring or new furniture. Smaller, more immediate measures such as using ventilation just before cooking starts will reduce the chance of being exposed to peak concentrations that occur as cold appliances start up.

Discussion

Sufficient evidence exists to show that poor air quality can damage health and affect wellbeing. Reducing exposure to poor air quality will increase both wellbeing and health. A large proportion of a person's exposure to

certain pollutants is due to background, or ambient levels of those pollutants that that individual cannot influence directly.

Governments around the world are acting to reduce the sources of most pollutants, with legislation to force manufacturers to lower emissions, ensuring that new developments minimize their impact on local air pollution and even forcing individuals to smoke in designated places. However, these intrusive governmental actions aimed at reducing air pollution exposure can improve public health.

Legislation to ban smoking in public places has reduced exposure to pollutants for many, although, for some, concerns continue about exposure in other locations, such as private cars and the home (Callinan, Clarke, Doherty, & Kelleher, 2010). This leads us to think about individual actions to reduce exposure.

Many air-quality problems are caused by simply not choosing the most appropriate option at the design stage. Designers and planners, for example, can improve air quality in and around buildings by taking a more long-term, wellbeing-oriented approach considering low-energy design options, low-emission materials, and ventilation strategies to minimize air pollutant concentrations.

We can take more control of our own immediate environment and our personal exposure to air pollutants by taking decisions regarding exposure to pollution sources around us, getting our heating appliances serviced and maintained regularly, using ventilation thoughtfully, and making choices that lead to lower pollutant exposure.

It is possible that some of these choices to reduce pollutant exposure might actually reduce wellbeing; for example, some smokers bemoan that they now have to go outside into the wind and rain to smoke. Their social life has been disrupted by the ban on smoking, they are less happy, so their wellbeing is possibly reduced. As with many choices in life there is a balance and getting the balance right is possibly the secret to wellbeing!

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21

Implications of Low-Carbon Design of Housing for Health and Wellbeing

A U.K. Case Study

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The overwhelming case for low-carbon development to mitigate anthropogenic climate change has been clearly articulated in successive reports of the Intergovernmental Panel on Climate Change (IPCC), most recently in the *2007 Fourth assessment report* (Metz, Davidson, Bosch, Dave, & Meyer, 2007; Parry, Canziani, Palutikof, Van Der Linden, & Hanson, 2007; Solomon et al., 2007). The challenge is daunting: a halving of global greenhouse gas (GHG) emissions by midcentury, with much larger reduction of 80–90% in high-income countries.

This chapter focuses on high-income countries. We will use the United Kingdom as a case study and concentrate on housing, given the potential of the built environment for GHG mitigation. Household energy interventions in low-income settings may have greater potential to improve public health than do those in high-income countries, but such interventions in high-income settings have greater potential for GHG reduction per dwelling while still being of significant importance for health.

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Achieving GHG targets will have major implications for all sectors of the economy. Improving the energy efficiency of housing is a key focus for action because of its substantial contribution to GHG emissions, and because the opportunities for early and substantial action are arguably greater than in many other sectors. As has been observed, however, while such potential undoubtedly exists the challenges are great (Levine et al., 2007):

> While buildings offer the largest share of cost-effective opportunities for GHG mitigation among the sectors examined, achieving a lower carbon future will require very significant efforts to enhance programs and policies for energy efficiency in buildings and low-carbon energy sources well beyond what is happening today.

What is implied is a nothing less than the transformation of the thermal properties and ventilation characteristics of the housing stock overall, with both low-carbon design of new dwellings and the retrofitting of substantial energy-efficiency improvements to the existing stock. Such changes will affect not only energy use but also the indoor environment with potential positive and negative impacts on human health. In this chapter we consider the nature of those changes and the implications for health and wellbeing, drawing largely on evidence for the United Kingdom.

The United Kingdom

The U.K. government has set itself a legally binding target of reducing GHG emissions by at least 80% by 2050 with 5-yearly carbon budgets also set between now and 2050 (Committee on Climate Change, 2010). In the United Kingdom the construction industry has the ability to influence over 50% of carbon dioxide emissions and residential buildings alone comprise a significant slice of emissions: over 25% (Department of Business, Information and Services [BIS], 2010). In 2009 total U.K. carbon dioxide emissions were estimated at approximately 560 Mt of CO_2 equivalents ($MtCO_2e$). Household energy use accounted for approximately 148 $MtCO_2e$ by final users (Department of Energy and Climate Change [DECC], 2012). Estimates of household emissions by end use are provided in Figure 21.1 (Hamilton et al., 2011).

This chapter will deal with interventions aimed at reducing the space heating related emissions as this accounts for approximately 53% of the dwelling-related carbon dioxide emissions, has the most direct relevance to

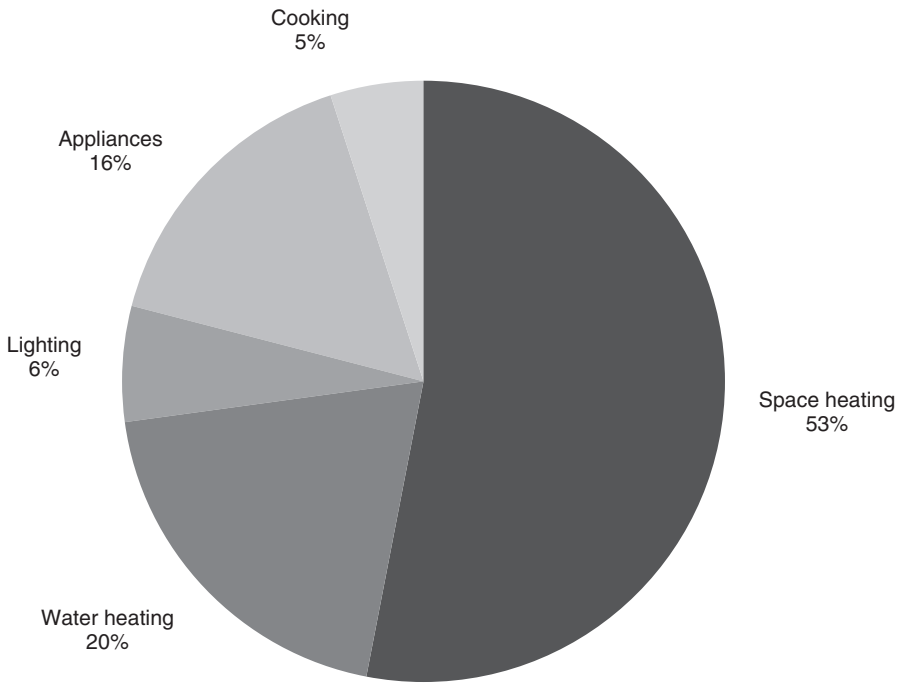

Figure 21.1. U.K. Household Emissions.

health and is a function largely of long-term changes to the building fabric (Hamilton et al., 2011).

Space-heating emissions in 2009 were estimated to be approximately 80 $MtCO_2e$ and can be broken down into three main components: fabric, ventilation, and heating-system efficiency (see Figure 21.2; Hamilton et al., 2011).

The next sections describe how the United Kingdom is planning to move towards a low-carbon housing stock. We will then discuss how such plans might impact on health.

Low-Carbon Housing

A low-carbon home requires attention to five main aspects of design and operation

- the thermal transmission characteristics of the building fabric (its walls, floors, and roof);
- the control of ventilation;

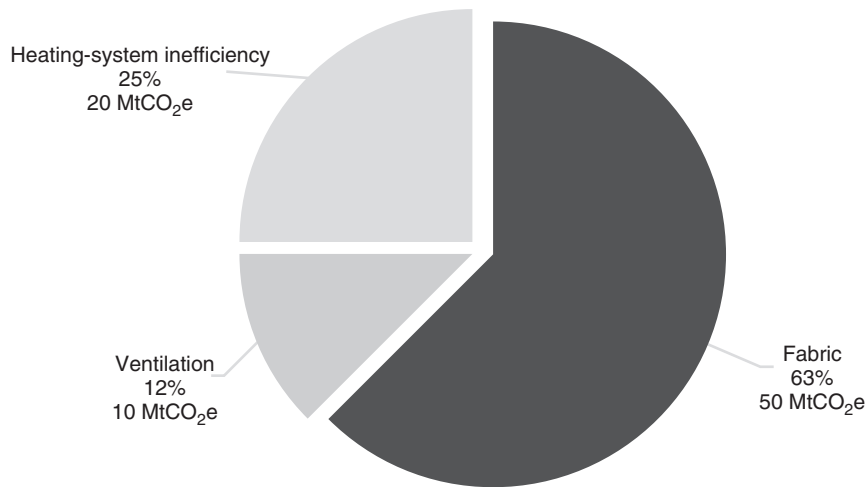

Figure 21.2. Breakdown of Space-Heating Emissions.

- the efficiency of heating and other energy-consuming devices used in the home;
- the onsite capture and utilization of energy sources (solar-, wind-, ground-, or air-source heat);
- the carbon content of supplied energy.

In general, to achieve close to zero carbon emissions requires a high level of specification in relation to each of these headings. Each of these five aspects of energy-efficient design also has potential for positive and negative impacts on human health, although, as noted, by far the greatest impacts relate to the first two—the thermal properties of the building fabric and the ventilation—because of their influence on the indoor environment. However, there is a complex interrelationship between these housing features in terms of health impacts as will be described later in the chapter.

Although new dwellings will play an important role in the decarbonization process, in most countries rates of demolition and replacement of existing housing, and the rates of new construction, are so low that the large majority of GHG emissions over the next few decades will arise from dwellings that have already been built. Residential stock turnover in the United Kingdom is just 1% per annum (Three Regions Climate Change Group, 2008), a rate that will mean that more than 60% of the approximately 27 million existing dwellings will still be standing in 2050. Thus, while having low-carbon design for new dwellings is important, transforming the energy-efficiency

characteristics of the existing stock is essential. We therefore consider both in this chapter.

New Homes

U.K. government policy has focused on the construction of new homes with "zero carbon" emissions (Boardman, 2007). Until recently, the plans for a zero-carbon requirement (as from 2016) covered emissions from both *regulated* sources (e.g., boilers and fixed lighting) and *unregulated* sources (e.g., cooking and appliances). However, the downgrading of the zero-carbon standard in the March 2011 budget now means that only regulated sources form part of the relevant policy. This is a significant change as nonregulated energy use has grown approximately 25% since 1970, of which appliance demand has increased by 88%. This compares to a 12% drop in demand of regulated (primarily space heating and hot water): see Figure 21.3.

The United Kingdom's Zero Carbon Hub is the public/private partnership that has been developing the framework within which low-carbon homes will be delivered. To comply with national (2016) Building Regulations, new homes will have to meet onsite requirements for "carbon compliance," achieved through the energy efficiency of the fabric; the

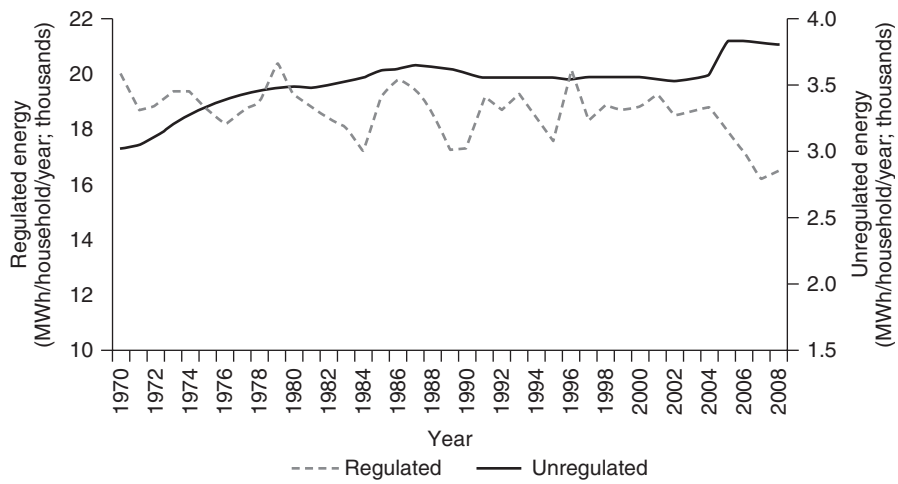

Figure 21.3. Regulated and Unregulated Energy Demands per U.K. Household. Regulated includes space heating and water; unregulated includes cooking and lighting. Adapted from Table 3.6, DECC (2010).

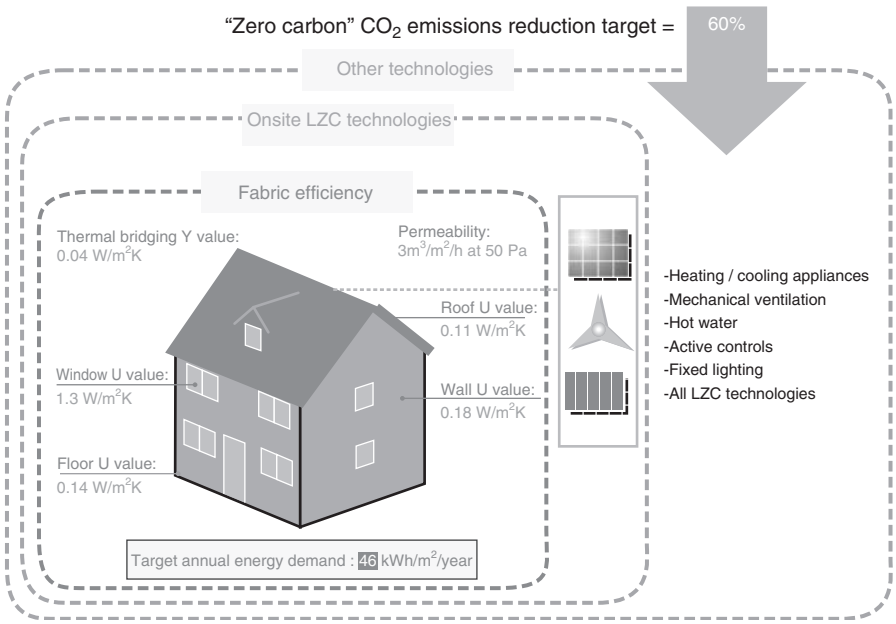

Figure 21.4. Required Performance of a Detached New "Zero-Carbon" Dwelling. LZC, low zero carbon. Adapted from Zero Carbon Hub (2009).

performance of heating, cooling, and lighting systems; and low- and zero-carbon technologies. This will vary depending on house type and ranges from 10 $kgCO_2/m^2$/year for a detached house to 14 $kgCO_2/m^2$/year for an apartment (see Figure 21.4). In addition, through "allowable solutions," the carbon emissions that are not offset on site will have to be accounted for via other means. These allowable solutions are expected to comprise a broad range of onsite, near-site, and offsite measures. Although aspects of householder health and wellbeing are acknowledged in the Zero Carbon Hub work, due to the limited understanding of the relationship between indoor air quality and associated ventilation strategies in homes with low air permeability, specific indoor air quality and ventilation targets were not set as part of the standard (Zero Carbon Hub, 2009).

Refurbishment of Existing Homes

For obvious reasons, the opportunities for achieving very low levels of carbon emissions from refurbishment of an existing dwelling are more limited than for a new build. There are often physical limitations to the

type of retrofitting that can be applied, and complexities in having to work with existing fabrics and structures that do not meet the same efficiency standards as can be achieved with modern materials and design. Despite this, it is possible to achieve target levels of reduction in carbon emissions by judicious retrofitting. Agendas that target the existing dwelling stock typically rely on a range of policy instruments that seek to incentivize, encourage, guide, and mandate changes to features of the dwelling to improve performance. These can range from voluntary improvement of appliance efficiency standards (e.g., the U.S. energy star rating scheme) to fuel taxation and mandatory building performance regulations to subsidized investment loans or grants to households (Ürge-Vorsatz, Koeppel, & Mirasgedis, 2007), with regulatory instruments being shown as among the most effective at reducing energy-related emissions.

The U.K. government has used a selection of policy instruments aimed at improving energy performance of buildings, including building regulations for new buildings, energy performance certificates on sales of new homes, grants for vulnerable households, and energy-efficiency obligations to name several. The main program to reduce carbon dioxide emissions from existing homes is the Green Deal, supported by the Energy Company Obligation (ECO). These schemes came into force in 2012 and 2013, respectively.

- The Green Deal: this scheme will provide households with upfront finance to pay for energy efficiency measures. The finance will be attached to the home and paid back through savings on energy bills.
- ECO: this obligation will replace the existing Carbon Emissions Reduction Target (CERT), Community Energy Savings Programme (CESP), and Warm Front schemes. The ECO is an obligation on energy suppliers and generators and is expected to continue to provide a package of insulation and heating improvements to low-income households, and subsidize more expensive measures, such as solid wall insulation, provided under the Green Deal.

The meeting of the U.K. GHG targets will involve a major refurbishment to close to zero carbon levels of approximately 27 million dwellings by 2050. This translates to an average refurbishment rate of more than one dwelling per minute (BIS, 2010). Meeting this target will require the rapid development of a new, large-scale, energy-efficiency refurbishment industry. This will involve an estimated expenditure of £200 billion and require the completion of the technically and economically feasible portion of:

- insulation of solid walls for 6.4 million homes;
- insulation of cavities for between 6.5 and 8.6 million homes;
- full or partial window replacement for up to 6 million homes;
- high-efficiency boilers to 15.5 million homes;
- installation and improvement of heating controls to 15 million homes;
- full or additional loft insulation in 9–13 million homes;
- general improvements in airtightness across the stock (BIS, 2010).

Although a huge investment, this approach is perceived to be one of the most cost effective decarbonization mechanisms. The marginal abatement costs (MACs)—the cost of the last unit—of carbon emission reductions associated with energy efficiency interventions are encouraging (Committee on Climate Change, 2010) (see Figure 21.5), although such MAC curves are subject to some criticism regarding transparency and assumptions (Kesicki & Ekins, 2011). Whatever the cost, it is vital that maximum value is achieved from this investment and that the same program also *adapts* the built environment appropriately for the range of projected climate change that is unavoidable.

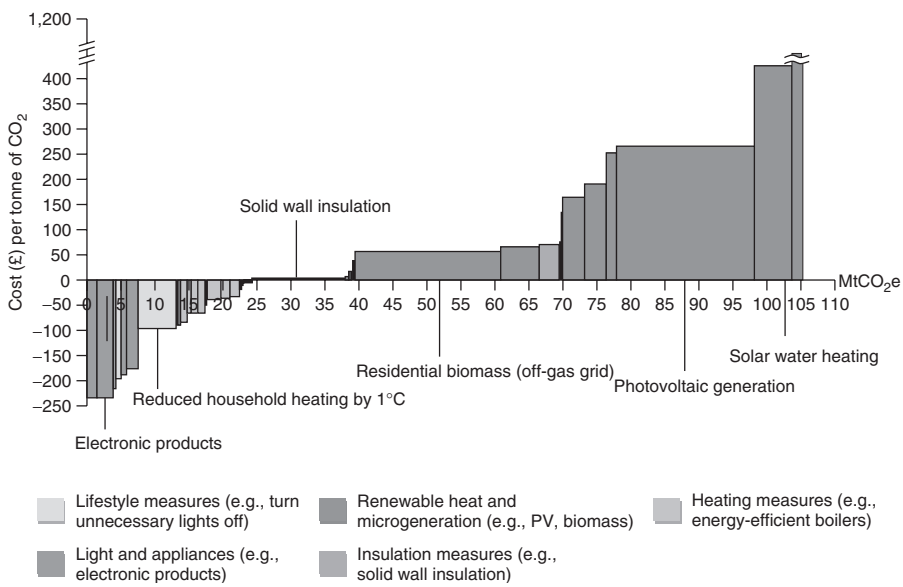

Figure 21.5. Residential-Sector MAC Curves. Shown is the technical potential in 2020 including hidden and missing costs and private discount rates and fuel prices. PV, photovoltaic. Adapted from Committee on Climate Change (2008).

Figure 21.6. Thermal Image of Passfield Drive, East London, 8.30 A.M. on January 31, 2012. Light areas show high heat loss across the terrace. Dark shows the positive effect of a Passivhaus retrofit. Courtesy of bere:architects.

As part of the effort to extend knowledge in this area, the Retrofit for the Future (R4TF) competition was launched by the U.K. Technology Strategy Board with the aim of investigating ways by which to enable the retrofitting of U.K. social housing stock to meet future targets and alleviate fuel poverty for vulnerable tenants.

One of the key projects funded by R4TF was Passfield Drive, a retrofit of a 1960s mid-terrace property led by bere:architects (see Figures 21.6 and 21.7). The basis of the design proposal was to achieve a "Passivhaus EnerPhit"-level retrofit that illustrated how improved thermal comfort, improved allergy protection and fresh air quality, reduced energy bills, and lower carbon emissions could be achieved in the social housing sector. As a high-specification "fabric-first" approach, the Passivhaus standard uses high levels of insulation and draught-proofing. Buildings designed to this standard place emphasis on the heat emitted by occupants, appliances, and solar gains from windows and require little additional energy for space heating or cooling. The retrofit strategy employed in the retrofit achieved the following improvements.

- Fabric efficiency upgrade: the U values of the building fabric elements were improved and the existing windows and doors were replaced with triple-glazed Passivhaus standard units with a U value of 0.8 W/m^2K. Given that the house was a mid-terrace property, expanded polystyrene external insulation was only installed on the front and rear elevations. Through such measures, the average fabric U value was improved from 1.76 W/m^2K to a postretrofit value of 0.13 W/m^2K. Vacuum insulation panels installed above a 4-mm protective layer of expanded polystyrene sheets were used in the floors, increasing the height of the existing concrete ground floor by 30 mm. In addition, 490 mm of mineral wool insulation was added to the attic space.

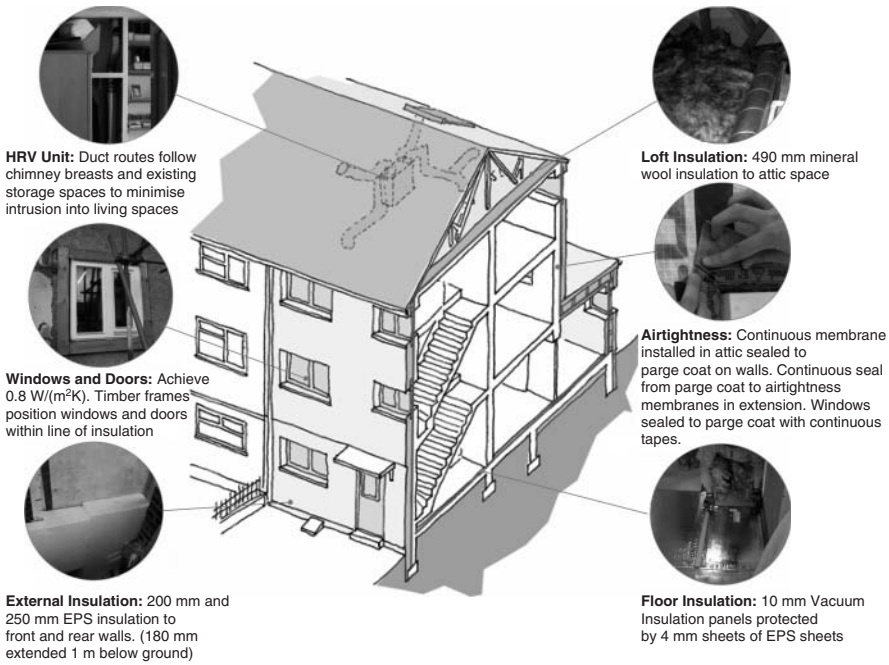

Figure 21.7. Details of the Thermal Upgrade for Passfield Drive, East London. EPS, expanded polystyrene; HRV, heat recovery and ventilation. Adapted from Gibbons (2012).

- Improved airtightness: the provision of a minimum level of airtightness is key to achieving the Passivhaus standard. Through a combination of draught-proofing and efficient ventilation systems, the airtightness was improved from 5.6 air changes per hour (ach) at 50 Pa to 1.9 ach at 50 Pa (Gibbons, 2012). Extract and fresh air was provided through a "mechanical ventilation with heat recovery" (MVHR) unit installed in the loft. The heating and cooling strategy of the house employed the MVHR system throughout the year and operable windows for summer cooling. The heating system involved the retention of the old conventional radiators and boiler. This was converted to a sealed system and the radiators were oversized to allow the running of the system on a low temperature. A solar collector backed up by a condensing gas boiler was used to provide domestic hot water.
- Additional benefits: in addition to an expected marked reduction of 90% in the winter gas heating bill, initial monitoring work also suggests benefits for summer internal temperatures. The triple glazing installed will also provide a reduction in external noise disruption (Gibbons, 2012).

Implications for the Indoor Environment

Temperature

Apart from the heating system, indoor temperatures are mainly governed by the thermal properties of the building fabric and to a lesser degree the level of ventilation. There are many factors that will determine indoor temperatures in U.K. dwellings. These factors include

- the external climate (which will vary with location in the United Kingdom);
- the external microclimate;
- dwelling morphology;
- dwelling orientation;
- room type;
- time of day;
- occupancy patterns;
- occupant behavior;
- capacity of heating system;
- occupant ability to pay for required energy;
- thermal characteristics of the building fabric.

The relative importance of these factors in determining indoor temperature will vary from dwelling to dwelling. Therefore, in addressing the impact of changes to the building fabric characteristics we must be mindful of the range of factors involved. The next two sections will provide some detail as to the implications for changes in exposure to cold and heat.

Cold.

Although improving insulation can be expected to improve indoor temperatures during periods of outdoor cold, the relationship is complicated by occupant choice. Thus, it is well known that when energy efficiency measures are introduced, total energy consumption does not fall as much as is often expected. This is in part due to the fact that when improving the energy performance of dwellings a significant element of the improvement can be taken as improved comfort (Oreszczyn, Ridley, Hong, & Wilkinson, 2006). Such "temperature take-back" has voluntary and involuntary components. The voluntary component involves conscious decisions to improve comfort, for example through interactions with heating controls (higher set points,

shorter heating-off periods); the involuntary component arises from interactions between intermittent heating and the changing dynamic behavior of the dwelling when insulated (e.g., longer cooling-time constants), and from the changing balance between heated and unheated parts of partially heated dwellings. Temperature take-back is one example of the "rebound effect," the implications of which for wider energy-efficiency measures are discussed in full by Sorrell (2007).

Temperature take-back is likely to be most significant with the fuel-poor and is a beneficial consequence (for health) of energy-efficiency improvements. It is possible to control this effect; for example, by increasing fuel prices at the same time as improving the efficiency of the stock. However, if the phasing of such measures is not aligned, significant sections of the population may move into fuel poverty. As a measure, fuel poverty has more than doubled in England over the past 8 years (Figure 21.8). Although it is not clear how efficiency measures would affect temperatures experienced in the home, there is certainly a greater potential for temperatures to increase in fuel-poor homes (Oreszczyn, Ridley, et al., 2006).

So, central to the understanding of changes in the indoor environment is the degree to which fabric (and ventilation) changes could result in increases in indoor temperature as opposed to lower energy consumption. This issue has implications for evaluating both health impacts and GHG emissions and

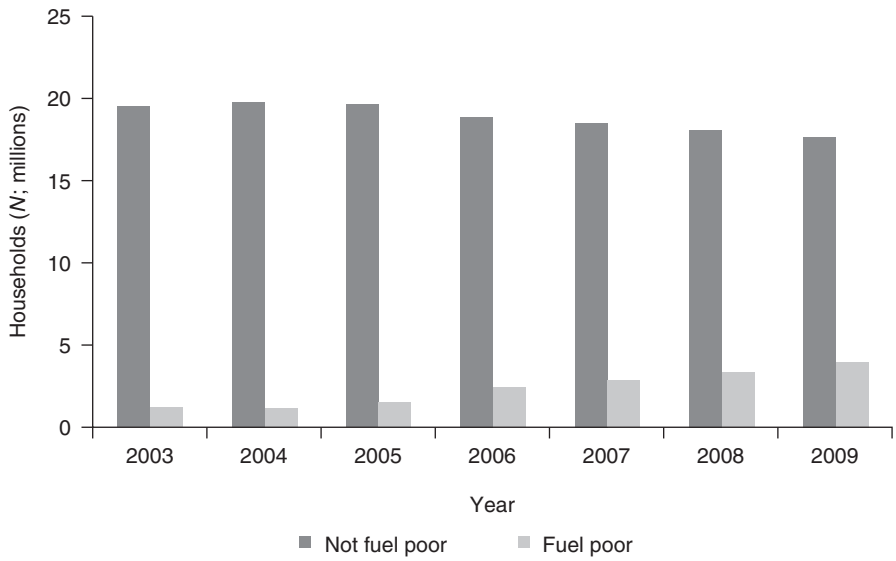

Figure 21.8. Number of Fuel-Poor Households in the United Kingdom. Adapted from DECC (2013).

we will now briefly discuss methods that have been employed for estimating this factor.

In a recent study (Hamilton et al., 2011), estimation of the temperature take-back effect was based on analysis of data from a national evaluation of the government's Warm Front domestic energy-efficiency scheme. This scheme seeks to make homes warmer, healthier, and more energy efficient by offering a package of measures to improve the heating and insulation of a dwelling for eligible low-income households. The national evaluation gathered detailed indoor-environment and energy-efficiency data from a subset of approximately 1,600 dwellings. Winter indoor temperatures and relative humidity measurements were recorded every half hour during heating periods for at least 3 weeks by use of data loggers located in the living room and main bedroom. The resulting data is one of the few sources that combines property thermal characteristics, monitored temperature, relative humidity, and mold-growth data.

The Warm Front evaluation established a relationship between dwelling heat transfer characteristics ("*E* value"[1]) and internal temperatures (standardized to an external temperature of 5 °C). Changes in temperature resulting from changes in the heat-transfer characteristics can thus be deduced.

Such an approach provides a useful indication of the scale of the temperature take-back effect. However, it is limited by reliance on one (albeit large) monitoring campaign and the inclusion of data from further large field studies will improve the reliability of the technique.

Heat.

Although the more obvious impact of energy efficiency is on protection against cold, the thermal properties of a dwelling also have implications for high summer temperatures. A recent review of the United Kingdom's preparations to adapt to climate change by the Committee on Climate Change Adaptation Sub-Committee (CCC ASC, 2010) noted the importance of designing and refurbishing properties so that they are suited to current and projected future temperatures. The review reported that U.K. buildings are already vulnerable to overheating and that this is likely to get worse as temperatures increase.

The literature describing the current knowledge as to how U.K. dwellings modify external temperatures during the cooling season is dominated by *modeling* studies. Published *measurement* data is scarce. There have been a large number of modeling studies examining the impact of projected climate change on homes, the effect of the urban heat island, and how different

building construction affects overheating (Mavrogianni et al., 2011). There are also studies on the different interventions that could be made to alleviate overheating problems. These studies have identified the key mechanisms associated with overheating at an individual building level. It has been shown that overheating risk could vary as a function of region, location within a city, construction age, dwelling type, building fabric characteristics, ventilation regime, and occupancy patterns.

- Region: current evidence suggests that the south of the United Kingdom is likely to face the largest risk of indoor overheating (Chartered Institution of Building Services Engineers [CIBSE], 2005; Peacock, Jenkins, & Kane, 2010).
- Location within a city: a recent study (Oikonomou et al., 2012) explored the relative importance of the urban heat island and building thermal quality. Although location does play a part in potential overheating, the effects of built form and other dwelling characteristics appear to be more important determinants of variation in high indoor temperatures than the location of a dwelling within London's urban heat island.
- Construction age and dwelling type: a relationship exists between dwelling construction age and overheating risk, owing to the potential correlation between age and parameters such as morphology, glazing levels, size, insulation, airtightness, etc. A common finding is that dwellings built around the 1960s and small top-floor purpose-built flats appear to be considerably more prone to overheating. This is attributed to the low solar thermal protection offered by the top floor of poorly insulated flats. In contrast, concrete ground floors were found to have a significant cooling effect. Another important issue is that not only older but also recently built dwellings will experience increased cooling loads by the 2080s. Whereas newly constructed houses are characterized by reduced heat losses and, hence, increased thermal efficiency during winter, they may not be suitably designed to cope with extreme heat events. The studies looking at which dwelling types (detached, semidetached, and terraced houses, low-rise and high-rise flats) overheat more do not always identify the same ranking because the findings depend on the way the house types are characterized and this has not been made standard.
- Building fabric characteristics: a number of studies have identified that an unintended consequence of high insulation and airtightness standards of newly built and retrofitted houses may be overheating. It has been suggested that changing the positioning of insulation—such as external

rather than internal—may minimize the risk of extreme temperatures during the summer. Generally, thermal mass coupled with night cooling through ventilation has been identified as a relatively effective measure to combat domestic overheating.

- Ventilation: as ambient temperatures are projected to increase, daytime ventilation may not be beneficial for the mitigation of overheating as the incoming air will be at a high temperature. In addition, night-purge ventilation will be effective only if the diurnal temperature variation is significant enough to flush away the heat stored in the building, However, this is likely to be reduced under current climate-change projections. Furthermore, nighttime ventilation might not be a viable solution for urban dwellings due to potential noise, security, and air-pollution concerns.
- Occupancy: recent modeling work (Porritt, Cropper, Shao, & Goodier, 2012; Porritt, Shao, Cropper, & Goodier, 2011) reviewed the effectiveness of different passive cooling strategies in existing dwellings as a function of occupancy schedules, type of room, and time of day. When the overheating assessment was carried out for a house occupied by a working couple with children at school, external wall insulation, followed by internal wall insulation, was shown to be the most effective measure for both the living room and the bedroom. In contrast, the internal wall insulation was found to increase overheating in the living room of an elderly couple with increased number of occupied hours during the daytime, as unwanted solar and internal heat gains were trapped within the building envelope. The importance of improving thermal insulation to contribute to climate-change mitigation is recognized, but it is suggested that solar and internal heat gains need to be limited to minimize the risk of overheating. Thus 'switch-off' solar protection strategies—for example, external shading and shutters—are likely to offer benefits for rooms that tend to be heavily occupied during the daytime.

Published summer thermal monitoring data from housing is rather limited owing, in part at least, to the fact that until recently overheating was not a major concern in the heating-dominated climate of the United Kingdom. However, there are several current projects gathering data, and so this position should improve.

For an individual dwelling, if sufficient data is available to characterize the thermal properties and occupant behavior it is possible to make some assessment of the vulnerability of the occupants to overheating and also make some

projections as to the impact of a range of energy-efficiency interventions. The challenge here is two-fold: firstly to develop a robust decision-analysis framework to enable the assessment of individual dwellings and secondly to ensure that adequate data is available to drive that framework. At the stock level there is much uncertainty associated with modeling inputs with regard to occupant behavior and a detailed knowledge of the thermal properties of the dwelling. Relevant monitored data is currently scarce and generally only available for small samples of the housing stock. Large-scale measurement and data-gathering campaigns are required to reduce the uncertainties associated with our current understanding of overheating at the stock level. Such work will allow the vulnerability of the overall U.K. stock to be better understood, in both its current state and a "low-carbon" future state.

Air Quality

Air quality is determined by the balance of air exchange and the sources of pollution in the outdoor and indoor environments. It is therefore affected by levels of occupancy, behavior (including the opening and closing of windows and doors), room sizes, urban or rural location, ventilation systems, and the permeability of the dwelling's shell.

Low-energy interventions that reduce uncontrolled ventilation are likely to have some impact on indoor air quality depending on the nature of the associated ventilation systems and the ventilation levels achieved. Different systems are likely to have different impacts. The overall level of air exchange in the dwelling is determined by purpose provided ventilation and the level of uncontrolled infiltration (the leakiness of the dwelling).

In the United Kingdom, purpose-provided ventilation is of three main types

- extract ventilation (by fans) from rooms where typically there are the most significant emissions of pollutants; that is, kitchens and bathrooms. Such an approach reduces pollutant concentrations in these zones but also reduces their spread to the rest of the dwelling. Such extract ventilation may be either intermittent or continuous–for dwellings it is common to use intermittent extract fans;
- continuous whole-dwelling ventilation to dilute and disperse residual pollutants not fully dealt with in the zones targeted by extract ventilation and remove pollutants which are released elsewhere in the dwelling. For dwellings it is common to use trickle ventilators for whole-dwelling ventilation;

- intermittent purge ventilation throughout the dwelling to aid removal of high concentrations of pollutants released from occasional activities such as painting or accidental releases such as smoke from burnt food. For dwellings it is common to use windows for purge ventilation.

There is increasing uptake of the use of MVHR which combines the extract and continuous whole-dwelling functions.

Uncontrolled infiltration is the result of gaps in the building fabric through which air may enter and leave. A measure of this leakiness is represented by the dwelling permeability test which is based on the measured rate of airflow from the dwelling when controlled positive pressure is applied using a door blower. Published test results on *existing* houses in the United Kingdom are limited: the most extensive set (Stephen, 2000) indicates that the United Kingdom stock has an average permeability (at 50 Pa) of approximately 13 $m^3/m^2/h$. It is very difficult, in a general manner, to translate a permeability to an average air change rate under normal operating pressures. However, the consensus is that the existing U.K. dwelling stock is excessively "leaky."

Ventilation heat losses are directly proportional to the dwelling air-change rate. The current agenda is to minimize air change rates to reduce energy loss and carbon emissions. The infiltration component of ventilation is thus normally targeted in an attempt to reduce this uncontrolled source of heat loss. When this is infiltration is reduced below an "acceptable" level, purpose-provided ventilation systems should be installed to ensure that a minimum rate of ventilation is achieved. Airtightness measures to limit infiltration are covered in Part L of the Building Regulations and its supporting approved documents. Part L1A (HM Government, 2010b) now requires a maximum permeability for new dwellings of 10 $m^3/m^2/h$. There is evidence that dwellings are now being built that are much tighter than this (Pan, 2010).

Approved document F (HM Government, 2010a) recommends methods of achieving "sufficient" ventilation, allowing for a reasonably high level of airtightness. However, it is very complex to determine what such a minimum air change rate should be. When indoor air is polluted, too little ventilation may be insufficient to remove pollutants from indoor sources; but too much, without modification, impairs the effectiveness of the indoor environment to provide protection against "outdoor pollution".

The consequence of simply reducing *infiltration* is protection against pollutants of outdoor origin, most notably fine particle fractions such as PM_{10} and $PM_{2.5}$ (particles of maximum aerodynamic diameter 10 and 2.5 μm

respectively). Although there is still steady ingress of particles through gaps around doors and windows and in ceilings and floors, if the rate of infiltration is low the natural deposition results in a substantial difference in outdoor and indoor concentrations. Thus, tightening of the dwelling to reduce adventitious air exchange helps to reduce exposure to particles and other outdoor pollutants especially in urban settings or locations with high traffic volumes or near industrial sources where outdoor concentrations are high.

On the other hand, reduced infiltration contributes to the buildup of pollutants of indoor origin. These pollutants include particle fractions and other pollutants (e.g., nitrogen dioxide, carbon monoxide) derived from cooking and combustion processes as well as ordinary household dust and abrasion products, second-hand tobacco smoke in homes with one or more smokers, radon gas (particularly in areas with suitable geology), volatile organic compounds derived from construction materials and furnishings, household chemical agents, and biological compounds and spores derived from mold growth. The balance of the positive and negative health consequences of alterations to ventilation rates when also considering purpose-provided ventilation systems is complex and depends on multiple factors including local environmental conditions, occupant behavior, and emission levels from specific sources.

Impacts on health

The energy-efficiency measures described here that alter ventilation and the thermal transmission characteristics of the dwelling fabric influence health through a variety of pathways (Figure 21.9). These pathways may be considered under four headings.

Consequences of Alterations to the Ventilation Characteristics of the Dwelling

The epidemiological evidence for adverse health effects from exposure to fine particle fractions (PM_{10} and $PM_{2.5}$) is very well established but largely comes from studies in which population exposure to particle pollution is defined on the basis of measurements at outdoor monitoring sites ("outdoor pollution epidemiology"). Risk estimates from semiecological cohort studies suggest a long-term increase in all-cause mortality of the order of 6% for each 10 $\mu g/m^3$ increase in annual average outdoor $PM_{2.5}$ levels (Pope et al., 2002). Such a change in annual average outdoor levels would usually result in

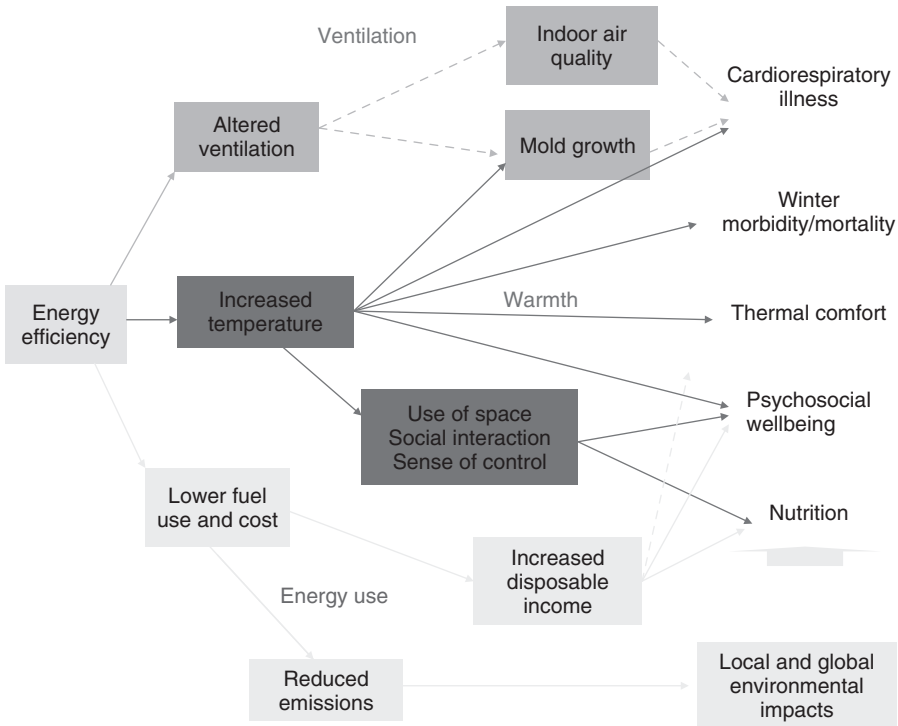

Figure 21.9. Connections Between the Built Indoor Environment and Health. Adapted from Wilkinson et al. (2009).

a smaller change in personal exposure because of the time spent indoors where concentrations of particles *of outdoor origin* are lower than outside. If it is overall personal exposure to $PM_{2.5}$ of outdoor origin that determines risk, then reduction of ventilation rates from energy-efficiency measures can be expected to reduce particle-related health impacts by increasing the differential in concentrations between outdoor and indoor environments.

However, what is unclear is whether particles of indoor origin are similarly toxic to those found in the outdoor air. If they are, reduced air exchange which leads to an increase in concentrations of particles of indoor origin (e.g., from cooking, combustion processes, etc.) would be expected to increase adverse health risks. Modeling studies suggest potentially substantial effects from energy efficiency measures on both the ingress of outdoor particles and the buildup of particles of indoor origin, which makes quantification of the overall health impact problematic given uncertainty over the relative toxicity of particles of different sources. In urban areas with appreciable particle

pollution, increased airtightness of the dwelling should offer quantifiable protection against the effects of outdoor particles, but the degree to which this may be offset or even exceeded by the increase in concentration of particles from indoor sources depends on behaviors, the toxicity of particles of indoor origin, and whether extraction devices may help reduce exposure from key particle sources such as during cooking.

One source of particles for which there is little uncertainty over its toxicity is that of second-hand tobacco smoke. The evidence is clear that exposure to second-hand tobacco smoke has adverse consequences on cardiovascular and selected other health outcomes, including child health, and it is this evidence that led many countries to introduce legislation to prohibit smoking in public places. What such legislation does not prohibit, however, is smoking in the home. If smokers continue to smoke in the home without taking steps to vent cigarette smoke outside, for example by sitting near an open window, then ambient levels inside the home will rise if there is greater airtightness and so likely increase the adverse health consequences for other (nonsmoking) family members, including children. Although smoking behavior is a choice, the effect of building design has a direct bearing on a potentially important "involuntary" exposure of household members who share a home with a smoker.

Exposure to radon in the home is primarily determined by local geology as well as certain characteristics of dwelling and occupant behavior. The risks to health are well understood and quantified, especially for lung cancer (Darby et al., 2005). The United Kingdom action level of 200 Bq/m^3 corresponds to an estimated lifetime risk of lung cancer of around 3%. Where high indoor radon levels are identified cost-effective remedial actions can be taken, and measures implementable with new-build dwellings can substantially lower exposures (Gray, Read, McGale, & Darby, 2009). However, a concern must be that if stringent energy-efficiency measures are applied across existing housing stock through an ambitious program of retrofitting then this may lead to a small but significant increase in population average radon levels with corresponding negative effects on health. The population burden of radon-related lung cancer lies not just in those people living in dwellings at above the action level, but also in the far greater number of people living in dwellings at lower levels of indoor radon that are insufficient to merit specific remedial action.

The health risks associated with many other pollutants of indoor origin, including volatile organic compounds and chemical and biological agents, remain uncertain (World Health Organization, 2010). However, safety

concerns have been raised for many such agents and if energy efficiency is in part achieved with lower ventilation then exposures may again rise. Problems with dampness and mold have a complex relationship with ventilation. With other conditions held constant, reduced ventilation would lead to higher risk of mold growth, but as part of energy-efficiency measures there may also be increased indoor temperatures which tend to lower mold growth by reducing relative humidity.

Evidence from programs such as the Warm Front scheme suggests that energy-efficiency improvements reduce the prevalence of significant mold growth (Oreszczyn, Hong, Ridley, & Wilkinson, 2006), although that particular empirical evidence derives from a study in which energy-efficiency interventions led to little overall change in dwelling permeability or ventilation. Whether the balance of ventilation effects and indoor temperature changes results in more or less mold growth depends on the circumstances. What is known from the epidemiological literature is that mold growth is associated with poorer respiratory and general health, especially among children, and this form of impact may be relatively common.

Consequences of Changes to the Thermal Characteristics of the Dwelling and Indoor Temperature

In the United Kingdom there is a very large annual burden of cold-related mortality and morbidity, which is larger than in many neighbouring countries of continental Europe and Scandinavia (Wilkinson et al., 2004). Although there is much debate on the relative contribution of exposure to cold in the outdoor and indoor environments there are many reasons to presume that inadequate home heating is a factor in vulnerability during periods of low outdoor temperature.

There is now a growing body of literature of the benefits of home energy efficiency and improved home heating on wellbeing, especially in relation to thermal comfort, social interaction, and mental health impacts (Hills, 2012). Surprisingly, however, there is only very limited evidence in relation to "hard" health outcomes such as mortality and hospital admission (Osman et al., 2007, 2010; Wilkinson, Landon, Armstrong, Stevenson, & McKee, 2001). The evidence which does exist is fully consistent with energy efficiency and indoor temperatures modifying the adverse effects on health of low *outdoor* temperatures. However, precise quantification of the impact of energy efficiency on cold-related mortality morbidity is difficult in part because of the paucity of available evidence and the uncertainty over the

degree to which cold-related risks arise from exposures inside the home as opposed to in other settings, and the fact that only a fraction of improved energy efficiency is taken as higher indoor temperatures rather than reduced fuel costs.

The evidence in relation to the adverse consequences for health of exposure to high ambient temperatures inside the home is still more complex. Although the relationship between high outdoor temperature and mortality is very well established (Armstrong et al., 2009), it is unclear how this relates to temperature exposure inside the home.

Theoretical arguments would suggest that a well-controlled indoor temperature would be highly protective against high outdoor temperatures, and indeed there is evidence for substantial protective effect from air conditioning (Kovats & Hajat, 2008; O'Neill, Zanobetti, & Schwartz, 2005). There is also physiological evidence about thermal comfort and the capacity for work in environments at different temperatures (Parsons, 2003). However, there remains only a very limited and indirect basis for quantifying the potential modification of outdoor heat risk by dwelling characteristics (Vandentorren et al., 2006). On the whole, improved energy efficiency is likely to reduce indoor temperatures during heatwaves (Mavrogianni, Wilkinson, Davies, Biddulph, & Oikonomou, et al., 2012), but not in all circumstances, and the degree of impact may vary with the nature and duration of the period of high temperatures.

Consequences of Changes in Fuel Use and Cost, Including Fuel Poverty

Improved energy efficiency also in theory reduces the need for fuel use and hence cost. Although the evidence is sketchy, this may have an effect on health additional to any direct influence on the adequacy of home heating (Hills, 2012). For low-income families, fuel expenditure is a substantial part of the overall household budget. If fuel costs are high, households may compromise on heating to save money, with consequential direct impacts on health from winter cold as briefly outlined in the previous section. However, also important may be effects on other areas of household expenditure such as the affordability of a healthy diet and resources for physical activity and for social activities that may also be essential for mental wellbeing. There is very little direct evidence to quantify how these influences on health are affected by the affordability of energy for home heating and cooking, but they are likely to be appreciable.

Consequences of Reduction in Emission of Toxic Atmospheric Pollutants and GHGs

A final set of pathways for health relates to the emissions to the outdoor environment both of pollutants toxic to health (particles, nitrogen oxides, and other combustion products) and GHGs. The contribution of household sources to ambient air quality varies by setting but is often appreciable, and reduced combustion of fuels or their cleaner more efficient combustion is therefore likely to have some beneficial impact on population levels of exposure to air pollutants. The effect on health of reducing GHG emissions from household sources is, of course, very difficult to estimate because of the long chain of causation, the substantial time lag for the evolution of climate-change-related health effects, and the multiple assumptions and uncertainties entailed. Nonetheless, a crucial motivation for improving home energy efficiency is climate-change mitigation, and key among many of the negative effects of climate change are those on population health. Thus, although the indirect impacts on health of climate-change mitigation of low-carbon homes may not be reliably quantified, this is an important route that contributes to the justification for accelerating low-carbon interventions in the housing sector.

Discussion

It is now widely accepted that GHG emissions of buildings, including housing, need to be dramatically reduced in high-income countries such as the United Kingdom to achieve climate-change-mitigation targets. Decarbonization strategies will entail major changes to the housing stock, with consequential effects on exposure to cold, heat, and a range of indoor pollutants. Some of these changes (e.g., reduced exposure to cold) will have positive health impacts whereas others (e.g., increased exposure to radon) have the potential for negative health impacts.

Improving our understanding of the relationship between energy efficiency changes to the housing stock and health is important to maximize potential health benefits and minimize the potential harms of housing strategies aimed at GHG emissions reduction. Given the potential trade-offs for health of reducing ventilation, one important question is whether there is an appropriate minimum level of air exchange that protects health. In the United Kingdom, approved document F specifies minimum airflows for

dwellings and a set of prescribed systems which are deemed to be capable of achieving a set of performance-based guidelines. These airflow rates and the prescribed systems were developed via the use of performance criteria for only a limited range of pollutants. A question then is whether consideration of additional pollutants would significantly impact on the recommended airflow rates. Indeed, in general, how should the complex and potentially competing requirements of reducing ventilation related energy demand and the health of the occupants be best addressed?

Without such knowledge, changes to ventilation systems may pose significant risk to population health if not implemented correctly. For example, the very large-scale installation of MVHR systems in the United Kingdom, coupled with the very high degree of dwelling airtightness that is required for the effective use of such systems, may be cause for concern if the systems are installed incorrectly, maintained incorrectly, or used incorrectly.

We have seen that current U.K. carbon emissions are approximately 560 $MtCO_2e$ and that of this, approximately 13 $MtCO_2e$ is related to ventilation in dwellings. So, a policy that targets such ventilation-related emissions will have uncertain impact on public health and the potential of only reducing overall U.K. emissions by approximately 2% (and most likely substantially less). So, we must carefully evaluate the implications of decarbonization policies and be mindful of the potential negative unintended consequences that could arise. However, we must also take opportunities to maximize the *cobenefits* of the decarbonization of the housing stock.

Note

1. E value is the required energy consumption by the principal heating device to maintain a 1°C temperature difference between outside and inside during steady-state conditions ignoring incidental gains and ventilation heat losses. E value $= (\sum U_i A_i)/\mu$, where U_i is the heat loss per square meter of surface area per degree Kelvin temperature difference between inside and outside (W/m^2K) for the ith building element, A_i is its surface area, and μ the efficiency of the main heating device for the dwelling.

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Cobenefits of Insulating Houses

Research Evidence and Policy Implications

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Introduction

In developed countries we spend most of our time indoors and most of that time is spent inside our homes (Baker, Keall, Lyn Au, & Howden-Chapman, 2007), so the quality of the indoor environment is crucial to occupants' health and wellbeing (World Health Organization Regional Office for Europe, 2009). Moreover, indoor air is only a chimney, an open window, or a door away from being outdoor air, so the quality of indoor air matters, both for outdoor air and the climate in general.

The design and maintenance of homes is a key factor in determining the wellbeing of the occupants, both inside and outside their homes. Most existing housing has not been built under modern building code standards, which, in any case, vary considerably across the developed world, so retrofitting insulation in existing housing is an important policy to improve health and wellbeing.

In this chapter we look at the growing international evidence that insulating houses improves health and wellbeing, as well as having many cobenefits, including reducing fuel poverty, increasing energy efficiency, mitigating climate change, and providing employment. We also analyze the different

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frameworks that have been used to justify insulation policies and summarize the outcomes of several large-scale programs.

Review of Evidence about Impacts of Insulation

The general link between housing and health is well known, but the exact nature of the complex causal relationship has been less clear (Lawrence, 1993, 1995, 2005). Given, the difficulty of implementing community-based housing intervention trials to establish clear causal connections (Krieger et al., 2002) it is not surprising that at the turn of the century relatively few intervention studies had rigorously examined the health effects of housing improvements (Krieger et al., 2002; Thomson, Petticrew, & Morrison, 2001). The Watcombe Housing Study in Cornwall, United Kingdom, randomized 119 houses to a retrofit, which included insulation or a waiting list (Barton, Basham, Foy, Buckingham, & Somerville, 2007; Mackenzie & Somerville, 2000; Sommerville et al., 2002). Although the sample was relatively small, the number of occupants fluctuated, and the period of following the households varied between 6 and 9 months, the study showed that houses in the intervention group were more energy efficient and there was significant improvement in self-reported respiratory conditions in adults in the intervention group, but not children. There were no other significant differences (Barton et al., 2007).

A major systematic review in 2009 highlighted that considerable progress has been made in the gathering of robust evidence and retrofitting insulation is the housing improvement that has been most intensively researched (Thomson, Thomas, Sellstrom, & Petticrew, 2009). Several prospective controlled studies have demonstrated the significant effects of improving the thermal quality of housing; for example, through upgrading cold, damp flats to be comfortably warm and dry self-measured general health and independent measures such as blood pressure improved (Lloyd, McCormack, McKeever, & Syme, 2008). A considerable number of retrospective controlled studies, such as those carried out by the English Warm Front Group, were also identified and were focused primarily on retrofitting (Barton et al., 2007; Critchley, Gilbertson, Grimsley, & Green, 2007). As well, in the last two decades there have been a number of modeling studies demonstrating the economic value of improved insulation driven by predicted energy savings and the positive impacts of insulation on health and wellbeing (Levy, Nishioka, & Spengler, 2003). But, however promising and

interesting these results, modeling studies tend not to take into account adequately all the factors that can render real-world results equivocal and nonrandomized designs do not enable causal conclusions to be drawn about the effects of insulation on health and wellbeing, because they cannot control for confounding, for example variations in temperature from winter to winter.

A series of community trials conducted in New Zealand has established the causal connection between retrofitting insulation in existing houses and improved health and wellbeing. Several of these studies have had concurrent qualitative studies to increase understanding of the underlying causal mechanisms. For over a decade the He Kainga Oranga/Housing and Health Research Programme, which draws on researchers from a variety of disciplines (social scientists, public health specialists, economists, engineers, physicists, and mycologists) has carried out research in partnership with local communities. Strong community partnerships are an essential building block for improving housing sustainability (Israel, Schulz, Parker, & Becker, 1998), and the partnership approach has led to participant retention rates of over 80% in these studies (Howden-Chapman et al., 2005).

The Housing, Insulation and Health Study

The initial community trial, entitled the Housing, Insulation and Health Study, built on a preexisting policy being implemented by a New Zealand Government energy efficiency agency with a single objective of reducing electricity consumption. Following considerable previous research which had established that older people's health suffered from being in cold houses (Howden-Chapman, Signal, & Crane, 1999; Keatinge, Coleshaw, & Holmes, 1989; Keatinge et al., 1997; Wilkinson et al., 2001, 2004), the decision was made to work with local communities to carry out a staggered, randomized community trial to look at the combined health and energy efficiency effects of retrofitting insulation to bring older houses up to the current Building Code (Howden-Chapman et al., 2005).

In seven communities in New Zealand, community health organizations identified 1,350 households in which there was at least one occupant with a chronic respiratory condition, who agreed to participate in the Housing, Insulation and Health Study (Howden-Chapman et al., 2007). These households contained 4,407 people, who were monitored over two successive winters (2001–2002). The intervention group received the retrofitted

insulation *before* the second winter and for equity reasons the control group houses were insulated *after* the second winter, when the follow-up data collection was completed. Self-report measures as well as independent measures of outcome for the winter months were obtained wherever possible, including general practitioner visits (collected via electronic linkage to general practice databases and hospitalization records using a patient identifier number) and power bills obtained from the electricity and gas companies (using the customer reference number).

Insulation was associated with a small increase in bedroom temperatures during the winter (0.5°C) and decreased relative humidity (2.3% reduction), despite energy consumption in insulated houses being 81% of that in uninsulated houses. Bedroom temperatures were below 10°C for 1.7 fewer hours each day in insulated homes than in uninsulated ones. These changes were associated with reduced odds in the insulated homes of fair or poor self-rated health [adjusted odds ratio 0.50; 95% confidence interval (CI) 0.38–0.68], self-reports of wheezing in the past 3 months (0.57; 0.47–0.70), self-reports of children taking a day off school (0.49; 0.31–0.80), and self-reports of adults taking a day off work (0.62; 95% 0.46–0.83). Visits to general practitioners were reported less often by occupants of insulated homes (0.73; 0.62–0.87). Hospital admissions for respiratory conditions were also reduced (0.53; 0.22–1.29), but this reduction was not statistically significant ($p = .16$) (Howden-Chapman et al., 2007).

This study showed that retrofitting insulation in houses where there were occupants with chronic respiratory problems significantly improved health, increased wellbeing, lowered energy consumption, and showed a trend in reduced hospitalization (Howden-Chapman et al., 2007), as well as reducing residential mobility (Viggers & Howden-Chapman, 2006). Moreover, the economic benefits of retrofitting insulation in these houses were estimated to exceed the costs, with a benefit/cost ratio approaching 2 : 1 (Chapman, Howden-Chapman, Viggers, O'Dea, & Kennedy, 2009).

Generalizing from a Community Trial to the General Population

The Housing, Insulation and Health Study showed that retrofitting insulation into existing older houses improved the health and wellbeing of households where occupants had respiratory problems. But, as with the

results of any community trial, the question that then arose was whether these results could be generalized to the general population, who were not selected to be part of a study because they had respiratory problems and lived in low-income households. Indeed, could the results be generalized to another country with a different climate?

An opportunity to look at an external generalization of a targeted program came with the evaluation of the Warm Up New Zealand: Heat Smart program, a population-level program. In response to the 2008 financial crisis, the New Zealand Government made a substantial budgetary allocation for the part funding of residential insulation and heating retrofits. The program was available for both low- and high-income households, unlike previous schemes, and offered funding for a range of improvements including floor and ceiling insulation, draught-proofing, and improved heating.

In 2011 researchers carried out a quasiexperimental evaluation of the first 46,655 houses that received funding under the program and compared the hospitalization, mortality, and pharmaceutical-use outcomes of the occupants of the retrofitted houses with those of the occupants of up to 10 control houses matched on location, age, and physical characteristics. Encouragingly, this Warm Up evaluation found similar results to the Housing, Insulation and Health Study. The anonymized Warm Up study design did not allow assessment of changes in general practitioner visits, or days off work, unlike the Housing, Insulation and Health Study. However, because the cohort studied was now almost 1 million people (in intervention or control houses) the study had much greater statistical power to assess the impact of insulation and heating on rare outcomes such as respiratory hospitalization and mortality, allowing researchers to be in a position to robustly assess the trend to reduced hospitalization rates observed in the Housing, Insulation and Health Study.

The results of the initial evaluation were broadly consistent with predictions. While receiving treatment under the program did not lead to a statistically significant reduction in hospitalization rates for individuals, there was a statistically significant reduction in hospitalization *costs* aggregated at the household level (indicating a reduction in the severity of illness measured in hospitalization time and cost of procedures), for total, respiratory, and circulatory system-related hospitalization costs for households that received floor and/or ceiling insulation under the program. Consistent with theory, these savings were driven by reductions in hospitalization costs for low-income households.

The evaluation found small, but highly statistically significant, reductions in pharmaceutical costs aggregated at the household level as a result of receiving insulation under the program. In addition, a separate analysis of anonymized household energy use provided by energy companies found that receiving an insulation retrofit under the program resulted in a 0.96% reduction in average annual household electricity use and a 0.66% reduction in average annual total metered energy use (Grimes et al., 2011). These energy use reductions, though small, were again statistically significant. Finally, an analysis of mortality rates for vulnerable subgroups found a statistically significant reduction in mortality rates for participants who received treatment under the program, were aged 65 and over and who had had a circulatory system related hospitalization in the period prior to treatment.

A further evaluation, which collected an additional year of hospitalization data and mortality data for the cohort, did not replicate the reductions in hospitalization costs observed in the initial evaluation; however, it confirmed the reductions in mortality rate described above (Preval, 2012). The reason for the inconsistency with regard to the hospitalization cost findings is unclear and is being further explored.

When reductions in energy costs, hospitalization costs, and pharmaceutical costs were initially combined with an estimate of the value of the life years gained from reduced mortality an overall cost–benefit analysis suggested that the program had sizeable net benefits in discounted present value terms, with benefits being almost four times as great as the costs of the program. The program was estimated to have produced benefits of NZ$1.28 billion compared with resource costs of $0.33 billion, a net benefit of $0.95 billion, and a benefit/cost ratio of 3.9 : 1 (Grimes et al., 2011). When this result was adjusted to take account of the most recent analysis, which found no statistically significant change in hospitalization costs, the benefit/cost ratio was reduced to 3.65 : 1 (Preval, 2012). The relatively small reduction in benefit reflects the fact that reductions in mortality found in both studies made up the majority of the benefit of the intervention in dollar terms.

The positive health outcomes found in the evaluation of the Warm Up New Zealand: Heat Smart program, while they do not directly confirm the results of the Housing, Insulation and Health Study, appear largely consistent with them. It is reasonable to suggest that reductions in pharmaceutical use costs and mortality observed are also likely markers for reductions in general practitioner visits, days off work, and the improvements in respiratory health found in the previous insulation study.

Fuel Poverty

The benefits of retrofitting insulation in existing houses on occupants' health and life expectancy have now been clearly shown, particularly for low-income households. This research has also highlighted the underlying problem of fuel poverty: currently defined as the need for households to spend more than 10% of their income on energy to enable them to live at indoor temperatures between 18 and 21°C, as recommended by the World Health Organization (Boardman, 2010).

With oil prices predicted to continue rising and to increase in volatility, insulation programs are being framed increasingly as low-income weatherization programs for mitigating fuel poverty (International Energy Agency, 2011). Many International Energy Agency member countries are pursuing such programs primarily to reduce the energy bills of low-income households, while recognizing that the energy-saving benefits alone provide a relatively modest return for the energy-efficiency investment required. However, when these programs are framed as having a range of societal cobenefits such as climate-change mitigation, and reducing property maintenance costs for owners, in addition to direct health benefits for household occupants and local communities, the broad value of these programs has become more evident. These nonenergy cobenefits are not currently considered in many program evaluations, but when they are included they provide a more complete picture of the impact of low-income weatherization/insulation programs.

In addition to insulation, another policy commonly proposed as offering fuel poverty alleviation benefits is improved residential heating. The following section presents the results of another randomized community trial carried out in New Zealand, designed to improve the health of children with asthma, by addressing fuel poverty through installing more sustainable, effective heaters.

The Housing, Heating and Health Study

After the Housing, Insulation and Health Study had established the causal relationship between retrofitted insulation and occupants' health, a subsequent trial, the Housing, Heating and Health Study, was conducted. This study showed that if, after retrofitting insulation, more effective heating was installed, children's health and wellbeing was further improved.

Despite the positive results of the Housing, Insulation and Health Study which included a temperature increase and drop in relative humidity, the retrofitted insulation still did not bring the indoor temperature up to the World Health Organization recommended levels. The Housing, Heating and Health Study supplemented this "passive" feature with the addition of effective heating and concentrated on vulnerable children. The study was designed to try to address a particularly prevalent health problem in New Zealand, as well as addressing issues of energy efficiency and sustainability. For largely unknown reasons, a third of New Zealand children have asthma symptoms, still one of the highest recorded rates in the world (Asher et al., 2006), and asthma is the second most common cause for childhood hospital admission (Asher and Byrnes, 2006). Apart from the extreme events leading to hospitalization, children with asthma are likely to have more days off school than other children, with adverse effects on their education (Taras & Potts-Datema, 2005), aside from their caregivers having to take significant time off work (Laforest et al., 2004).

We do know that asthma symptoms can be triggered by aspects of the indoor environment, such as cold, damp, mold, and pollutants, as well as combustion by-products from heating (Strachan, 2000). The indoor environment is poorly regulated in New Zealand; for example, a third of households own unflued gas heaters (Statistics New Zealand, 2007), legal in New Zealand but not in other jurisdictions. Unflued gas heaters emit nitrogen dioxide and other gases and particulates, all of which can inflame the lining of the lungs and increase the severity of respiratory viral infections (Chauhan et al., 2003). The Housing, Heating and Health Study was designed to establish whether, in addition to retrofitting insulation, installing nonpolluting, more effective home heating reduced children's asthma symptoms over the winter period as well as increasing the energy efficiency of houses and thereby lowering fuel poverty.

A randomized community trial of 409 households was conducted in five communities. The inclusion criteria were a 6–12-year-old child, with doctor-diagnosed asthma, living in a household where the main form of heating was a plug-in electric heater or an unflued gas heater (Howden-Chapman et al., 2008). Two thirds of the houses in the insulation and control groups required insulation before baseline measurements were taken, at a cost of NZ$2,500. Community partners helped set up community meetings with participants to discuss the pros and cons of the three replacement heater types available for installation (heat pumps, wood pellet burners, or flued gas heaters) and a report on heater types was placed on the research group's

website (http://www.healthyhousing.org.nz). All homeowners chose from a range of effective heaters that produced minimal indoor or outdoor emissions to replace their existing 2 kW electric heaters or portable unflued gas heaters and landlords were encouraged to consider their tenants' heater preferences. Following the winter in which baseline measures were taken, low-emission heaters capable of generating at least 6 kW thermal output were installed by contractors in the intervention households before the beginning of the follow-up winter period of 2006. All control households received the heater of their choice when the follow-up measurements were completed.

A broad range of data was collected from households, which were again supplemented by independent hourly measures of temperature and relative humidity, as well as measures of nitrogen dioxide. The children kept daily diaries with twice-daily recordings of their lung function (PEFR and FEV_1[1]) as well as making note of their respiratory symptoms and any medication they took. Again, independent measures of outcome for the winter months were obtained and included records of school attendance measured in half days.

Results from the Heating Study showed that indoor temperatures increased by 1.1°C in the living room ($t = 5.63$; $p < .001$) and 0.53°C in the bedroom of the child with asthma ($t = 2.87$; $p = 0.002$). Exposure to low temperatures (hours per day, weighted by number of degrees less than 10°C) was about 50% less in the intervention compared to the control group in both the living room ($t = 4.67$; $p < .001$) and the child's bedroom ($t = 4.94$; $p < .001$). The levels of indoor nitrogen dioxide reduced by half (Gillespie-Bennett et al., 2008). Parents of children in the intervention group reported less poor health (adjusted odds ratio 0.44; 95% CI 0.28–0.70; $p < .001$) and subsequently lower levels of asthma symptoms than children in the control group. Sleep disturbance by wheeze (0.51; 0.32–0.81; $p = .005$) and dry cough (0.50; 0.31–0.82; $p = 0.01$) were also reduced. Daily diaries showed reduced lower respiratory symptoms ($p = .01$), less coughing at night ($p = .003$), and less reliever use in the morning ($p = .05$). School records showed that the children in the intervention group had 1.8 days less off school during the 50 days of the winter term (95% CI 0.11–3.13; $p = .04$) (Free, Howden-Chapman, Pierse, & Viggers, 2010); and fewer visits to general practitioners (0.13; 0.05–0.20; $p = .005$) and pharmacists (0.06; 0.03–0.07; $p = 0.007$). There was no difference in lung function between the intervention and

control group, but the difference in FEV_1 was significant after controlling for nitrogen dioxide levels in the home.

The results of the Housing, Heating and Health Study reinforce earlier research indicating that higher indoor temperatures caused by improved heating reduce asthma symptoms (Sommerville et al., 2002) and builds on the results of the Housing, Insulation and Health Study which found that higher temperatures improve health status and respiratory symptoms (Howden-Chapman et al., 2007). After controlling for a wide range of confounding factors, the results show a significant impact of less polluting, more effective heating on children's self-reported asthma symptom severity.

Although only half the houses in each group had unflued gas heaters, the halving of mean nitrogen dioxide in the intervention group suggests a dual beneficial effect of the new heaters: raising indoor temperatures and reducing nitrogen dioxide levels. Analyses indicate that, when controlling for nitrogen dioxide levels, installation of new heaters led to significant increases in FEV_1 measures of lung function in the children with asthma (Gillespie-Bennett, Pierse, Wickens, Crane, & Howden-Chapman, 2011). Moreover, changes in children's bedroom temperatures were more important than changes in the living room temperatures. The effects were greatest when children were exposed to very cold temperatures of less than 12°C; a decrease in lung function was still detectable 2 weeks after exposure (Pierse et al., 2013).

The capital cost of the study intervention was again not borne by the participants and was relatively high for a population-based intervention (NZ$3,000) compared to the cost of the portable heater at $100 (Preval, Chapman, Pierse, Howden-Chapman, & Housing Heating and Health Study Research Team, 2010). Nonetheless, the results suggest that improving both the type and extent of heating in the homes of children with asthma has a number of beneficial effects. Houses in this study included all forms of tenure, so apportioning the relative benefits to the participants and to the public good is an important policy issue.

While the fuel poverty status of occupants was not able to be directly assessed under the study, a cost–benefit analysis found that there was a nonstatistically significant drop in annual total energy use valued at $76.65 ($p = .19$). When this is combined with the temperature increases reported, this indicates that, all other things being equal, the intervention reduced the proportion of treated households in fuel poverty.

Additional Cobenefits of Home Insulation

While the studies discussed so far have concentrated on the effect of insulating houses or improving heating to protect occupants from cold temperatures, improving the thermal properties of a house also protects the occupants from extremes of heat, as well as cold. In the context of climate change, ensuring that all houses are insulated to protect people from extreme weather events and from the urban heat island effect may become increasingly important. For example, 739 people died in the 1995 Chicago heat wave (Klinenberg, 2002) and it is estimated that 14,800 people in France alone died in the heat wave of August 1–20, 2003 (Grynszpan, 2003). A careful cost-control study of risk factors for the death of people over 65 in this French heat wave found that, apart from lack of mobility, preexisting medical conditions, and social isolation, the lack of insulation exacerbated by sleeping on the top floor was strongly associated with the risk of mortality and the authors recommended that improving insulation in existing buildings and urban planning are needed to prevent mortality in older people during future heat waves (Vandentorren et al., 2006).

Apart from protecting occupants from climate extremes, home insulation has other benefits. Insulating houses and apartments reduces the transmission of noise, which the Large Analysis and Review of European Housing and Health Status (LARES) study has indicated is one of the major health hazards in urban areas (Braubach, Jacobs, & Ormandy, 2011).

Possible Health Costs from Insulating Houses

While there is increasing evidence about the benefits to health and wellbeing, in some circumstances retrofitted insulation can also negatively affect occupants' health and wellbeing, if the ventilation in the house falls to suboptimal levels. In New Zealand, standalone wooden houses are the norm, so ventilation and airflow are not a problem; however, in other types of housing a lack of ventilation, due to the absence of opening windows or extractor fans, can lead to detrimental health effects. For example, in parts of the world where radon levels are a problem insulation can increase occupants' exposure to radon (Cohen, 1980).

The products used in insulation material can also be problematic. The use of urea formaldehyde foam in insulation and particle board can result in long-term formaldehyde release, causing dermatitis and inducing inflammatory

bronchitis and bronchial asthma (Wieslander, Norbäck, Björnsson, Janson, & Boman, 1997). Another problem can occur if gypsum board gets damp from structural failures that cause water intrusion or flooding; the dampness can encourage mold growth which has demonstrable respiratory health effects (Douwes, Howden-Chapman, & Crane, 2011; Hyvärinen, Meklin, Vepsäläinen, & Nevalainen, 2002).

Despite these problems, the positive net benefits of home insulation demonstrated by the community trials in existing houses described here are consistent with the positive results of a broad risk-based health impact life-cycle assessment of insulating new houses to the International Energy Conservation Code (Nishioka, Levy, Norris, Bennett, & Spengler, 2005).

Further Research

Insulation has such a strong effect on occupant health, behavior, energy use, and indoor temperature that it is often not possible or sensible to use a community trial to study the impact of other home improvements without first ensuring that treatment and control homes have similar levels of insulation at baseline. For example, a further community trial carried out by the Housing and Health Research Programme, the Warm Homes for Elderly New Zealanders (the WHEZ study), is looking at whether giving vouchers to subsidize heating reduces rehospitalization for chronic obstructive pulmonary disease after retrofitting homes with floor and ceiling insulation at baseline (Viggers et al., 2013). Similarly, the Home Injury Prevention Intervention (the HIPI study) is examining whether remediating home hazards, after retrofitting insulation, reduces claims for financial compensation for home-based injuries (Keall et al., 2013).

Policy Implications of Insulating Homes

There are three distinct approaches to the research evidence on insulating houses. The first, most proactive approach is to enact a Building Code which regulates the standard of insulation in new housing and is the benchmark for existing housing. This is the case in the European Union and has been largely driven by concerns about energy security and mitigating and adapting to climate change. Regulating insulation standards is seen by policy makers as an effective supply-side way to reduce energy consumption and carbon emissions (Lah, 2009).

Those who favor government intervention argue for the importance of giving adequate consideration to the public good (especially in promoting health and safety in vulnerable members of society, such as children, older people, and the sick) and the importance of consumer protection, on the basis that at least some of the benefits accrue to the wider public; for example, through reduced government health spending, or on an ethical basis. Furthermore, government investment in improving the thermal properties of housing maintains capital investments in the housing stock (Daunton, 1987).

Secondly, in Organisation for Economic Co-operation and Development (OECD) countries like the United States (Kuholski, Tohn, & Morley, 2010), Australia (Australian National Audit Office [ANAO], 2010), and New Zealand (Howden-Chapman et al., 2012), retrofitting insulation in existing buildings has recently been largely driven by the need for economic stimulus and job creation in the aftermath of the 2008 financial crisis. Benefits cited as justification for these "Green Stimulus" programs also included energy savings, reductions in carbon dioxide emissions, and the health benefits of warmer homes (Howden-Chapman & Chapman, 2012).

In the United States US$5 billion dollars has been spent on weatherization for modest-income homes under the $787 billion American Recovery and Reinvestment Act of 2009. Weatherization typically includes a wide range of home improvements including installing insulation, draught-proofing, and measures that protect against extreme weather such as storm doors. The Act also included a $4.3 billion tax credit allowing home owners who made energy-efficiency improvements to their properties to recoup 30% of their costs up to $1,500 (Kuholski et al., 2010).

In Australia the AUS$2.7 billion Home Insulation program was part of a larger $42 billion stimulus package and focused entirely on providing funding of up to $1,600 per household for ceiling insulation retrofits. The program started full operation in July 2009 but ended in disarray early in 2010 (ANAO, 2010).

As explained, in New Zealand retrofitting insulation and improved heating has taken place under the NZ$347 million Warm Up New Zealand: Heat Smart program, a highly successful program that funded insulation, draught-proofing, and heating retrofits and that is expected to produce large net benefits for New Zealand.

The European Union has instituted energy audits and linked efficiency programs, which are at least partially publicly funded, because they are recognized to have health benefits and make households more resilient to

rising energy costs, natural hazards, and climate change (Poel, van Cruchten, & Balaras, 2007).

Several global agencies, such as the International Energy Agency (2010), the World Health Organization (2011), the World Bank (Hallegatte, Heal, Fay, & Treguer, 2012), and the International Council of Science Union Science Planning Group on Health and Wellbeing in the Changing Urban Environment and Regional Committee for Asia and the Pacific (2011), have recently published major reports highlighting that improving housing by retrofitting insulation provides health and wellbeing benefits, and reiterating that in addition to these benefits insulation provides cobenefits for energy efficiency, social outcomes, and more balanced urban and regional development.

The third argument refutes the earlier arguments that, because of market failure, central and local governments need to intervene to at least encourage and in some cases require houses to be insulated. The arguments for the *nonregulation* of housing are underpinned by neoliberal political arguments: market intervention that alters the provision of housing types and/or quality overrides consumer preferences. If home owners and landlords value the benefits of insulation they will purchase insulation; official guidelines or regulations which override market trends encourage inefficient investment, and imposed minimum standards increase costs to consumers, producers, and government (Herandez & Bird, 2010).

Finally, this chapter has focused on developed countries, but in many developing countries with informal settlements in low-income urban areas, even though inhabitants of such dwellings are among those who would benefit most, there is almost no regulatory control over even the most basic aspects of building form and quality (Rydin et al., 2012).

Conclusion

Integrated policy planning for housing and energy together has many advantages for low-income households, who are more vulnerable to social and economic deprivation. Installing a good standard of insulation in new housing and retrofitting insulation in existing housing has clear benefits for health and wellbeing. Most housing is privately owned and the occupants benefit in terms of having their health protected and their wellbeing increased. However, it is also clear than insulating housing has public benefits in reducing health costs, reducing children's absences from school and reducing demand

for energy, which can make an important contribution to reducing carbon dioxide emissions. During an economic recession, retrofitting insulation can also create employment. Installing and retrofitting insulation has both private and public benefits.

Note

1. FEV_1 is the maximal amount of air that can be forcefully exhaled in 1 s. It is calculated using a spirometer. PEFR, or peak expiratory flow rate, is a person's maximum speed of expiration, as measured with a peak flow meter. It measures the airflow through the bronchi and thus the degree of obstruction in the airways.

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23

The Multiple Pathways between Environment and Health

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Background

In our urbanizing world, planners are increasingly interested in the health impacts of urban environments. Over half of the global population already live in cities (World Urbanization Prospects, 2011) and the trend of urbanization is still continuing. While environmental health research has blossomed during recent decades, the findings reveal a rather complex view of the health impacts related to various urban planning solutions. Urbanization seems to pertain to both health problems and possibilities for promoting healthier lifestyles. The current, partly conflicting evidence base from several research fields makes it difficult for urban planners to apply environmental health research findings to their concerns.

To make the situation even more challenging, urban planners are facing strong demands to improve the ecological sustainability of urban systems; that is, the ecological health of the planet. Among the main urban planning strategies in climate-change mitigation is the urban densification policy. It includes among other things improved compactness, sustainable transport, mixed land uses, and diversity (Jabareen, 2006). Although there is rather solid evidence that urban densification in fact leads to positive outcomes, at least in regard to transport-related energy consumption (Le Néchet, 2012),

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there are also concerns about the social sustainability of urban, compact settings. In addition to the ecological benefits, urban densification can lead to a decline in the perceived quality of the living environment, contribute to unexpected changes in everyday life practices and affect the wellbeing of inhabitants (Vallance, Perkins, & Moore, 2005; Williams, 1999).

This chapter introduces a new kind of place-based research strategy that can potentially help environmental health promotion researchers to produce findings that have utility for urban planners as well as to make sense of the complex health enhancing and reducing processes. Ideally, this strategy can simultaneously provide tools for the continuous ex-post evaluation of the health outcomes of planning as part of health impact assessment (HIA). The new, place-based tool package to be discussed here, softGIS methodology, can assist planners' efforts to promote health through planning by identifying context-sensitive solutions for more healthy environments.

The Intriguing Paths of Environmental Health Research

Traditional environmental health studies have concentrated on the illness-producing aspects of the physical environment: health problems that are connected to pollution of the urban environment, air quality, toxic soil, water sanitation, or social problems like crowding, crime, residential segregation, etc. Rapidly increasing lifestyle-related health issues, like obesity and type 1 diabetes as well as mental health problems, paved the way to a fundamental paradigm shift. During the last 20 years, the interest of environmental health researchers has gradually shifted from sickness-producing processes to the health-promoting qualities of physical environment. An essential part of the current, second-wave environmental health research paradigm is to study the qualities of physical environment that promote healthy lifestyles (Boarnet, 2006; Killingsworth, Earp, & Moore, 2003). This paradigm shift also brought new actors to the field: "Planning and health is big news" wrote Boarnet in 2006. Among the main tasks for the second-wave environmental health promotion researchers has been therefore to inform urban planners how to plan and design settings that promote the health and wellbeing of all inhabitants.

It is not at all straightforward how communities should be planned to allow for physical, mental, and social health and wellbeing of people and society. Indeed, the recent literature concerning the health-promoting qualities of urban structure reveals rather confusing results. In the following, we briefly highlight the main findings of three lines of research; namely,

active living research, research concerning the restorative qualities of green settings, and finally research concerning the urban settings and social health. Currently these lines of inquiry largely operate separately and have separate publication channels and conferences. There is no doubt, however, that almost all researchers in the field strive to promote human and environmental wellbeing in a very holistic manner.

Active Living Research and Physical Health

There is a vast body of research concerned with active living[1] that clarifies the associations between different urban settings and physical activity, and hence the possible *physical health* outcomes of different urban forms. This research has produced fairly compelling evidence to show that a compact urban structure with high neighborhood accessibility is associated with a higher probability of walking and cycling to school and work, and while running errands (Durand, Andalib, Dunton, Wolch, & Pentz, 2011), and therefore can contribute to positive physical health outcomes. As for urban sprawl, it is shown to be related to a lower level of physical daily activity and higher risk of overweight and hypertension (Ewing, Schmid, Killingsworth, Zlot, & Raudenbush, 2003). According to an excellent synthesis by Van Loon and Frank (2011), the positive outcomes of compact urban form apply also to children's physical activity and health. They concluded that positive associations have generally been noted between the objective measures of urban density and land-use mix, and the measures of physical activity, amount of walking, active school travel mode, and weekly physical activity.

Dense urban settings seem to promote an active lifestyle in particular by offering a friendly mobility environment with good possibilities for walking and cycling and easy access to goods and services. A traffic environment that promotes mobility without a car includes, for example, good walking and cycling facilities, cul-de-sacs, traffic-light-controlled junctions, speed humps, and a well-functioning public transportation network, and also parking arrangements that are not too easy for drivers (Van Dyck et al., 2012). Inhabitants, however, do not walk unless the immediate surroundings of their homes offer accessible points of interest in attractive and safe contexts.

The availability of new technology applications has made it possible to overcome a major barrier of active living research, namely a reliance on subjective evaluations of physical environment characteristics and the behavior patterns of inhabitants. Geographic information system (GIS) technology has enabled the objective measure of urban structural characteristics; global

positioning system (GPS) tracking allows the study of actual mobility patterns; and accelerometers, pedometers, and heart rate monitors can enable objective measurement of physical activity levels. Although the direct links between urban structure and physical health have not been shown in many studies, the main message for urban planners from this body of literature is that an active lifestyle and physical health can be promoted by increasing urban density.

Research Concerning Restorative Places and Mental Health

The results from the literature concerning the health benefits of the natural environment provide some contrast, to some extent. It has been shown, for example, that proximity to nature associated with sparse buildings promotes *mental health* and provides a setting for restoration and recovery from stress. Perhaps the study of Maas, Verheij, Groenewegen, de Vries, and Spreeuwenberg (2006) provides the most convincing evidence about the direct health impacts of "green structure." In a study of the amount of green space around the homes of over 250,000 Dutch inhabitants, Maas et al. were able to show that the percentage of green space in people's living environment has a positive association with the self-reported general health of residents. Even mortality risk has been shown to be lower if the exposure to green space is present (Hu, Liebens, & Ranga, 2008).

Also the type of green setting seems to matter: restorative experiences are stronger in exercise and activity outdoor areas and extensively managed natural settings than in places in built urban settings or urban parks (Korpela, Ylén, Tyrväinen, & Silvennoinen, 2010). Especially water elements, the so-called blue structure, have strong, positive health impacts on people (Völke & Kistemann, 2011). Even small allotment gardens can have stress-reducing effects (Hawings, Thirlaway, Backx, & Clayton, 2011).

It is noteworthy that the large literature on the stress-reductive capacity of natural environment cited briefly here does not rule out the possibility that urban settings could also be restorative. The urban and natural settings chosen for the comparative studies have often been biased: it may not be fair to compare a natural setting with a commercial or industrial area because, in addition to the degree of "naturalness," numerous other dimensions also vary in these settings. Karmanov and Hamel (2008) were able to show that a well-designed and attractive urban environment can also have a stress-reducing and mood-enhancing power equal to that of an attractive natural environment. Also, the ecological validity of some of the studies in this field

can be doubtful; for example, when the restoration potential is studied as a reaction to texts describing various green settings (Nordh, Alalouch, & Hartig, 2011) or to photographs representing study settings (Berto, 2005). Currently, many researchers are keen to provide objective, physiological evidence about the healing power of natural environment (Ward Thompson et al., 2012). To sum up, the message from this literature to urban planners is that human health is best strengthened by increasing the amount and accessibility of green structure.

Research Concerning Urban Settings and Social Health

Evidence concerning the urban structure characteristics that promote *social health* is even more complex. An abundance of researchers have studied the relationships between health and various aspects of social capital and social cohesion in a diverse array of urban and rural settings. The health impacts related to social capital have mainly focused on so-called bonding social capital, which refers to aspects of "inward-looking" social networks in neighborhoods (Poortinga, 2012). As for social cohesion, the neighborhood-level correlates include social interaction and networks, sense of community, trust and reciprocity, participation in organized activities, sense of place attachment, and perceived safety. Various studies have found either some correlations with urban structural variables and these measures of social structure or no associations at all (Dempsey, Bramley, Power, & Brown, 2009).

For example, according to some studies, a moderate level of urban density is related to an increased sense of community (Brown & Cropper, 2001; Kim & Kaplan, 2004). Other studies have found that rural settings compared to more urban ones had a stronger sense of community (Kitchen, Williams, & Chowhan, 2012). Similarly, some studies concerning perceived safety indicate that dense building is related to lower levels of perceived safety (Miceli, Roccato, & Rosato, 2004), while others relate perceived safety more to sociophysical characteristics of neighborhoods, like perceived signs of disorder (Brittney et al., 2010) or natural surveillance (Colquhoun, 2004).

Among studies that attempt to look at social capital as a whole in various neighborhoods is an impressive Dutch study of over 60,000 respondents in over 3200 neighborhoods (Mohnen, Groenewegen, Völker, & Flap, 2011). They found that residents in urban neighborhoods benefit particularly from their neighborhood social capital. Another study conducted in Australia concluded that social capital and its relationship to health differed for participants in rural and urban areas in quite a complex manner (Ziersch,

Baum, Darmawan, Kavanagh, & Bentley, 2009): Social capital was associated with good mental health for both urban and rural participants, but with physical health only for urban participants. Collectively, then, these findings seem to indicate that rather than urbanity or density level as such, social health is promoted by complex, contextual processes that are rather more probabilistic or possibilistic by their very nature than deterministic (Kyttä, Broberg, & Kahila, 2012).

Towards a More Integrated Understanding of Environmental Health

Although nearly all environmental health researchers are committed to the World Health Organization's (WHO's) enlarged definition of health—the simultaneous enhancement of the physical, mental, social, and environmental wellbeing and health—there are surprisingly few attempts to study contexts that support more than one or two dimensions of health, and few studies that look at the interaction between various health-enhancing processes. It can hardly be the case that the only way to build a health-promoting living environment is to reserve separate areas with dramatically differing physical characteristics to promote mental, physical, and social health, respectively.

Among the few exceptions of examining both place-based accessibility of green space and the walkability of urban settings is the work of Cutts, Darby, Boone, and Brewis (2009). Using GIS data they evaluated the distribution of populations vulnerable to obesity in relation to proximity to parks and walkable street networks. They found, contrary to their expectations, that in the study setting of the city of Phoenix subpopulations most vulnerable to obesity were more likely to live in walkable neighborhoods and had better walking access to neighborhood parks than other groups. After considering data on perceptions of resource quality, safety, and cultural relevance, they found that the most walkable areas, in which there were high rates of obesity, were also highest in crime. So, to promote physical health and active lifestyles it is not enough to increase walkability. Sociocultural and experiential factors also have to be taken into account, such as in the present case, to enhance the perceived safety of the area.

Socioeconomically sensitive research, in turn, is required to recognize the variation in environmental health promotion processes due to the lifestyle- and background-related differences of individual dwellers. Another massive study of more than 366,000 British inhabitants is enlightening. The study

was able to show that the association between exposure to green space and the likelihood of death was not the same for individuals in different income categories (Mitchell & Popham, 2008). Very interestingly, for individuals in the highest-income category there was not a statistically significant association between green space exposure and likelihood of death. But for the middle-income and especially for the low-income groups there was a highly significant, negative relationship: the greater the exposure to green spaces, the lower the likelihood of death. As a possible explanation for the lack of association in the highest-income group, the authors suggested that green spaces well beyond immediately proximate home zones are more easily accessible to these inhabitants. For example, they are more likely to own second homes and to travel than the other income-groups which allows them to seek out complementary experiences beyond home zones. A more realistic understanding of health-enhancing processes of various contexts would, therefore, have to scrutinize the variation in lifestyles of people in relation to environmental opportunities.

Complex health outcomes can be tied to a single planning solution. For example, studies of the North American suburbs have shown contradictory health outcomes associated with this urban form. On the one hand, suburbs offer possibilities to live close to nature in spacious houses that afford refuge from the urban hussle and provide opportunities for mental restoration. On the other hand, suburban lifestyles entail stressful and time-consuming commuting and can lead to the erosion of social capital due to social stratification, individualized lifestyle, unequal accessibility of resources and, disproportional exposure to health hazards (Frumkin, 2002). The health impact assessment of an urban setting can clearly be misleading if it does not take into account all aspects of health.

For all of these reasons and more, practitioners and politicians confront challenges when trying to apply existing contradictory research findings, such as those outlined here, in attempt to create sustainable urban settings without compromising the wellbeing of inhabitants. In particular the mixed messages concerning the health outcomes of urban densification question the premises of urban infill policy and call for new approaches to better bridge research and practice. We agree with King, Stokols, Talen, Brassington, and Killingsworth (2002) and Van Loon and Frank (2011) that the currently dominating theoretical approaches in environmental health promotion research that focus on a limited number of individual measures should give way to ecological models; that is, the analysis of complex, situational processes at different scales of the environment.

Place-Based, Context-Sensitive Strategy for Environmental Health Promotion Research

To operationalize the ecological approach we suggest a combination of contextually and experientially sensitive research and close cooperation with practitioners. A place-based, multilayer analysis of health promotion processes can also provide a key to the integration of dispersed environmental health promotion research. In the following we will illustrate through two examples how complex and contradictory health-enhancing processes can be made more applicable through a place-based research strategy.

A place-based strategy is not possible, however, without a specific methodology. Both examples to be described—one concerning adults and the other children—utilize the Internet-based softGIS methodology developed in Aalto University in Finland. SoftGIS methods are an example of public participation GIS (PPGIS) methods that allow inhabitants to express their environmental experiences and daily behavior practices with respect to specific locations. SoftGIS methodology has been developed together with urban planners and other actors in the health promotion field—professionals from the social, health, cultural, education, and youth work sectors, among others—in an attempt to produce applicable knowledge for these multisectoral actors (Kahila & Kyttä, 2009; Kyttä, 2011).

Two Examples of Complex Health-Promoting Processes of Urban Settings

To illustrate how locality-based information can help research on health-promoting urban structures we present some results from softGIS studies in Finland. These examples hopefully can pave a way for a more context sensitive approach, although they represent only a first step towards more integrated health promotive research.

The first example concerns the study of socially sustainable, health-promoting urban densification process in the Helsinki metropolitan area. This large study among adults revealed complex, partly contradictory experiential results. The second example among children and young people in cities of Turku and Helsinki also depicts environmental health promotion as a multidimensional phenomenon. The softGIS applications applied in these studies were tailored to be as user friendly as possible for the inhabitant groups involved (see Figure 23.1).

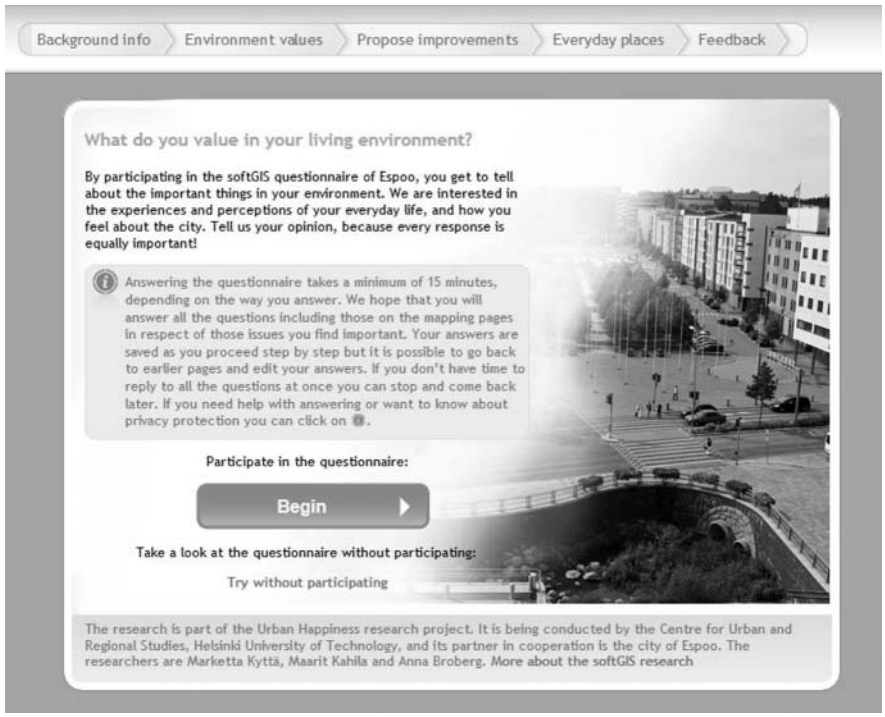
Inhabitant-Friendly, Socially Sustainable, and Healthy Urban Environments

According to our findings from a large study[2] in the Helsinki metropolitan area, inhabitants' experiences with respect to urban density and green areas are very complex and partly contradictory. Earlier evidence from Britain (Bramley, Dempsey, Power, Brown, & Watkins, 2009; Bramley & Power, 2009) and our previous findings from four Finnish small towns (Kyttä, Kahila, & Broberg, 2011) suggested that experiential outcomes would be more positive in low-density settings than in more densely built urban locations.

In contrast to these results, our current study revealed that the relationship between urban density and the perceived overall quality of the living environment appears not to be negative or linear but curvilinear: the average perceived environmental quality increased until the density level reached around 100 housing units/hectare and after that it decreased again. In this study, urban structural analysis was performed with an individually sensitive lens: the density (housing units per hectare) was calculated within 500-m buffers around each home. Further multilevel modeling revealed that the perceived quality of home environment in more dense, centrally located urban areas was higher than in less dense suburban areas. In suburban neighborhoods, but not in the city center, the association between density and perceived environmental quality was, however, negative.

These results corroborate the complex, context-specific links between urban density and perceived environmental quality. They also suggest that the experiential benefits of densely built environment become evident only at a moderate level of density. Too high a density can, however, result in a decrease in perceived quality. The optimal density level according to this study was around 100 housing units/hectare. Further research is needed to confirm this finding and to more systematically study the experiential impacts of all urban density levels.

The experiential value of low-density places was, nevertheless, also shown in the same study. In addition to the analysis of the density of the home surroundings of inhabitants, we also studied the physical structure of the single places marked as meaningful by inhabitants. We found that positively perceived places were located in clearly less dense settings. This was true in regard to the functional quality as well as perceived quality related to the appearance and atmosphere (see Figure 23.2).



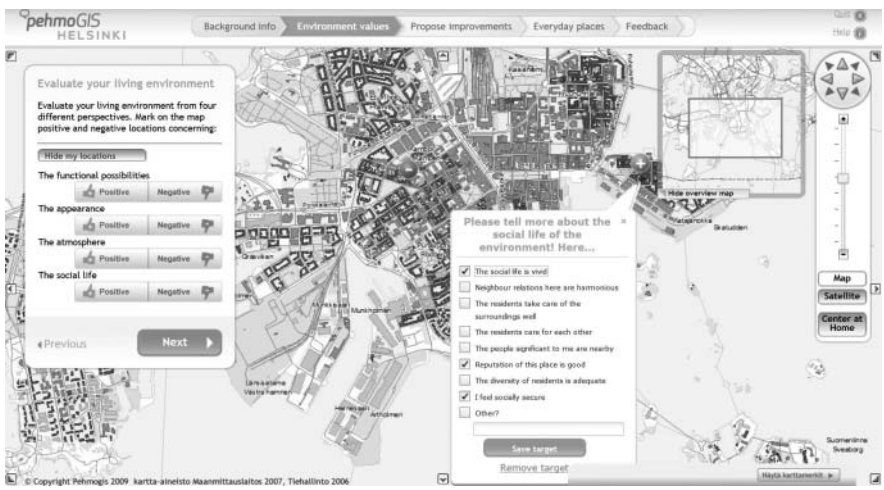


Figure 23.1. The softGIS Applications used in Helsinki Metropolitan Area among Adults (this page) and Children (next page).

Figure 23.1. (Continued).

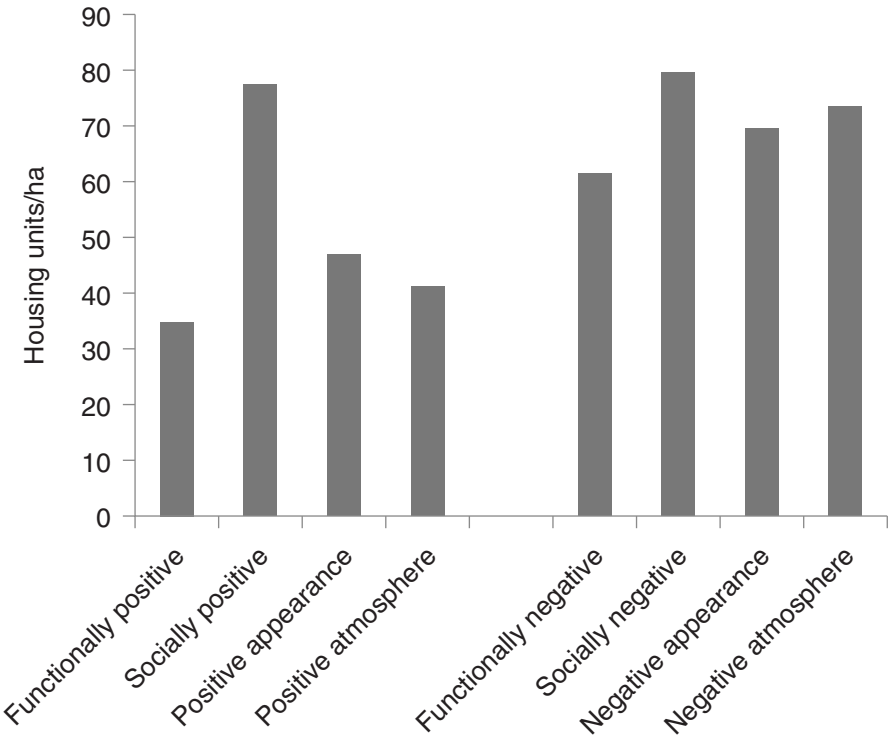


Figure 23.2. The Density of the Positive and Negative Places Meaningful for Inhabitants.

However, with regard to social quality, there was no significant difference between the density of positively and negatively perceived places: both socially meaningful place types (positive and negative) were located in densely built settings. Also, other place-based analysis corroborated the importance of green areas for urban dwellers: positive places were located more often in green areas than in areas representing other land-use patterns. Finally, the places that inhabitants marked as their personal places of happiness were also located most often (49%) in green settings.

Although densely built places were generally evaluated more negatively than the sparsely built ones, they seem to have clear social value for inhabitants. The important, positive social quality criteria in dense settings included active neighboring, shared responsibility, social safety, and tolerance (see Figure 23.3). These findings do not corroborate earlier negative experiential outcomes of urban density (Dempsey, Brown, & Bramley, 2012).

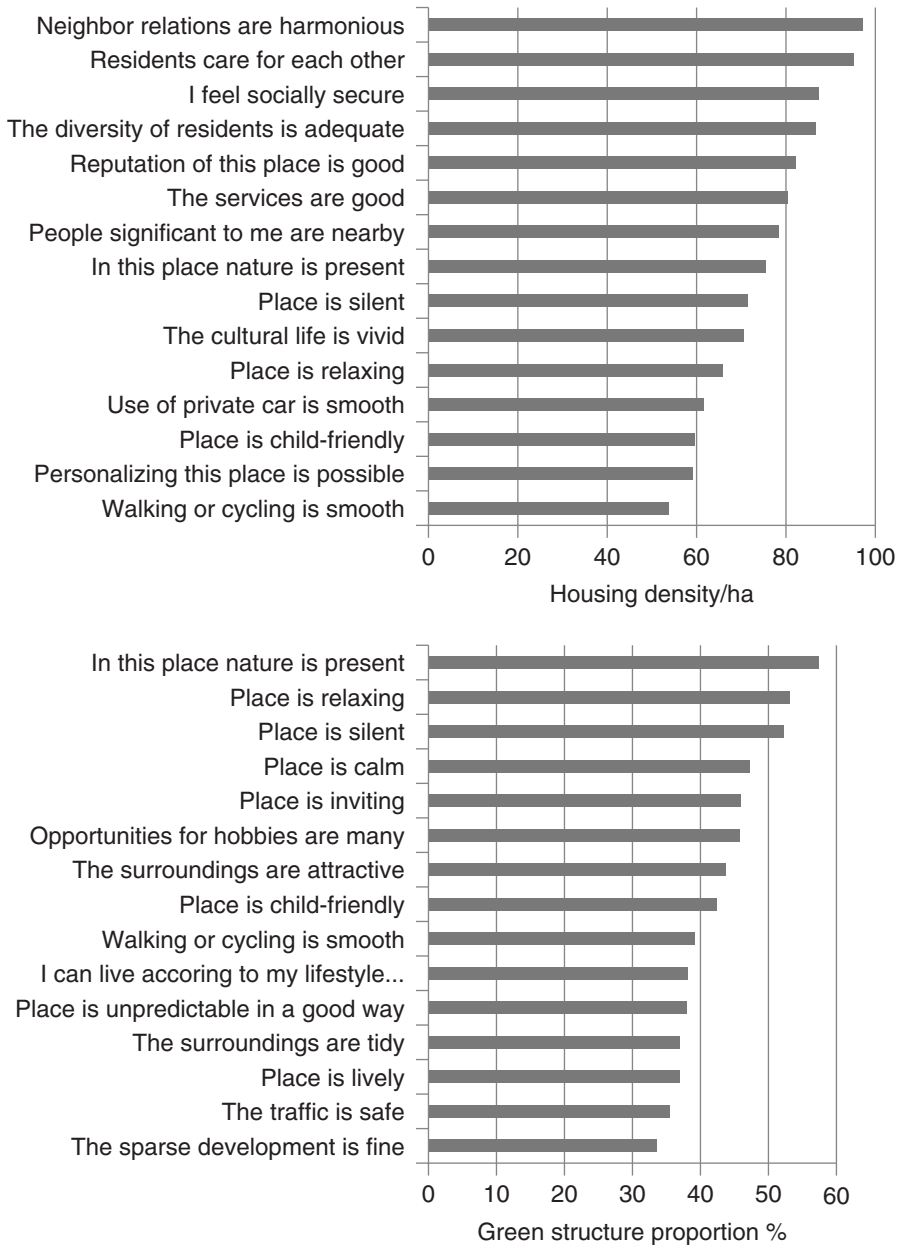


Figure 23.3. The Most Common Quality Criteria Associated by Inhabitants to the Most Densely Built Places (top) and the Greenest Places (bottom).

The positive experiences in the most green places included strong presence of nature and a relaxing, silent, calm, and inviting feel of the place.

Surprisingly enough, in the greenest settings in our study, which were in the suburbs, the positive places were located on average significantly further away from home than the negative places. Especially far were the suburban dwellers' positive places located in green areas: in the suburbs the distance to these places was on average 1.8 km whereas in the city center it was 0.8 km (Figure 23.4). This might be unexpected considering that "suburbs" here means the Finnish suburban concept: a block of flats surrounded by forest. The finding may suggest that for inhabitants the quality of green settings is more important than the quantity. Arnberger and Eder (2012) came to the same conclusion when comparing urban and suburban dwellers' perceptions of green settings.

In this study, no direct associations between the urban structure factors and wellbeing variables were found. It is possible that these associations were not found because the variation of urban structural characteristics was rather limited in this study. Only city center neighborhoods and one type of suburban neighborhood were included. Future studies should increase structural variation at both ends of the continuum by including both very low and high urban density settings.

The perceived quality of the urban environment was, however, not without meaning when it came to health and wellbeing outcomes. The overall, perceived environmental quality was highly and positively associated with both the general wellbeing of respondents and the scores of perceived happiness, health, and quality of life.

These multifaceted results originating from this one research effort convey messages to urban planners who are targeting to densify specific neighborhoods

- context-sensitive planning solutions should be searched for in each neighborhood about how to combine dense-enough urban structure with high-quality, accessible green areas;
- with the help of place-based, experiential knowledge, urban densification can be performed sensitively by respecting inhabitants' experiences;
- urban densification should aim to increase the accessibility of all meaningful quality factors for inhabitants.

With this more place- and inhabitant-sensitive approach the resistance to urban infill policies could also potentially decrease.

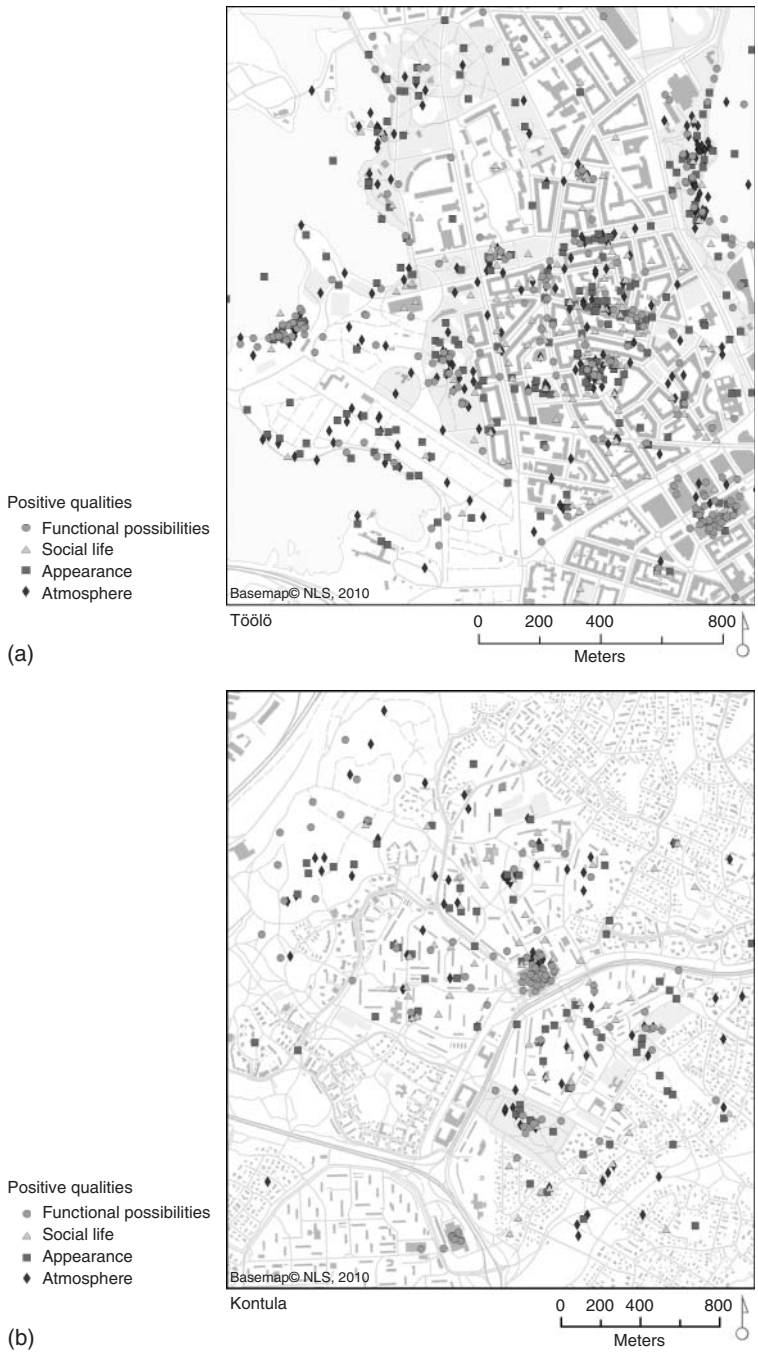


Figure 23.4. The Location of Positive Quality Places in (a) City Center and (b) Suburban Settings.

Child-Friendly, Health-Promoting Urban Environment

Our studies among children and young people also partly corroborate the above, complex findings concerning the experiential and health-enhancing qualities of urban settings. The following findings among children are based on two large research projects in cities of Helsinki and Turku.[3] In both studies we found a negative association between the proportion of green structure around a child's home and the mode of active travel to school. In other words, the greener the home surroundings of a child, the less likely she/he would go to school actively. The study in Turku also showed that the more green a child's home surroundings were, the further away were the personally meaningful places that a child had marked. Children, however, identified larger territorial ranges in lower-density, greener neighborhoods.

The Helsinki study compared various types of urban setting: city center, inner suburban, and outer suburban settings. The results revealed intriguing differences among these forms of urbanity: active school travel mode was most predominant in outer suburbs where 89% of school children traveled to and from school actively. In the city center only 46% and in inner suburbs 58% of children traveled actively to and from school. We concluded that when a very good public transportation system is available and when children enjoy high mobility, as was the case in the city center neighborhoods in Helsinki, children used public transportation very actively, even at the rather young age of 11. When it comes to active living, somewhat lower density suburban settings can promote the active mobility of children even more than higher-density inner-city settings.

The place-based analysis in both cities revealed that urban density predicted active travel mode and independent access (access permitted alone) to personally meaningful places for children. Urban density also indicated the degree of likeability of places that a child had marked. In Turku, the meaningful places marked by girls were in significantly less green surroundings than those marked by boys. Boys, on the other hand, reached their places alone more often than girls. In Helsinki, only 8% of meaningful places were reached by car and 12% places with an adult. It seems that the Finnish urban environment really allows children and young people to be active and independent users of urban space.

Again, green areas were found to be very important settings for children's experiences. The Turku study indicated that especially functionally meaningful places were in surroundings where green structures are prominent. Among the greenest places were those for physical activity, such as

skating, swimming, and sledging, and those offering mental restoration and relaxation, like beautiful and quiet places (Figure 23.5). When looking at emotionally meaningful places, the bigger the proportion of green structures, the more likely it was that the place received a positive evaluation.

Children are very sociable: in both Helsinki and Turku among the most oft-cited places were those that allowed the meeting of friends. Also, children's mobility is predominantly social. At least in Finland, the independence of mobility is not necessarily about moving alone, but moving without adults, among peers. The importance of the social dimension, which has been shown also in many other studies, should be taken seriously in environmental health research as a potentially highly important motivational factor for active living (Figure 23.6).

In both the Turku and Helsinki studies children's behavior patterns and environmental experiences were associated with health and wellbeing measures. Children in Turku were less likely to be overweight if they traveled to school actively. In Helsinki, in contrast, only the amount of moderate physical activity during free time decreased the risk of overweight. Interestingly, environmental fears also increased the risk of being overweight among children in Helsinki. Environmental fears predicted the number of daily symptoms, such as headache, feeling low, or having sleeping difficulties, in both samples. The number of fears, nevertheless, had no association with urban structure variables. We found only one direct link between urban structure variables and children's health and wellbeing variables: in the Turku study a large proportion of green structure in the child's home environment was positively associated with good perceived overall health.

According to our experience, the multisectoral actors attempting to strengthen the active lifestyles of children and young people find it useful to have place-based, context-sensitive information about children. The messages for practitioners from the studies discussed here include

- children and young people can be very active users of urban space if their mobility is not restricted and if the physical environment supports this; for example, by providing good networks for walking and cycling as well as public transportation services;
- green settings have a special role in children's lives, especially when it comes to emotionally laden environmental experiences;
- the best way to promote children's active use of the outdoor environment is to invest in possibilities for socializing

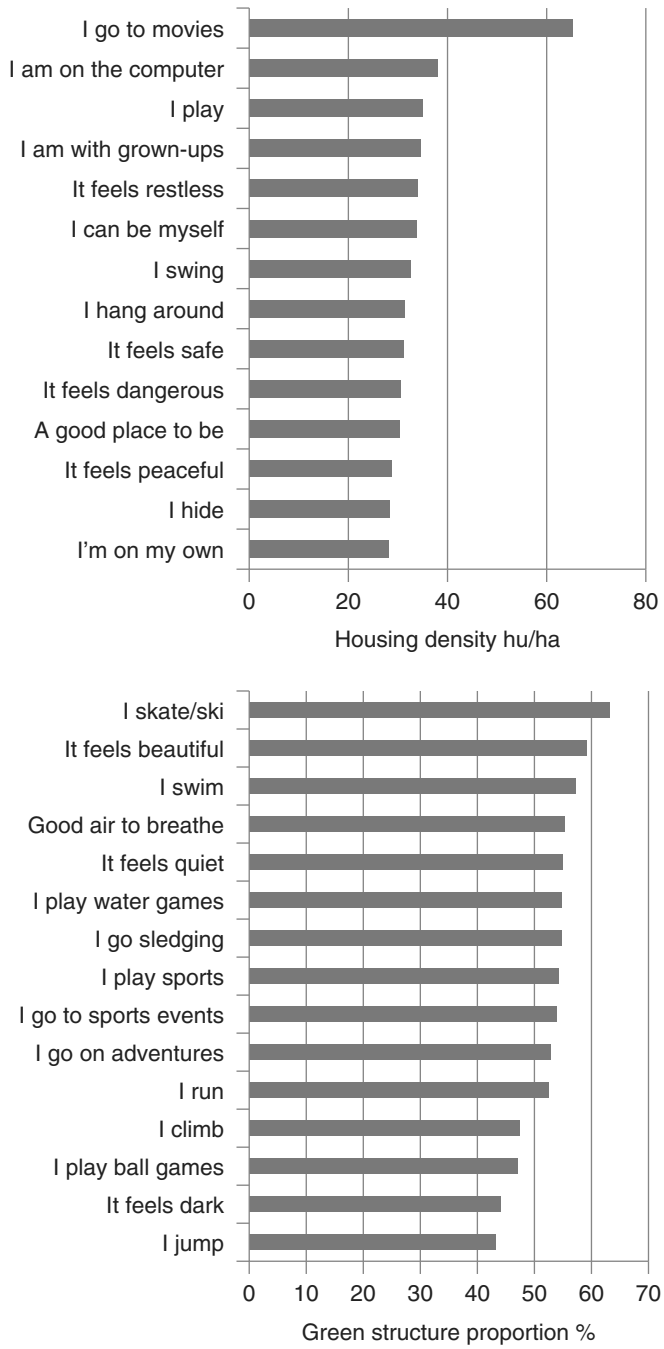


Figure 23.5. Children's Experiences in the Most Densely Built Places (top) and in the Greenest Places (bottom).

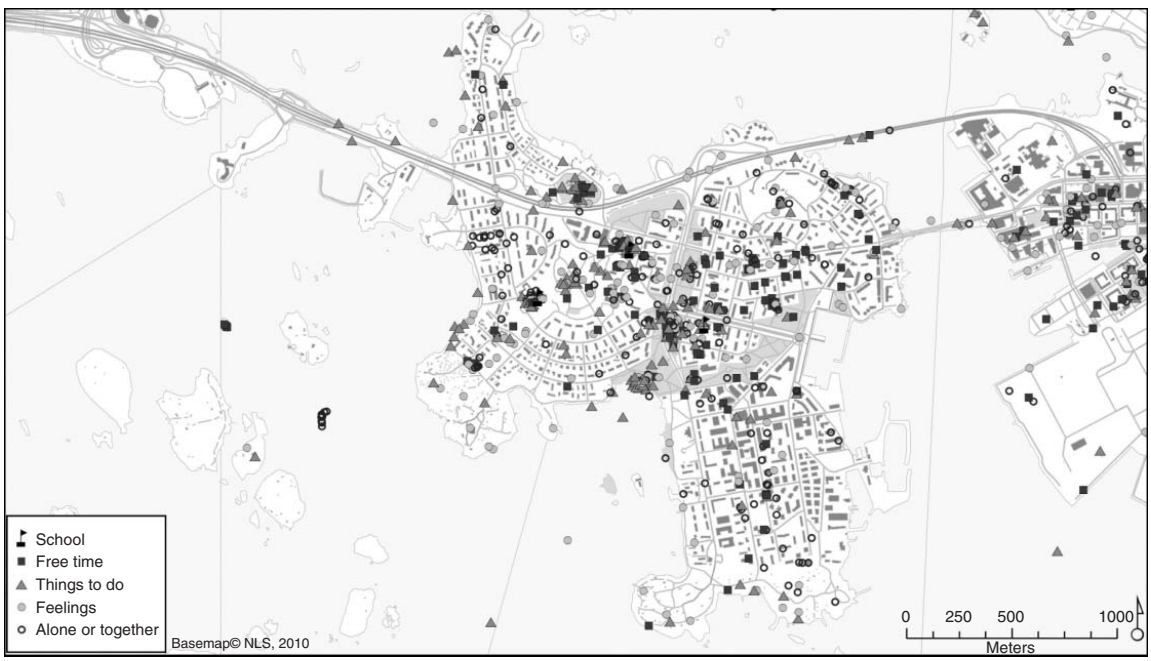


Figure 23.6. The Hotspots of Children's Meaningful Places in Lauttasaari, Helsinki. Note the social hotspot in the middle of the map: the local children's activity park.

Conclusion: The Integrated View of Health Promotion Applied to Urban Planning

In this chapter we have argued that the dispersed field of environmental health research and the partly contradictory research findings make it hard for urban planners to apply research findings in practice. To develop more healthy urban settings an enlarged view of health is needed: not only physical health but also mental, social, and ecological health. Of course, doing so increases the challenge of our task. We suggested a contextually and experientially sensitive research paradigm that can pave the way to a more integrated understanding of context-specific health-promoting processes. In what follows, we will discuss which steps can be taken in research and practice to proceed towards a more holistic, ecological understanding of environmental health promotion.

Place-based research approach utilizing PPGIS methodology can produce place-sensitive behavioral and experiential information for planners. It helps to go beyond simple listings of the presence of general resources and abstract preferences of an average user. Interest in how various inhabitant groups actually make use of environmental resources in the pursuit of desired personal goals can be seen as an example of the Senean capability approach that Lewis (2011) presents as an eligible goal for health audits. We think that it can also be seen as a target for health promotion research more generally. According to Lewis, Millsean utilitarian audits, which evaluate the built environment in terms of the equal distribution of preference fulfillments regarding physical health, and the Rawlsian general resource audits, which evaluate the built environment in terms of the equal distribution of opportunities for a healthy lifestyle, should give way to Senean capability audits that evaluate the built environment in compound terms, as an equal distribution of opportunity-plus-agency, or capability.

To proceed in this direction even conventional place-based research paradigms are not enough. They do not normally capture the environmental opportunities or individual variation sensitively enough. In most studies where location-specific information is collected it is based on far too large and rigid geographical boundaries. Also the GIS analysis of the examples in this chapter relied on rigid boundaries, 500-m buffers around homes. Although this was a step towards a more individually sensitive way to measure urban structural characteristics, it does not recognize the varying ways residents use their home environments. We agree with Rainham, McDowell, Krewski, and

Sawada (2010) that to conduct truly contextually and individually sensitive health promotion research a few new steps are needed

- the dynamic definition of the boundaries of individual living environments is essential where the scope of everyday life environment is based on individual usage patterns instead of rigid predetermined boundaries;
- the accessibility of environmental resources has to be studied in multifaceted ways: various types of individual, social, and physical barrier effects should be included in the research; for example, the equality of access to environmental resources;
- the influence of individual, personal motivation and past experiences on current behavior in resource actualization has to be taken into account;
- the inclusion of time-use patterns is essential in addition to place-use patterns.

We believe that these steps are necessary to integrate and deepen our understanding of the complex health-promotive processes of specific contexts. They can also potentially contribute to the formation of the next generation of environmental health promotion research.

To advance the wellbeing of inhabitants, new approaches for urban planners and other actors in the health promotion field are also needed. Measurable criteria help to follow up the progress and compare various contexts. The WHO European Healthy Cities Network has developed a set of healthy city indicators (HCIs) to capture a range of local initiatives addressing the wider dimensions of health (Webster & Sanderson, 2012). Unfortunately this set still does not represent a fully balanced view of health: within the environmental indicators, negative health indicators and physical activity promotion criteria dominate while mental and social health-related indicators are less present. Lifestyle/behavioral factors are, however, mentioned among the additional future indicators. The WHO report also highlighted that information has to be provided in a way that helps the actors target resources to those in greater need. To do this, the information needs to be linked to smaller geographical areas within the city and to population groups known to be vulnerable.

Measurable criteria for the better integration of health into urban planning are useful in health impact assessment (HIA). Still, a review by Carmichael, Barton, Gray, Lease, and Pilkington (2012) of impact-assessment processes around the world shows that the use of common, comparable criteria is still far from a reality. An overly limited definition of health is still a major barrier and the overemphasis on negative health impacts rather than positive benefits

narrows the knowledge base. Issues like accessibility, physical activity, and access to natural settings that we dealt with in our two examples are included in the most thorough HIA procedures (Slotterback, Forsyth, Krizek, Johnson, & Pennucci, 2011). We argue that HIA can be effectively performed in a place-manner based with softGIS methodology and therefore anchored to urban structural characteristics and ecological health themes like urban densification. A context-driven PPGIS approach not only can facilitate participatory HIA processes but also can provide a tool to assess the cumulative impacts of multiple health hazards affecting a common area.

The final question is, which new urban planning concepts have emerged to promote mental, social, physical, and ecological health simultaneously? Some concepts exist, like new urbanism or smart growth, that attempt to increase both the ecological and social sustainability of new neighborhoods. Compact cities also have potential advantages for both ecological and social sustainability in terms of more efficient resource use and transport as well as being lively, vibrant, and desirable places to live for many people. On the one hand people clearly want and can benefit from access to everyday nature, and over the long run they may suffer from crowded conditions (Van den Berg, Hartig, & Staats, 2007). As Joye and Van den Berg (2011) put it: we should move beyond a nature–urban dichotomy and concentrate on how to successfully merge natural and urban elements to promote human health and wellbeing.

An even more burning question than how to design new, health-promoting communities is how to strengthen the health-promotive qualities of existing communities in a holistic manner using micro-, meso-, and macrolevel solutions. This, we think, should be always done in a context-sensitive manner. Valuable place-based data-delivery services already exist—such as Healthycity.org in California, United States—that allows developers access to all available, register-based, and survey information through interactive mapping services. More fine-grained behavioral and experiential information would, nevertheless, be essential for truly context-sensitive development. This kind of knowledge can be produced with the help of PPGIS methods like softGIS. They hopefully will pave a way to a next generation of health promotion research and practice where unique solutions are sought for each community and its diverse inhabitants.

Notes

1. For an overview, see the Active Living Research literature database: http://www.activelivingresearch.org/resourcesearch/literaturedatabase.

2. The research in Helsinki and the neighboring city Espoo among adults (n = 3119) was carried out in 2009. A random sample of 15–65-year-old inhabitants was collected from 11 neighborhoods. The study is reported in Kyttä, Broberg, and Haybatollahi (2013) and Kyttä, Broberg, Tzoulas, and Snabb (2013) and as a series of web-based reports at http://ytk.aalto.fi/fi/tutkimus/hankkeet/urb_onni_results/.
3. Children's data were collected from 17 schools in six neighborhoods of Helsinki (in 2010; n = 1128) and from 54 schools in all parts of the city of Turku (in 2008; n = 1863). The respondents in both of these studies were fifth (11–12 years) and seventh (13–14 years) graders. The Turku study has been published in Kyttä, Broberg, and Kahila (2012) and Broberg, Kyttä, and Fagerholm (2013) and the Helsinki study in Broberg, Hynynen, Iltanen, Kyttä, & Paronen (2011) (in Finnish) and Broberg, Salminen, and Kyttä (2013) (in English).

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24

Summary

Wellbeing and the Environmental Implications for Design

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Gilbert and Galea (Chapter 2 in this volume) start this volume by outlining the complex interactions between socioeconomic factors that affect our environment and thus our wellbeing. The obvious relationship is cyclical: poor-quality environments contribute to poor mental and physical health; poor mental and physical health harms socioeconomic circumstances and leads to decaying, poor-quality environments. Unless we design ways out of this, "addressing the comprehensive set of features of the environment" that affect health, we will never be able to fully optimize the health of our populations over their life course. This chapter attempts to bring together some of the evidence related to wellbeing and the environment into a set of insights for design decision making. There are of course complementary and also competing recommendations that leave design decision makers with the responsibility to consider carefully how they make choices that will have an impact negative or positive on the individual, the community, and the environment.

Wellbeing and the Environment: Wellbeing: A Complete Reference Guide, Volume II.
Edited by Rachel Cooper, Elizabeth Burton, and Cary L. Cooper.

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Neighborhoods

Jane Jacobs' principles (discussed in Chapter 5) still hold; that is, safe streets, eyes on the street, mixed uses and connectivity, short blocks, and density: preserving historic neighborhoods. However, as Evans (Chapter 6) points out, Jacobs failed to recognize the wider context of post-war social and economic restructuring and the consumption-orientated subcultures. Evans goes on to discuss how mixed uses can result in crowding and increased wear and tear, families being underrepresented, a nighttime economy, and daytime economy problems. Mixed-use development requires an urban disposition and a fine balance, otherwise the dynamic process that generates diversity and mixed-use neighborhoods can destabalize.

It is clear that understanding the tipping points in neighborhoods, in relation to the design of the environment, the level of diversity of the population, and the activities that are housed in that space is critical and complex. There is still a level of urgency in terms of providing the evidence on how mixed uses and compactness work, in relation to the wellbeing of the citizen, the economy, and the environment.

Compactness is of course associated with density, and high densities have been purported to be a solution to population growth and urban sprawl, as well as the effective provision of resources such as energy and transport. High-density, mixed-use development has been identified as contributing vibrancy and to an increase in positive social interaction. However, the evidence also suggests that overcrowding may contribute to psychological distress (Chapter 4). Therefore, to ensure that high density provides a liveable environment it must be constructed with better-quality materials to withstand wear and tear and ensure adequate soundproofing. The physical infrastructure must be maintainable and durable, yet cost-effective. Dense spaces also need restorative breathing spaces, such as green spaces, allotments, gardens, and even rough unused land. Dense places also need "a narrative," a way of understanding and navigating them; therefore good building design and signage are required to provide the citizen with a clear picture of what the environment affords them. Design decision makers must consider the relationship between population density, urban design, and crime and the perceptions of crime. There has also been some evidence that low-density built form but with a high population leads to a higher sense and fear of crime. Therefore, the design of the built form needs to

take into account criminology theory and design-against-crime approaches (see Chapter 18).

Neighborhoods are essentially social places, places where we build relationships, grow old, and build families and businesses. As social animals we need our neighborhoods to provide the conditions for these processes to exist in a convenient and effective manner. Therefore we need to "think social" when we design neighborhoods, to ensure access to the services we need for supporting our living—schools, health care, residential care, leisure, etc.—all of which would appear to be common sense. But there are aspects that make them work well for different generations, genders, and ethnicities.

Mobility supports social interaction, and it is important to provide safe streets: safe in terms of physical infrastructure, and in terms of traffic and crime. Martin and Wood (Chapter 7) recommend streets that are well connected, with traffic calming, and if the design is for children it will work for everyone. Brown and Lombard (Chapter 5) suggest that mixed building uses, shorter blocks, and enhanced street connectivity offer higher levels of walking and greater social interaction. However, Townshend (Chapter 9) questions the walking and pedestrian-friendly evidence and suggests that "connectivity alone is not necessarily a good predictor of walkability." There is some suggestion that walking more is a personal lifestyle preference rather than the influence of the built environment, yet housing market evidence shows market demand for walkable neighborhoods and there is evidence that children in walkable neighborhoods are more likely to walk to school and are less likely to be obese. Martin also recommends transport for young people, and indeed public transport for all ages, especially those with accessibility issues. Designing public transport for older people is critical in relation to social issues and a sense of wellbeing.

Tyler (Chapter 19) reminds us that we must understand transport policy in relation to the "meaning of mobility," to look at it as an accessible enhanced system. We must consider the impact that pollution has on our physical health and the necessity to reduce our energy usage, to promote a sustainable future for the city's inhabitants. Tyler suggests that "planning a city should include as its starting point the availability of resources within a walkable distance if possible and, if this cannot be achieved for all resources, the public transport system should be devised in a way to cover the remaining distance. In other words the design of the transport system needs to be driven by the needs of the more movement-deprived groups in society." However, he also acknowledges that the system must take into account the challenge

of moving car owners from the convienience of individual transport to other modes that accommodate their desire for instant transport.

Adams (Chapter 10) reminds us that the neighborhood is a sensory experience, that we need to rethink density from a sensory perspective "that acknowledges the links between physical spaces, emotional responses, and wellbeing." We often forget that what we hear, see, smell, and touch needs to be considered in isolation and holistically. So designing the soundscape, as well as the aesthetics of places, is important to how we feel in the neighborhood.

Socialization and physical activity is usually increased of course by the provision of formal recreation, such as sport facilities for all ages. Parks and other green spaces offer opportunities for recreation but again, as Ellaway (Chapter 3) suggests, parks and green space are not always associated with positive experiences so in designing them one must consider gender, demographics, and ethnicity. For physical exercise the space must be of a sufficient size and capacity, as well as durable and with interesting designs for sport and leisure. For example, child-friendly neighborhoods (Chapter 7) recommend that play areas have less landscaping, be less manicured, and have natural bases on playgrounds with trees, rocks, and water. Playgrounds must balance safety through, for instance, infrastructure and natural surveillance, with a sense of risk and adventure.

For adolescents it is especially important to consult with them on their requirements for "hang out" places, that are accessible, provide natural surveillance but also privacy, yet do not antagonize other residents and users of facilities. Locks and fencing, while reducing vandalism, prevent accessibility and increase fear of crime. Formal parks and leisure spaces must be maintained, as poorly maintained areas are detrimental to crime resilience.

Due to the increasingly aging population in many cities around the world, creating dementia-friendly neighborhoods should be another important objective in the design of the urban environment. Mitchell (Chapter 8) identifies 17 features key for new developments or neighborhoods. Many of the dementia-friendly design recommendations are related to visual and environmental cues for remembering locations and aiding navigation, or supporting infrastructure such as handrails, sturdy, comfortable public seating, and enclosed bus shelters. Mitchell also makes 20 recommendations for improving existing neighborhoods in relation to dementia. These include adding landmarks and distinctive structures; special features (e.g., mailboxes, telephone boxes, trees, statues) at junctions, particularly complex ones; adding porches, canopies and clear signs to make entrances to public

buildings obvious; on busy roads, creating a green buffer zone between pedestrians and cars; fixing clear signs and symbols (where existing ones are poor) to publicly accessible buildings, preferably perpendicular to walls; and removing all unclear and unnecessary signs.

The design of neigbourhoods is to some degree a health promotion process that should (as illustrated in Chapter 23) be considered throughout design and planning. In Chapter 23, Kyttä and Broberg recommend that location and urban structural characteristics of place-based data are used to create fine-grained and inhabitant-specific neighborhoods.

Many of the general principles of good neighborhood design have been associated with maintaining the quality of the environment and reducing its susceptability to crime. Good practice includes, for instance, having well-designed and managed open space, good lighting, and natural surveillance. Further factors need to be considered: reducing the fortress look to a neigbourhood while restricting access and intrusion means "creating a sense of ownership of an area . . . that has the potential to empower residents to respond to threats of intrusion" (Newman, 1973, 1995, cited in Chapter 18). One crucial aspect in the prevention of crime is neigbourhood maintenance and management: derelict buildings, vandalism, litter, and graffiti give the impression that an area is uncared for and leads to further degradation, encouraging crime, and antisocial behavior. Planning and designing a neigbourhood requires careful consideration of how it can and will be maintained following completion or regeneration.

Green Spaces

Sullivan (Chapter 16) suggests the general principles of neighborhood design when he says "we should work to create walkable, human-scaled, safe neighborhoods that contain a number of shared public and semipublic spaces such as parks, squares, and tree-lined neighborhood streets that promote, or at least provide opportunities for, social interaction" and "Our cities should be green with vegetation, especially with trees."

Coles (Chapter 17) emphasizes that sensory engagement with nature, sound, water, wildlife, a view of horizon, the night sky, natural materials, and access to trees of different ages, providing smells, shade, sound, and a sense of seasons, is important for city residents. Like transport, this goes beyond just designing neighborhoods to the whole urban environment. Urban design must create access to urban infrastructure that includes

woodlands, canals, and other bodies of water that support wellbeing. Coles goes on to list the characteristics of places designed for wellbeing: safety and accessibility; giving dominance to the walker; linking to other places; multifunctional/allowing interpretation; inspiring and encouraging sensory engagement and exploration; allowing empowerment/ownership; being iconic in meaning; having changes in level; containing views and vistas; allowing opportunities for relaxation and socializing, including calm areas to provide refuges; promoting engagement/contact with "nature's constants;" and containing artifacts/sculpture to increase aspects of performance.

Buildings

Within the urban form of well-balanced neighborhoods and green space there are of course the buildings. There is a plethora of advice on the design of buildings, and it is not our intention to summarize or repeat this here, but we note where research evidence set out in this volume indicates critical issues to be considered. For example, in terms of housing it is clear that homes should be designed to be flexible, to accommodate us through the life course, and to support social interaction. Brown and Lombard (Chapter 5) identified balconies and porches as providing space for safe social interactions. Maxwell and Evans (Chapter 11) state the need for space, soundproofing, and privacy for children's wellbeing. Dutton's (Chapter 13) focus on older people tells us that in addition to good heating, lighting, use of colors, safe environments, good navigation, and access to the outdoors, factors such as adequate space—for guests and carers and for equipment—is necessary, and running costs are important. Again specialist housing, care homes, and homes for those with dementia are well researched, but for mental wellbeing Dutton noted the need for a noninstitutional look and feel both internally and externally.

Other buildings are significant to our wellbeing; for instance, schools. Jones and Harrison (Chapter 12) state that a good school environment in a safe neighborhood results in less bullying, although there is still a need for more research on its relationship with design. While the careful design of sports facilities promotes physical activity, better neighborhood sidewalks and fewer fast-food outlets in the local vicinity also promote good physical health. Therefore Jones and Harrison promote the presence of vegetation, woodland, wildlife gardens, vegetable plots, grass, better zones for sport and multiactivity, and quiet play areas. Maxwell and Evans (Chapter 11) also

recommend reducing noise levels in schools, avoiding chaos, because better school conditions may negate poor home conditions.

Once a person is out of childhood and learning environments, the workplace is the other building that has a significant effect on our physical and psychological wellbeing. Again much design guidance is available on the design of workspaces, including ergonomics, light, noise, and temperature. However, careful design for psychological wellbeing must consider views of nature and also spaces for privacy, enrichment, and empowerment, as well as color, choice and control, personal mementos, places of attachment, and greater employee ownership of the design.

Hospitals and healthcare buildings are environments that have a significant effect on our health and wellbeing and have been studied from that perspective. Payne et al. (Chapter 15) outline the features that must be designed into these environments; for example, easy wayfinding, clustered rooms, short corridors, personalization, waiting spaces that encourage supportive relationships, facilities that enable autonomy (bed rails, floor types), and vitality. Further, daylight, views of nature, windows, gardens, artistic images (surrogate views), and minimization of noise promote health improvement.

Health care, like work and education, is changing due to advances in technology and practices. When the purpose and character of such places change it is important not to lose the underlying design principles necessary to deliver environments that support good physical and psychological wellbeing.

Global Context

Current global challenges such as climate change, carbon reduction, energy, and food security, and those that will emerge over the coming decades, will always require shifts in our thinking in relation to designing and planning the physical environment. Davies et al. (Chapter 21) introduce issues around low-carbon design of housing, looking at fabric upgrade, airtightness, temperature, energy use, ventilation, etc. We know already that insulation in housing reduces hospitalization and absence from school. Croxford (Chapter 20) explores the important aspect of air quality, which must be addressed at a global, local, and residential scale. He says, for example, "Cities can be designed to have more pedestrian zones, and polluting industries and sources can be kept out of airsheds . . . streets can be designed to keep pedestrians further from busy intersections, and to make vehicles go more slowly and smoothly, which reduces emissions . . .

buildings can be designed to be ultra low energy, exceeding the building regulations, by increasing insulation beyond that required, and thus minimizing consumption and thus emissions of fossil fuels . . . buildings can be designed to have low concentrations of indoor pollutants."

Table 24.1 summarizes the knowledge that is outlined in this volume, in the form of guidance on designing for wellbeing in the built environment.

The Way Ahead

This volume marks the burgeoning of research as well as interest in wellbeing and the built environment. There is a rapidly expanding body of expertise and knowledge in the field. It could be argued that awareness stemmed initially from concern about obesity levels and acknowledgement that some neighborhoods promoted walking more than others. There was also a realization that where you live makes a difference to your health and how long you live, regardless of your socioeconomic background. Parallel to this interest in the built environment has been a shift in thinking in the health sector away from treating illness to prevention of ill-health, even promotion of "wellness." At the same time, those concerned with climate change and sustainability were conscious that social and emotional aspects were being overlooked. They were faced with the failure of schemes designed to promote energy efficiency because they were unappealing to their users. What can be seen now in built-environment research is an expansion of focus from the promotion of physical activity to broader ideas of wellbeing. Given a choice, most people would choose happiness over good health. And who wants to live a long life if that life is of poor quality?

Although progress has been made there is still a long way to go. We need more research, but in plotting the future of this work we can see several issues that need to be addressed.

The Quality of Research

The research in this field is by definition cross-disciplinary and this can cause problems when it comes to developing methodologies. Much of the work is now being led by epidemiologists and other health academics, for whom the randomized controlled trial is the gold standard. Findings from studies stemming from built-environment disciplines are sometimes dismissed in reviews because the quality of the research is considered substandard. There

Table 24.1. Design Guidance for Promoting Health and Wellbeing.

Objective	Possible built-environment solutions
Health objectives	
Promote physical activity and healthy diet	Solutions mainly at street and neighborhood scale: incorporate traffic-calming devices (e.g., curving streets, sharp bends, chicanes, narrow roads, changes in surface to signify pedestrian priority); provide interconnected street layouts and short blocks; ensure footways are wide and smooth; incorporate greenery, especially to provide a buffer zone between pedestrians and traffic; ensure good links to nearby facilities and amenities, especially food stores. Create mixed-use development, particularly through the inclusion of shops and restaurants/cafés in residential areas. Provide space for growing fruit and vegetables.
Combat respiratory illnesses and allergies	Ensure homes have good air quality through adequate ventilation; maximize the use of natural materials. Use greenery to combat effects of traffic on air quality outside; minimize traffic congestion.
Reduce the likelihood of injuries in the home and on the street	In the home: ensure the design of stairs, windows, balconies, and heat sources does not create unnecessary risks. On the street: design to reduce the speed of traffic (as above).
Mitigate the health impacts of climate change, resulting from: (a) heat waves and cold waves (many vulnerable people, e.g., older people, die in these conditions); (b) natural disasters	Ensure homes can be kept warm in winter (cheaply) and cool in summer (without the need for air conditioning), using passive design where possible (e.g., passive solar gain, cross-ventilation). Ensure homes are flood-resistant. Mitigate the urban heat-island effect through use of reflective surfaces and greenery.
Wellbeing objectives	
Facilitate successful childhood development	In the home: ensure adequate space and privacy between rooms (e.g., through good sound insulation), and especially allow space for homework; ensure good sound insulation from external noise; ensure good air quality and warm homes; provide a high level of natural daylighting; provide houses rather than flats for families. On the street: ensure the space is safe for children to play in, by calming traffic, including crossings and facilitating surveillance from

(*continued overleaf*)

Table 24.1. (*Continued*)

Objective	Possible built-environment solutions
	inside homes (windows facing the street, etc.); optimize the amount of greenery in the environment; incorporate features that encourage informal play (especially natural ones such as shallow water features, stones, logs, etc.). Provide parks and open spaces, including play areas, especially those comprising natural elements such as trees, water, and rocks which stimulate creativity. Provide dedicated spaces in neighborhoods for teenagers to "hang out."
Enable independence in older age	In the home: incorporate Lifetime Homes standards and dementia-friendly design features. Provide a range of house types including assisted living developments, retirement villages, and cohousing schemes. In the neighborhood: provide a hierarchy of streets from busier, main streets to quieter, residential ones. Provide a "deformed grid" street network, with gently curving streets and T junctions rather than crossroads. On the street: ensure footways are smooth, plain, and wide (2 m minimum); incorporate seating, preferably wooden seats with arm- and backrests; provide a buffer zone (e.g., grass verge) between the footway and road. Provide adequate toilet facilities. Incorporate landmarks and wayfinding cues (e.g., trees, mailboxes, clocks, towers) in buildings and neighborhoods.
Reduce stress	In the home: ensure good sound insulation between rooms and from the outside; optimize natural daylighting. On the street: optimize the amount of greenery (e.g., street trees), especially in terms of views from inside; use greenery to absorb sound. Provide quiet, natural spaces that offer opportunities for rest and retreat. When designing public and healthcare buildings/areas, provide clear signage, obvious entrances and wayfinding cues. Provide a user-centered, flexible public transport system.
Promote positive mood/emotions	Provide homes where people can feel private, and where they can experience peace and quiet; include interesting features where possible; incorporate human-scale details (flower boxes, balconies, etc.); optimize greenery and views of it.

(*continued overleaf*)

Table 24.1. (*Continued*)

Objective	Possible built-environment solutions
Facilitate good relationships (adequate privacy as well as opportunities for social interaction)	In the home: provide good sound insulation between rooms; ensure enough spaces for different activities to take place; provide space for families to eat together. On the street: provide a buffer zone between the private realm of the home and public realm of the street, e.g., through small front gardens; maximize opportunities for interaction with neighbors, e.g., through front doors facing the street, inclusion of porches and terraces/balconies; lower-level boundaries to allow "chatting over the fence," clearly demarcated private backs and public fronts. Design a connected, walkable street network. Include retail, services, and amenities in residential areas. Provision of an efficient, effective public transport system can facilitate people's ability to get out and about and meet others.
Enable people to concentrate and be productive when working	Provide good sound insulation and natural daylighting; ensure good air quality; provide views of greenery. Create spaces that people can control, adapt, and personalize.
Help make people feel safe from crime	Ensure clear demarcation of private and public space (usually private backs and public fronts); ensure entrances to homes face the street; provide good surveillance of public spaces; provide adequate street lighting. Design places and spaces that are easy to maintain.

is a need for innovation and creativity in research methods, but what the authors of this volume generally agree on is the need for more longitudinal studies. The majority of existing studies are cross-sectional in nature, which means that, although they may find relationships between wellbeing and features of the built environment they are unable to unravel cause and effect. It is possible that relationships arise through self-selection; for example, people who like to walk choose to live in more "walkable" neighborhoods. "Social drift" also occurs; that is, people who have poor health, particularly mental health, tend to drift down the socioeconomic scale and may end up living in more deprived neighborhoods with dilapidated, neglected environments. Another issue identified by the authors in this volume is source bias. This may be the case when the research relies on self-reporting

to measure the quality of the built environment. It is wrong to assume that a poorly rated environment leads to poor wellbeing or depression; it may just be that someone who is depressed is more likely to be negative about life in general, including their environment.

On a positive note, it has also been noted by authors in previous chapters that new technology offers the opportunity to improve research methods. GIS in particular have great potential (e.g., see Chapter 23), as does the application of satellite imagery such as Google Earth. Further, increased collaboration and close partnership between academics of different disciplines is likely to provoke new ideas and novel methods, which could raise the bar in research quality.

Defining Wellbeing

It is obvious from reading the chapters in this volume that one of the main issues is a lack of definition or consistency in the concept of wellbeing. This is an issue that extends beyond built-environment research, but this field presents particular challenges. One of the main problems stemming from the use of varied ideas of wellbeing is that it is difficult to compare studies or conduct a metaanalysis of the findings. This in turn weakens the body of knowledge. Another more salient problem for built-environment research is that there may be different and even conflicting findings for different aspects of wellbeing. Townshend (Chapter 9) articulates this very well, as do Tyler (Chapter 19) and Davies et al. (Chapter 21). For example, inclusion of open, green spaces in a neighborhood may provide opportunities for residents to restore their mental energy, but they also lead to lower densities and further distances to walk to facilities, resulting in a less walkable environment.

What is encouraging from the work described in this volume is a growing understanding of the mechanisms and theories that explain the relationships between wellbeing and the built environment. Different models are emerging, each with a different focus, whether biomedical, social, or psychological. It is clear that, in developing ideas of wellbeing for this research, they should be those related to the environment through plausible theory.

It is not at all clear what we are aiming for in terms of designing for wellbeing. Many of the authors in this volume call for a more holistic approach, and a nuanced interpretation of wellbeing, considering the impact of the built environment on all the senses and on social as well as emotional responses (e.g., Chapters 10 and 17). However, it just may not be possible to get it all right at once. In addition, there is the added complexity that

what may work for one person would not for another. What is emerging from the research is that there are different impacts depending on a person's age, social circumstances, personality, and so on. In most instances the built environment has to suit the needs of a whole range of users. So, how do we decide whose needs to prioritize? Do we adopt the Rawls principle as Tyler suggests and seek to ensure that no one is worse off? Or do we prioritize the needs of the least well off or those with disabilities, in order to reduce inequality? An alternative approach is a utilitarian one: to maximize the happiness of the greatest number. This is the time to open up the debate and to move toward a consensus on what we aim to achieve.

Generation of Usable Evidence

We have long contended that the main problem with the evidence we have to date is not so much its poor quality but its lack of usefulness in practice. This is the result mainly of the research being led by health and social science disciplines, which lack design knowledge.

The usefulness of the research is closely related to how the built environment is measured. Studies need to identify the contribution to wellbeing of individual design features. Of course, a difficulty is that some features are almost impossible to quantify. The best example of this is "attractiveness." We are convinced, and the chapters in this volume support the view, that attractiveness is a key element in how the built environment affects our wellbeing. Numerous studies show that people who live in more attractive environments (usually as rated by residents themselves) are better off. We know that we should design and deliver attractive environments. But we don't know what these are. It is perhaps the holy grail of architecture: to understand what constitutes beauty. There have been many theories, from as far back as Roman times. Some might contest the idea of any "rules," that beauty is in the eye of the beholder. But there has been progress in understanding what is considered beautiful in a human face, so why can't we achieve the same for buildings?

Perhaps the main challenge in built-environment research is to know what aspects to investigate. To date, the research has used fairly crude measures such as residential density (population or households per square kilometre) or overall amount of "green" space. Density is a good example of where the research fails. It is not surprising to us that the findings from density studies are inconclusive and often contradictory. High-density development can be delivered in a whole variety of forms, from a single tower block to

medium-rise courtyard schemes and terraced or "row" housing. Further, these forms can vary enormously in terms of details such as materials, window types, and general style. Whether or not the development promotes wellbeing is likely to depend more on these forms and detailed qualities than on overall density levels. In some ways the work in this volume raises more questions than it answers. It calls us to look more closely at different aspects of design. For example, Evans (Chapter 6) argues that while mixed uses have generally been seen to be beneficial for wellbeing, it really depends on the form they take. Large, institutional uses set back from the street in residential areas will impede social interaction while small corner shops will promote it. Brown and Lombard (Chapter 5) also make this point. The same goes for the type/form of housing. High-rise housing is usually seen to be problematic for wellbeing, but for the right people, with the right facilities (e.g., a concierge and lifts that are well maintained) it can perform very well. Ellaway (Chapter 3) found an inverse relationship between wellbeing and access to green space. This hints, again, at the importance of quality or detailed characteristics. It is essential that research in this field, as it develops, starts to investigate the "qualitative" as well as the quantitative aspects of the built environment. That is not to say that the research itself should be qualitative: we need to develop robust, quantitative ways of measuring the design qualities that matter, at the human scale.

The authors in the volume also point to the need to consider thresholds and nonlinear relationships. For example, it has been pointed out that wellbeing seems to be supported by moderate densities of development, while lower and higher densities cause problems. Kyttä and Broberg (Chapter 23) suggest that, certainly for the Finnish urban context, there is a threshold of about 100 housing units per hectare beyond which negative effects begin to arise.

To ensure research is designed to generate useful evidence it will be beneficial to strengthen the contribution and presence of built-environment disciplines in multidisciplinary teams.

Approaches to the Use of Evidence in Practice

Even if we have plenty of strong evidence nothing will be achieved unless it is used in practice. Development of research in this field needs to be matched with a step change in the way built environments are designed and delivered. Over the last 50 years or so architecture has become an "art," with buildings considered sculptural entities and originality prized above all else. To create

buildings and places in which people can flourish, first of all design for wellbeing needs to be made a primary goal. Second, designers need to use evidence of what works in developing their schemes. Where possible, involving users in the process can add further benefits. Of course, in practice decisions about how to create and adapt built environments are complex. There are other goals to be met—such as minimizing costs and reducing energy consumption—and design for wellbeing needs to be balanced against these.

Responsibility lies not just with designers. As pointed out by several authors in this volume, ongoing maintenance and care of built environments is essential if they are to achieve benefits for users. There is a role for local authorities to take a more proactive role in managing their towns and cities. Other groups, including associations of local residents and social housing providers, could also provide important roles. Housing and urban policy can have a significant impact on how the built environment is experienced. We need to break the cycle of decline where the least well off are further disadvantaged by living in neighborhoods that fail them in terms of schooling, access to green space, and food choices. This can only be done through policies that minimize residential segregation; for example, through mixing social housing imperceptibly among privately owned homes.

Developers still have a lot of power in the delivery of built environments. How can they be encouraged to create and adapt environments that support wellbeing? One tool we advocate is a rating system or kitemark that recognizes and rewards design for wellbeing in buildings, housing, and larger developments. Such a tool would provide the knowledge consumers need to make informed decisions about the buildings they buy or rent. We also need to provide people with information specific to their own needs and circumstances. There may be conflicts between the requirements of different social group; for example, between older people and teenagers. Careful design could minimize these conflicts, or people could be guided towards places to which they are best suited.

Progress in research, methods, and approaches to implementation of evidence in practice needs to continue. There are still big gaps, and what we know, on the whole, stems from the context of Western society. There is, however, huge potential for the future. There is the potential to create places in which we can grow and learn, develop good relationships and feel safe, where we can find excitement and stimulation, as well as space in which to retreat and rest. We are all influenced every day by the environments that surround us. Let us work together to make these environments ones in which we can truly flourish.

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