Making the Case for Investment in the Walking Environment

A review of the evidence

University of the West of England, Bristol, and Cavill Associates

LOTTERY FUNDED

BIG LOTTERY FUND

LIVING STREETS
PUTTING PEOPLE FIRST

Authors:

Dr Danielle Sinnett (UWE)

Professor Katie Williams (UWE)

Dr Kiron Chatterjee (UWE)

Dr Nick Cavill (Cavill Associates)

The authors would like to also thank the following for their contributions:

Caroline Bird (UWE)

Louise King (UWE)

Hugh Barton (UWE)

Jim Mayor (Brighton and Hove City Council; New Road, Brighton Case Study)

Paul Osbourne (Exeter City Council; Exeter Case Study)

Gregor Hamilton (Dundee City Council)

Foreword

The places we live in shape our lives. Ask any citizen of any great city, town and village what makes it great, and you will find issues that affect the walking environment at the top of the list: how safe they feel when walking around their area; how attractive their local streets are; the quality and proximity of their local shops and services; and the care taken to maintain the basic quality of the street. Our streets are the one public service everyone uses every day, but this is often overlooked when considering where public and private investment and attention should be directed. Those of us who have championed better streets for many years fully understand the benefits of such attention and investment, but unfortunately we have not yet reached the position where this is second nature to all of those with responsibility and influence over our public spaces.

I'm therefore delighted that Living Streets has commissioned this report from the University of the West of England which reviews the available evidence on the benefits of investing in the walking environment. Living Streets is an organisation that is passionate about and understands the importance of this agenda and works with decision-makers and professionals across the country to improve our streets. This report is an incredibly useful step in helping them and anyone else interested in the state of our streets and public spaces to raise the profile of the walking environment in spending priorities.

Many people will associate me with the improvements made to Kensington High Street, when I was Deputy Leader of the Royal Borough of Kensington and Chelsea. This is one of the case studies used in the report, along with other examples of good practice from the UK and abroad. Together the case studies demonstrate the impact and the value of investing in our public spaces. We have seen many benefits from the improvements on Kensington High Street and there are clear lessons for other decision-makers and practitioners on how they can realise the added value that comes from public space improvement. The scheme did not happen overnight, and it did not happen without considerable effort to get the changes agreed and implemented. We had to overcome some considerable hurdles to get the outcome we wanted, but as a result of our efforts we have retained the street's status as a premier shopping destination and traffic collisions have been reduced by more than 40%, with pedestrian casualties reducing by 59%.

I hope that this report will help others to understand the importance of investing in the walking environment and help decision-makers prioritise improvement schemes despite tighter public finances and potential opposition to change. One of the most striking findings of this report is the positive impact of walking friendly environments on local economies - showing that improving the public realm should be a key part of any package to revitalise local economies. Transport for London has developed a toolkit for measuring and comparing these benefits. In terms of value for money, improvement schemes score very well against other initiatives - and bring such a wide range of other benefits ranging from increasing physical activity, improved safety, reductions in carbon emissions and improved air quality.

More and more people today understand the benefits of great streets and public spaces. By bringing the available evidence together in one place, I hope that this report will further make the case for public realm to be a higher priority and for greater investment in walking friendly streets and spaces.

Councillor Daniel Moylan

Deputy Chairman, Transport for London

Contents

Key Findings

Overview

This report sets out the arguments and evidence for investing in the walking environment. Investments in the walking environment can take a number of forms (see Figure 1, left hand box). These investments can lead directly to higher walking levels and pedestrian numbers, and can also create better places for the users of the urban environment. Both increases in walking and area improvements have a wide range of benefits for 'people' and 'place' (see right hand box).

These relationships are complex and sometimes difficult to measure precisely. However, there is now sufficient evidence from numerous sources to build a picture of the benefits of investment in the walking environment, and this evidence is presented in the report.

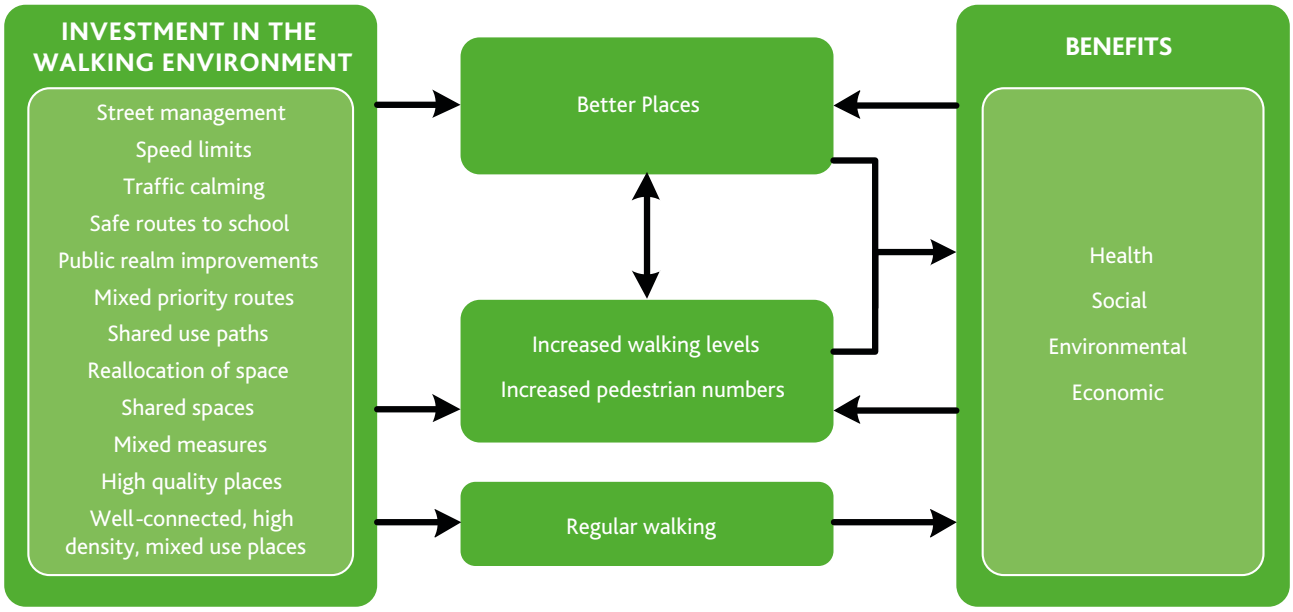


Figure 1. The relationships between investments in the walking environment and their benefits

It is also important to know if investing in walking environments provides 'value for money'. To address this, the report summarises cost-benefit analyses of different types of investment in the walking environment.

The report also presents several evaluated case studies of completed walking environment schemes from the UK and internationally.

The benefits of walking-friendly environments and walking

The benefits of walking-friendly environments and walking to both 'people' and 'place' are extensive and far-reaching.

- Walking has significant **physical and mental health benefits**: higher levels of walking are associated with lower risks of mortality (mainly through reduced risk of cardiovascular disease and cancer). Walking helps prevent obesity; diabetes; high blood pressure and can also improve self-worth, mood and have a positive impact on self-esteem. It is also linked with reductions in anxiety and depression.

- **Specific groups such as children and older people** who are often more reliant on their local neighbourhoods can gain significant health benefits and independence through walking
- **Residents of walking-friendly neighbourhoods** (in terms of density, connectivity, quality, greenery etc.) are less likely to be depressed, and more likely to have better physical and mental health
- Investments in walking environments can help alleviate the significant societal and economic **costs related to poor health**
- Walking and walking-friendly environments have **social benefits**. They contribute to increased social interaction, the development of social capital and increased safety (and perceptions of safety)
- **Perceived levels of safety affect how much people walk**. People walk more when they feel their neighbourhood is safe, well maintained and lively. Localised investments to improve perceptions of safety will encourage people to walk more, with resulting benefits for health and social interaction
- **The environmental benefits** of walking-friendly environments are largely related to shifts from other modes. Reductions in carbon emissions and, noise and improvements in air quality are potential benefits
- Investments in walking environments have **significant economic benefits**. They can increase the value of residential and commercial properties, and increase rental income. They can also support local economies by attracting new businesses and events
- **The public and retailers are willing to pay**, to varying degrees, for improvements to the walking environment

What makes a good walking environment?

- **Interventions in the walking environment can take many forms**. Key interventions currently being implemented in the UK and internationally include:
    - Speed limits
    - Safe routes to schools
    - Traffic calming
    - Public realm improvements
    - Mixed priority routes
    - Shared use paths
    - Reallocation of space
    - Shared spaces
    - Mixed measures

- These interventions have a **range of benefits which are common to many schemes**. Overall, they are successful in:
    - Significantly **increasing pedestrian activity** (footfall)
    - **Improving safety**: they lead to fewer road casualties, injuries to pedestrians and traffic collisions
    - **Reducing vehicle speeds**: where the schemes set out to reduce speeds, they are successful, and this contributes to a more walking-friendly environment
    - **Delivering social benefits**: these interventions increase opportunities for social interaction which can facilitate the development of social capital. They can also lead to higher numbers of people taking part in outdoor activities and spending time outside their homes

- **Delivering economic value**: the schemes have increased the sale prices of nearby homes and increased retail rents
- **Encouraging more physical activity**: this is particularly noticeable in, for example, increases in the proportion of children walking to school
- **Reducing noise levels**
- **Reducing the number and distance of car trips**, implying a modal shift away from the car to walking
- **Providing attractive and popular places**: the public are positive about investments in the walking environment, and the schemes usually have the support of visitors and residents. People tend to report that investments in the walking environment lead to more attractive and safe places

- There are also a number of characteristics of existing urban environments that encourage walking. These tend to be places that are higher density, well connected, mixed use, and attractive (high quality)
- Overall, urban walking-friendly environments are associated with between 25 and 100% greater levels of likelihood of walking
- The aesthetic quality of a place is the most consistently important factor in relationships between the public realm and recreational walking, health and well-being

How cost effective are investments in the walking environment?

- Investments in the walking environment are **good value for money compared with other transport investments**
- Investments in the walking environment are **good value for money** – even accounting for the fact that most **evaluations only consider a small number of potential benefits**. Cost benefit analyses tend to underestimate the value of the walking environment, because very few studies have accounted for the impacts of increased walking on road casualties, congestion, fuel costs and other motorised travel costs, noise and air pollution, carbon dioxide and reduced public costs of providing for motorised transport. There are likely to be substantial benefits arising in these areas where investment in walking leads to modal shift
- The most **significant measured benefit of investments in the walking environment is improved health from increased physical activity**, and again, this is despite the fact that only part of the total health benefit has been assessed. UK and international studies have reported significant potential health benefits from relatively minor investments
- **User experience (often referred to as journey ambience) is the second largest benefit**. This represents the improved travel experience of users of a walking environment
- **All the evidence reviewed of evaluations of walking environments showed positive cost benefit ratios**, of up to 37.6
- **In comparison with other transport projects, investments in walking are value for money**. The **highest value for money transport projects are smarter choices, cycle and pedestrian schemes, local safety schemes and some bus schemes**. This suggests that investment in the walking environment is likely to be at least, if not better, value for money than other transport projects

Chapter 1: Introduction: why invest in walking environments?

The scope of the report

The purpose of this report is to set out the arguments and evidence for investing in the walking environment. Walking, either as a form of transport, or for pleasure has many benefits: it is good for the environment, for health and social sustainability, and for economic conditions. Yet many of our environments are not conducive to walking. City and town centres are often poorly designed for pedestrians and dominated by traffic, and local neighbourhoods are often planned for car use, above other modes of travel.

However, in the last decade or so there has been a real shift in interest to designing and re-designing places to promote walking and other sustainable forms of mobility, such as cycling. A range of interventions in urban environments has been developed, implemented and tested. These interventions include pedestrianisation schemes, public realm improvements, the reallocation of public space and traffic calming measures. In addition a range of 'mixed' strategies, including physical changes to the built environment alongside management and behaviour change initiatives, have also been developed, implemented and reviewed. Much research has also been done into the characteristics of existing urban environments to see what types of place seem to encourage more walking. This report reviews and presents evidence from implemented projects and research, in the UK and internationally, on the benefits of investing in walking environments.

The starting point for the report is an understanding that investments in the walking environment can take a number of forms (see Figure 1, left hand box). These investments are aimed at creating better places which encourage more walking to take place and more pedestrian activity. Enhancements to the walking environment and increased walking and numbers of pedestrians can generate a wide range of benefits for 'people' and 'place'. These include benefits to physical and mental health and wellbeing, social interaction and safety, the environment (such as better air quality and more liveable neighbourhoods) and the economy (such as increased retail activity). Of course, many of these relationships are complex, and in some cases multi-directional. For example, investments in the walking environment can lead to increased walking levels, which then make neighbourhoods feel safer, and encourage even more people to walk. Causality is often indirect and sometimes difficult to measure precisely. However, there is now sufficient evidence from numerous sources to build a picture of these multi-faceted relationships, and this is presented in the report.

Understanding the nature and extent of the relationship between investments in the walking environment and their associated benefits still begs questions about the cost effectiveness of such initiatives. It is important to know if investing in walking environments provides 'value for money'. To address this, the report summarises cost-benefit analyses and cost-effectiveness of different types of investment in the walking environment and, where possible, compares these to studies that have looked at the cost-benefit of other transport projects and other interventions to encourage walking.

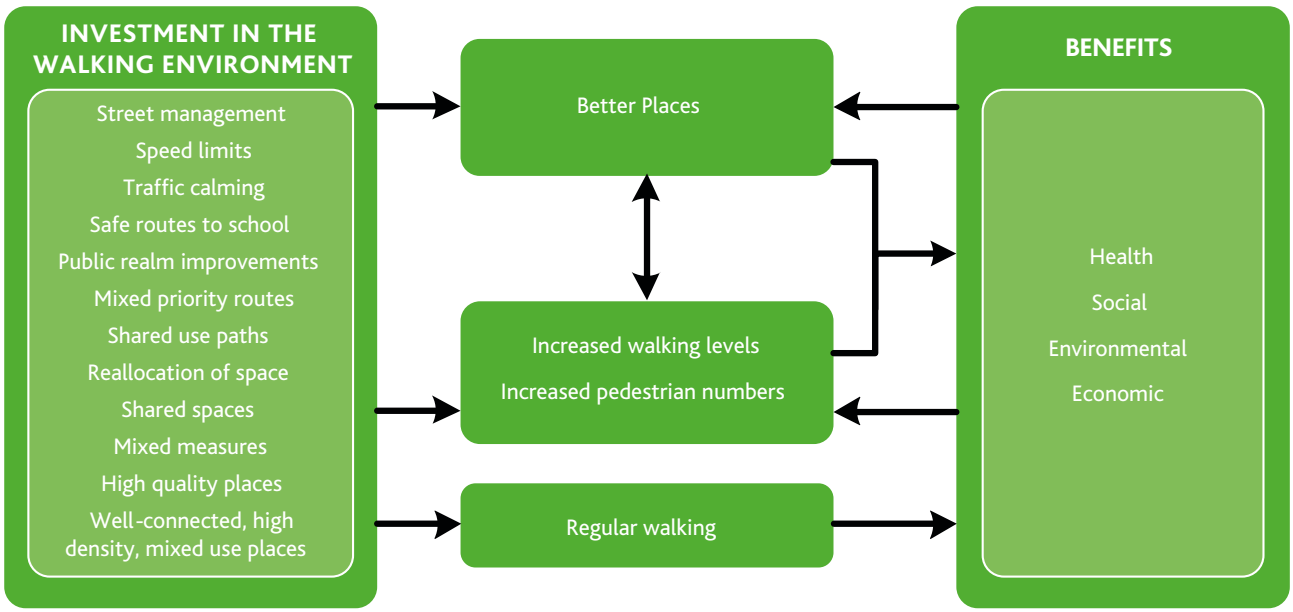


Figure 1. The relationships between investments in the walking environment and their benefits.

Report Structure

This chapter (chapter 1) sets out the scope of the report, and presents the rationale for the review that follows. Chapter 2 identifies wider benefits to society of walking friendly environments and walking. It makes the link between environments conducive to walking and the numerous positive impacts that can be achieved, in terms of health, social, environmental and economic benefits. Chapter 3 presents an analysis of 'what makes a good walking environment?' It presents the evidence of the impacts of a number of interventions in the walking environment (speed limits, safe routes to school, traffic calming, public realm improvements, mixed priority routes, shared use paths, reallocation of space, shared spaces and mixed measures). It also presents evidence on the characteristics of existing places that are beneficial for walking, covering well-connected, high density and mixed use places and high quality places. Chapter 4 then presents an analysis of the value for money of investments in the walking environment and compares value for money to other transport investments and other interventions to encourage walking. Chapter 5 presents ten case study vignettes of examples of investments in walking environments. These are drawn from the UK, USA, Australia, Denmark and the Netherlands. Each case study describes the scheme, and presents an evaluation of its impacts on walking, as well as wider benefits. Finally, Chapter 6 presents the conclusions of the report.

Methods used for the review

It is worth commenting briefly on the methods used in this evidence review. Broadly, two types of literature were used. First, studies that evaluated some form of intervention in the walking environment were sourced and reviewed. The majority of these studies are 'grey' literature produced by organisations responsible for the intervention (for example the Local Authority) or by independent teams appointed to undertake a review (e.g. by government). Second, academic research papers were reviewed. Evidence from the UK was prioritised, but where it was absent or incomplete, international studies were also drawn upon. UK and international case studies are included in the report. Information on these was gathered from primary and secondary sources.

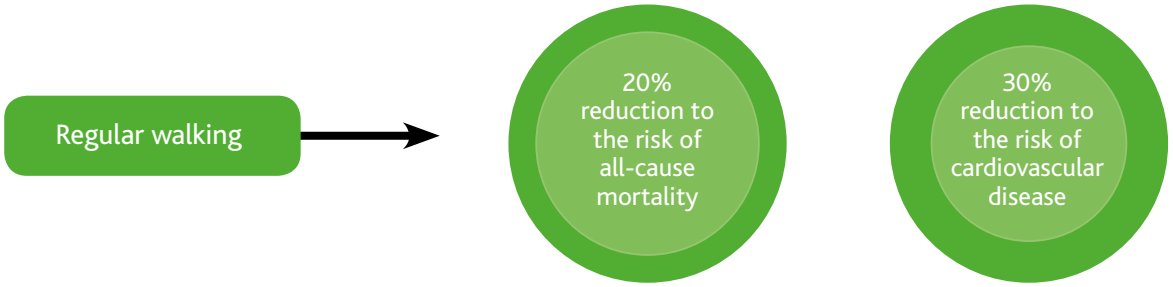
Chapter 2: The wider benefits of walking friendly environments and walking

Photo: Dave Charnley

The wider benefits of walking friendly environments and walking to both 'people' and 'place' are extensive and far-reaching. This chapter sets out the wider benefits to society based on the literature and following the logic set out in Figure 1 (Chapter 1). Direct transport benefits of interventions that increase walking, and decrease motorised traffic, include improved travel experience; reduced road collisions; reduced travel times and unreliability; reduced fuel and other transport costs; reduced emissions and improved ability for people to access facilities and services. The extent of these benefits will depend to a large extent on the degree of modal shift from motorised modes of transport to walking. This chapter considers the wider benefits to society that arise from walking and walking friendly environments. Evidence on the direct transport benefits of investments in the walking environment is presented in Chapter 3.

Health benefits

Walking can have a number of positive health outcomes. Walking reduces the risk of all-cause mortality by up to 20% and cardiovascular disease by up to 30%[1] (meaning that regular walkers are likely to live longer than non-walkers). Walking **reduces the risk of high blood pressure**[2,3,4], stroke, and high cholesterol[5]. Walking expends energy and therefore can help energy balance and body composition[3,6] (potentially **reducing obesity**).



Walking can also improve mental health and well-being, by having a positive impact on self-esteem, physical self-worth[6], **stress**[7], **mood**[7] **and mindset**[7]. Studies have shown, for example, that in older women walking can reduce anxiety[8] and depressive symptoms[8,9]. For this group, walking has been found to be as effective as other forms of physical activity in achieving reductions in anxiety and depression[8], with several short sessions per week being more effective than one long session[9], suggesting that walking around the local neighbourhood may provide an important source of physical activity. An Australian study found that those who walked for recreation for more than 8.6 minutes per day were 72% more likely to report better physical health and 33% more likely to report better mental health[10] than those who walked less.

Children can also gain health benefits from walking. Regular walking of around 20 minutes per day can increase their physical performance[11]. Children who travel by walking use twice as many calories as those who travel by car[12] and, over the course of a week, use about the same amount of calories as those used during PE lessons in school[12]. Parents' concerns about safety are one of the main reasons that fewer children walk regularly in the UK, so investments in walking environments can be significant for the young. Furthermore, patterns of walking behaviour are likely to be influenced by childhood habits, so it is important to encourage walking early on in life.

Strong relationships have also been found between quality of the local walking environment and health. Studies in the US[13], Europe[14,15,16,17] and Australia[10,18] have all found such links. **Residents of walking friendly neighbourhoods**, in terms of density, mix of use and connectivity, are **less likely to report depressive symptoms**[13] **or poor mental health**[18] and those in neighbourhoods with high social-environmental quality[14,18] or greenery[10] are more likely to report good health. Looking specifically at the UK:

- In Britain, those with poor neighbourhood facilities were around twice as likely to have worse self-reported health as those who rated their facilities as very good[15]; and those who felt that their neighbourhood had very big problems in terms of traffic, noise, crime, air quality, litter, rubbish or graffiti were more than 70% more likely to have worse self-reported health than those who felt their neighbourhood had no problems[15]
- In Scotland, those who liked the facilities in their neighbourhood were 15% less likely to report not being in good health, 21% less likely to have a long-term illness or disability and 12% less likely to be a frequent GP visitor[16]; and those who liked the appearance of their neighbourhood were 17% less likely to report not being in good health, 13% less likely to have a long-term illness or disability and 13% less likely to be a frequent GP visitor[16]
- In South Wales, a lower score for neighbourhood quality corresponded to lower self-reported mental health[17]

The cost implications of poor health related to low levels of exercise have been found to be substantial. Cardiovascular disease alone was estimated to cost the UK economy £29 billion in 2004 in care costs and lost productivity[19], whilst the cost to the NHS of elevated body mass index (BMI) was estimated at £7 billion in 2001, with a predicted increase to £27 billion by 2015[20]. Mental health problems have been estimated to cost the UK economy £106 billion in 2009/2010 in care costs, lost productivity and reductions in quality of life[21]. Given these figures, **increasing regular walking in the population through investments in walking environments could contribute to considerable cost savings** (see Chapter 4).

Social benefits

Walking, and walking friendly environments, are associated with a number of social benefits, including increased social interaction, the development of social capital and increased safety. Social capital can be defined as the networks and interactions between citizens; generally categorised by engagement with the political process, volunteering in community activities and socialising in the community[22]. It is well established that walking in the local neighbourhood increases the potential for chance encounters or social interaction, which in turn can increase the sense of community[18,23,24,25] and social control[26,27]. However, these relationships are complex and associated with numerous elements of urban design and place making, as well as with the quality and management of local environments.

Studies, in the US[24,28] and Europe[22,29] have found that **walking friendly neighbourhoods are associated with greater levels of social interaction**[24,29], **sense of community**[22,29], **social capital**[22] **and place attachment**[24,29]. One study, carried out in Ireland[22], found that residents of highly 'walkable', mixed use neighbourhoods exhibited at least 80% greater levels of four indicators of social capital (knowing neighbours, sociability, trust and political participation) than those in less 'walkable' neighbourhoods. Another study, this time from the UK[29], found that the perception residents had of the quality of their neighbourhood, its level of maintenance and character were all positively associated with a sense of community and attachment to place.

As well as at the neighbourhood level in general, **specific aspects of the walking environment have also been found to be associated with social interaction and sense of community**[18,30]. In particular, a greater land use mix[22,28], well placed seating[31], greenery[18], interesting features[28], wide pavements[31], interesting[31] and active[29] frontages, trees and canopies to provide shade[31] and articulated façades[31] can all increase pedestrians' social interaction. These features are more effective in the promotion of lively streets when they are found in combination with businesses that support stationary activities, for example food outlets with tables[31]. Social interaction has also been associated with lower crime rates[26].

Perceived levels of safety have been associated with both levels of walking and self-rated health which highlights the virtuous circle that is possible from investing in walking environments. In Glasgow, those who felt their neighbourhoods were safe to walk in after dark were 70% more likely to walk at least five times per week than those who did not feel their neighbourhoods were safe[32]. Similarly, another study in Scotland found that those who felt their neighbourhood was not safe to walk in during the evening were 27% less likely to walk for fitness or pleasure more than four times per week, 39% more likely to report not being in good health, 49% more likely to have a long-term illness or disability and 19% more likely to be a frequent GP visitor than those who felt their neighbourhoods were safe[14].

Perceived safety, fear and mistrust have all been linked to the levels of maintenance or incivilities, for example vandalism or graffiti, in a neighbourhood[26,27,33]. Residents who feel that maintenance and vandalism are a problem have been found to be more than twice as likely to be fearful of crime[33]. As well as maintenance levels, perceived safety has also been linked to the liveliness of streets; the presence of other people reduces fearfulness[34] and informal social interactions can buffer fear and mistrust in neighbourhoods[26,27]. Given that walking and walking friendly neighbourhoods have been associated with increased potential for social interaction[22,24,28,29] it is likely that they are also related to perceptions of safety, for example as more people are visible in the neighbourhood. One study in Australia found that there was a 40-64% reduction in the likelihood of being fearful in neighbourhoods with high levels of walking-friendliness[33].

The evidence suggests that **perception of safety is an important factor in the likelihood of walking**. Perceived safety may be more strongly related to leisure-time walking as opposed to transport walking. Generally, perceptions of traffic safety are not associated with differences in walking levels or sense of community[27,28,34]; more important is the overall safety of the neighbourhood (as affected by its appearance, crime rate, and level of incivilities). However, streets with high traffic loads have been associated with reductions in social interaction[18]. It is likely that, **in order to reanimate the streets, changes to the walking environment will be necessary to reduce fear and encourage local residents to use the streets which will, in turn, encourage further use**.

Environmental benefits

Environmental benefits from walking investments, in terms of air quality, carbon dioxide emissions and noise reductions, are related primarily to shifts from motorised transport. Initiatives that have achieved a modal shift from car use to public transport use, walking and cycling have reported **carbon emissions reductions**. One review of soft measures to promote active travel modes[35] (e.g. personalised travel planning, active travel to school) has found that between 5 and 13 kg of carbon could be saved per person per year taking part in walking initiatives, 17 and 57 kg could be saved through walking to work and active travel to school respectively, and 183 kg through personalised travel plans. A review of the UK's 'Sustainable Travel Towns' initiative, which included a comprehensive set of measures to achieve travel behaviour change, including enhancements of the walking environment, estimated that carbon savings of around 50 kg per person per year could be made[35]. Initiatives that change the behaviour of motorists, for example through the use of speed restrictions or shared spaces, may also result in carbon savings as patterns of driving which rely on heavy acceleration and braking consume more energy[35].

Unfortunately, the evaluation of changes to the walking environment has generally not included measurements of environmental outcomes such as air quality or noise. One exception is the evaluation of the ten 'Mixed Priority Routes' across the UK (see Chapter 3) which found no consistent patterns for air quality but that **noise levels generally decreased** after implementation of the schemes[36].

Economic benefits

Improvements to the walking environment have the potential to increase economic value and economic activity in the local area[37], and this can be reflected by the sale price of residential property[38,39] and the rental price of retail premises[38,39,40].

The impacts on economic activity of walking investments have been examined using property sale and rental prices as an indicator. A number of studies have used the Pedestrian Environment Review System (PERS) developed by Transport Research Laboratory[38,39,41] to examine the economic impact of enhancement of the public realm. This system has been used in combination with the sale price of flats, the rental price of Retail Zone A property (i.e. the most valuable retail premises), a stated preference analysis with willingness to pay for improvements to the public realm and an analysis of stakeholders from the retail sector. Generally, the following economic benefits have been estimated:

- The **sale price of flats in London were significantly greater in areas with higher quality pedestrian environments**[38] (all other factors being considered)
- The elements that were most strongly associated with differences in the sale price of flats were personal security, lighting, maintenance, and quality of environment, with each having an estimated £5,096 contribution to the sale price of flats[38]
- The stated preference study of street users in London found that the most important attributes were generally in accordance with the elements above: **lighting, pavement quality and maintenance, vehicles not parking on the pavement, provision of direct 'green man' crossings, local area maps, information boards and signed routes**[41]
- Representatives of the retail sector placed the greatest value on footway surface quality, maintenance and quality of the environment, specifically favouring decluttering, maintenance and lighting[38]
- **Twelve public realm improvement schemes in London were associated with an above average growth in the sale price of nearby flats** of between 0.9% and 28% per annum (average of 7%)[38]
- Public realm **improvement schemes that had an emphasis on pedestrian priority were associated with a 12% growth in the sale price of flats**, those with an emphasis on decluttering or materials and fixtures a growth of 7% and 3% respectively[38]
- **Street users in London were, on average, willing to pay** an extra £14.78 to £17.35 per year on their Council Tax, 17 to 18 pence per journey on public transport and £1.90 to £2.02 per week on their rent[41] **for improvements to the walking environment**
- **Retailers** felt that the public realm was important and, despite expressing a reluctance to pay for improvements, they were **willing to pay a one-off payment** of 1.03-4.15% of existing business rates[41]

Despite this evidence, it is interesting to note that **the importance of pedestrian activity to the local economy can be underestimated by retailers**[37]. A study in Bristol found that retailers on a local high street overestimated the proportion of shoppers arriving by car by almost double at 41% compared with the actual proportion of 22%[37]. In fact, over half of the shoppers had arrived there by foot, and greater proportions had arrived by bus and cycle than those estimated by retailers. The retailers also underestimated how far pedestrians had travelled to get to the high street; over 60% lived within 1 mile, possibly explaining the greater proportion that walked, and pedestrians generally visited more shops than those arriving by car[37].

This misconception of the contribution that pedestrians make to local shops may also explain the importance placed on features to support motorised access (e.g. public transport and parking) by retailers[38]. Improvements to the public realm in Exeter City Centre (see case studies) have resulted in an increase in retail zone A rental prices of £5 per square foot between 2006 and 2008, which have been maintained despite falling prices in the region[40]. In Exeter, the increase in retail rental prices corresponded with an increase in footfall of almost 20% over the same period[40].

In summary, the walking environment has a direct impact on the economic performance of an area. Improvements to the urban realm can contribute positively to retail activity, and the economic value of such improvements is reflected in increased residential and commercial property values. The role of pedestrians is likely to be a significant factor in ensuring a vibrant local economy.

Conclusions

This Chapter has demonstrated that investments in walking environments can have a number of significant benefits:

- Walking has significant **physical and mental health benefits**: higher levels of walking are associated with lower risks of mortality (mainly through reduced risk of cardiovascular disease and cancer). Walking helps prevent obesity; diabetes; high blood pressure and can also improve self-worth, mood and have a positive impact on self-esteem. It is also linked with reductions in anxiety and depression
- **Specific groups such as children and older people**, who are often more reliant on their local neighbourhoods can gain significant health benefits and independence through walking
- **Residents of walking friendly neighbourhoods** (in terms of density, connectivity, quality, greenery etc.) are less likely to be depressed, have poor mental health or poor health in general
- There are significant societal and economic **costs related to poor health**, which could be alleviated cost-effectively through investments in walking environments
- Walking and walking friendly environments have **social benefits**. They contribute to increased social interaction, the development of social capital and increased safety (and perceptions of safety)
- **Perceived levels of safety affect how much people walk**. People walk more when they feel their neighbourhood is safe, well maintained and lively. Hence localised investments to improve perceptions of safety will encourage people to walk more
- **The environmental benefits** of walking friendly environments are largely related to modal shift from other modes. Reductions in carbon emissions and noise, and improvements in air quality are potential impacts
- Investments in walking environments have **significant economic benefits**. They can increase the value of residential and commercial properties, and of rental income. They can also support local economies by attracting new businesses and events
- **Street users and retailers are willing to pay**, to varying degrees, for improvements to the walking environment

References

1 Hamer, M., Chida, Y. 2008. Walking and primary prevention: a meta-analysis of prospective cohort studies. British Journal of Sports Medicine 42: 238-243.

2 Kelley, G.A., Kelley, K.S., Tran, Z.V. 2001. Walking and resting blood pressure in adults: A meta-analysis. Preventive Medicine 33: 120-127.

3 Murphy, M.H., Nevill, A.M., Murtagh, E.M., Holder, R.L. 2007. The effect of walking on fitness, fatness and resting blood pressure: A meta-analysis of randomised, controlled trials. Preventive Medicine 44: 377-385.

4 Lee, L-L., Watson, M.C., Mulvaney, C.A., Tsai, C-C., Lo, S-F. 2010. The effect of walking intervention on blood pressure control: a systematic review. International Journal of Nursing Studies 47:1545-1561.

5 Kelley, G.A., Shelley, K.S., Tran, Z.V. 2004. Walking, lipids, and lipoproteins: a meta-analysis of randomised controlled trials. Preventive Medicine 38: 651-661.

6 McAuley, E., Blissmer, B., Katula, J., Duncan, T.E., Mihalko, S.L. 2000. Physical activity, self-esteem, and self-efficacy relationships in older adults: A randomized controlled trial. Annals of Behavioural Medicine 22(2):131-139.

7 Roe, J., Aspinall, P. 2011. The restorative benefits of walking in urban and rural settings in adults with good and poor mental health Health & Place 17 (2011) 103-113.

8 Heesch, K.C., Burton, N.W., Brown, W.J. 2010. Concurrent and prospective associations between physical activity, walking and mental health in older women. J Epidemiol Community Health (2010). doi:10.1136/jech.2009.103077.

9 Legrand, F.D., Mille, C.R. 2009. The effects of 60 minutes of supervised weekly walking (in a single vs. 3-5 session format) on depressive symptoms among older women: Findings from a pilot randomized trial. Mental Health and Physical Activity 2: 71–75.

10 Sugiyama, T., Leslie, E., Giles-Corti, B., Owen, N. 2008. Associations of neighbourhood greenness with physical and mental health: do walking, social coherence and local social interaction explain the relationships? Journal of Epidemiology and Community Health 62: e9.

11 Mønness, E., Sjølie, A. N. 2009. An alternative design for small-scale school health experiments: does daily walking produce benefits in physical performance of school children? Child: care, health and development, 35(6): 858-867.

12 Mackett, R.L., Lucas, L., Paskins, J., Turbin J. 2005. The therapeutic value of children's everyday travel. Transportation Research Part A 39: 205-219.

13 Berke, E.M., Gottlieb, L.M., Moudon, A.V., Larson, E.B. 2007. Protective association between neighborhood walkability and depression in older men. Journal of the American Geriatric Society 55: 526-533.

14 Stronegger, W.J., Titze, S., Oja, P. 2010. Perceived characteristics of the neighbourhood and its associations with physical activity behaviour and self-rates health. Health & Place 16: 736-743.

15 Bowling, A., Barber, J., Morris, R., Ebrahim, S. 2006. Do perceptions of neighbourhood environment influence health? Baseline findings from a British survey of ageing. Journal of Epidemiology and Community Health 60: 476-483.

16 McDonald, K.N., Oakes, J.M., Forsyth, A. In press. Effect of street connectivity and density on adult BMI: results from the Twin Cities Walking Study. Journal of Epidemiology and Community Health.

17 Araya, R., Dunstan, F., Playle, R., Thomas, H., Palmer, S., Lewis, G. 2006. Perceptions of social capital and the built environment and mental health. Social Science & Medicine 62: 3072-3083.

18 Leslie, E., Cerin, E. 2008. Are perceptions of the local environment related to neighbourhood satisfaction and mental health in adults? Preventative Medicine 47: 273-278.

19 Luengo-Fernández, R., Leal, J., Gray, A., Petersen, S., Rayner, M. 2006. Cost of cardiovascular diseases in the United Kingdom. Heart 2006;92:1384–1389.

20 McPherson, K., Marsh, T., Brown, M. 2007. Tackling Obesities: Future Choices - Modelling Future Trends in Obesity and the Impact on Health. 2nd Edition. Government Office for Science, London.

21 Centre for Mental Health. 2010. The economic and social cost of mental health problems in 2009/10. The Centre for Mental Health, available at http://www.centreformentalhealth.org.uk/pdfs/Economic_and_social_costs_2010.pdf.

22 Leyden, K.M. 2003. Social capital and the built environment: the importance of walkable neighbourhoods. American Journal of Public Health 93(9): 1546-1551.

[23] Brown, B.B., Cropper, V.L. 2001. New urban and standard suburban subdivisions: Evaluating psychological and social goals. Journal of the American Planning Association 67(4): 402-419.

[24] Kim, J. 2007. Perceiving and valuing sense of community in a New Urbanist development: A case study of Kentlands. Journal of Urban Design 12(2): 203-230.

[25] Talen, E. Sense of community and neighbourhood form: An assessment of the social doctrine of New Urbanism. Urban Studies 36(8): 1361-1379.

[26] Bellair, P.E. 1997. Social interaction and community crime: Examining the importance of neighbour networks. Criminology 35(4): 677-703.

[27] Ross, C.E., Jang, S.J. 2000. Neighborhood disorder, fear, and mistrust: The buffering role of social ties with neighbors. American Journal of Community Psychology 28(4): 401-420.

[28] Wood, L., Frank, L.D., Giles-Corti, B. 2010. Sense of community and its relationship with walking and neighbourhood design. Social Science & Medicine 70: 1381-1390.

[29] Dempsey, N. 2008. Does quality of the built environment affect social cohesion? Urban Design and Planning 161: 105-114.

[30] Lund, H. 2002. Pedestrian environments and sense of community. Journal of Planning Education and Research 21: 301-312.

[31] Mehta, V. 2009. Look closely and you will see, listen carefully and you will hear: Urban design and social interactions on streets. Journal of Urban Design 14(1): 29-64.

[32] Mason, P., Kearns, A., Bond, L. In press. Neighbourhood walking and regeneration in deprived communities. Health & Place.

[33] Foster, S., Giles-Corti, B., Knuiman, M. 2010. Neighbourhood design and fear of crime: A social-ecological examination of the correlates of residents' fear in new suburban housing developments. Health & Place 16: 1156-1165.

[34] Tiesdell, S., Oc, T. 1998. Beyond 'fortress' and 'panoptic' cities – towards a safer urban public realm. Environment and Planning B: Planning and Design 25: 639-655.

[35] Ashcroft, P., Davis, A., Ginger, M., Heat, H., Miller, I., Roper, A., Skinner, B., Warren, N. 2011. Soft measures - hard facts: The value for money of transport measures which change travel behaviour. A Review of the Evidence. Available from http://www.swpho.nhs.uk/resource/item.aspx?RID=81967.

[36] DfT. 2008. Mixed Priority Routes Road Safety Demonstration Project: Summary Scheme Report. Report to Department for Transport by WSP UK, Birmingham.

[37] Sustrans. 2006. Shoppers and how they travel. Information Sheet LN02. Sustrans, Bristol.

[38] MVA. 2008. Valuing Urban Realm: Seeing Issues Clearly. Report for Design for London. Available from http://urbandesign.tfl.gov.uk/Valuing-Urban-Realm/Project-History-(1).aspx.

[39] Accent. 2006. Valuing Urban Realm: Business Cases for Public Spaces. Technical Report to Transport for London. Available from http://urbandesign.tfl.gov.uk/Valuing-Urban-Realm/Project-History-(1).aspx.

[40] Landscape Institute. 2011. Why invest in landscape? Landscape Institute, London.

[41] CABE Space. 2007. Paved with Gold: The real value of good street design. CABE Space, London.

Chapter 3: What makes a good walking environment?

Which interventions in the walking environment encourage more walking and have wider benefits?

This chapter sets out the evidence on benefits arising from a number of interventions in the walking environment. It considers the impacts of speed limits, safe routes to schools, traffic calming, public realm improvements, mixed priority routes, shared use paths, the reallocation of space, shared spaces and mixed measures. It then presents evidence on the characteristics of existing places that are beneficial for walking, covering well-connected, high density and mixed use places and high quality places. The examples considered have been included in the category that represents the primary form of intervention. However, many of the schemes include a mixture of interventions (for example the intervention in Exeter has been included in 'public realm improvements' but it also involved some reallocation of space). This chapter draws heavily on evaluations of real schemes in the UK and internationally in outlining the impacts on walking levels and wider benefits of the initiatives.

Speed limit areas and zones

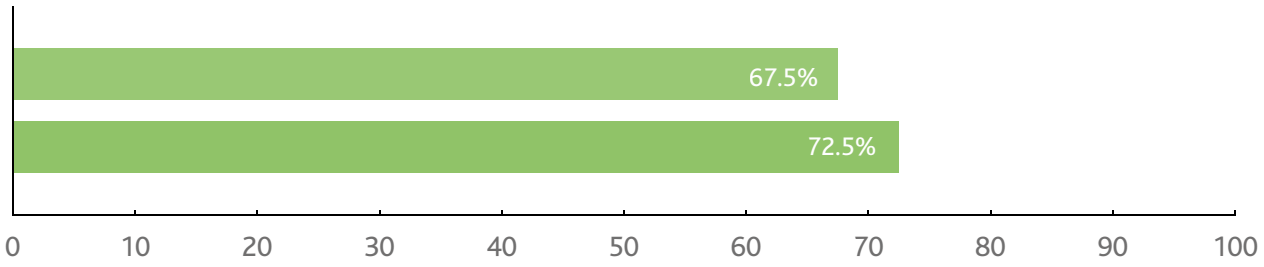
The application of speed limits is often considered more a traffic management issue than an investment in the walking environment. However, reduced speed zones are now often part of wider improvements and initiatives. For example, there have been a number of 20 mph schemes implemented across Manchester, Liverpool[42] and Portsmouth[43]. The six 20 mph speed limit zones in Manchester and Liverpool were accompanied by physical engineering measures (vertical and horizontal deflection, crossings). The scheme in Portsmouth was area-wide covering 94% of the roads in Portsmouth City Council area at a cost of £572,988[43]. This is the first extensive example in England of area-wide speed limit reduction to 20 mph using signing alone.

In Liverpool and Manchester, **vehicle speeds decreased** by, on average, 8.7 mph at the location of the traffic calming measures, but they also decreased by 5.5 mph between the traffic calming measures[42]. **Traffic flows in the 20 mph speed limit zones fell** by an average of 17%, traffic collisions were significantly reduced by between 30% and 100%[42] and local residents were overwhelmingly in favour of the zones[42].

In Portsmouth, vehicle speeds over 24 mph decreased by 6.3 mph in the two years following implementation of the scheme[43]. **Casualties from traffic collisions reduced** by 22% compared with a national trend of a 14% reduction and pedestrian casualties decreased by 16% against a national trend of a 13% decrease[43]. However, there was a 6% increase in the number of collisions resulting in fatal and seriously injured casualties[43].

The proportion of children walking to school in the Portsmouth local authority area increased from 67.5% to 72.5% in the first year after implementation with an associated reduction in the proportion travelling by car[43]. **Public perception of the scheme was generally good** with 40% of respondents believing that vehicle speeds had reduced and 43% agreeing that the environment was safer for walking and cycling[43]. Respondents who did not think vehicle speeds had reduced cited drivers ignoring signs and lack of enforcement as possible reasons for this lack of reduction, as opposed to problems with the principle of the scheme[43]. 20 mph speed limits appear to have broad public support and are associated with substantial improvements in road safety, where implemented effectively.

Increase in children walking to school in Portsmouth after implementation of area-wide 20mph



Safe routes to schools

Safe routes to school generally involve improvements to the walking environment connecting residential areas with local schools in order to facilitate children travelling to school on foot or by bicycle as opposed to by car. The California Safe Routes to School (SR2S) programme included the improvement or creation of footways, traffic signals, pedestrian crossings and bicycle paths[44]. An evaluation of the programme at ten nearby schools found that 21% of children walked or cycled and **those who passed the SR2S were more than three times more likely to have increased their active travel to school than those who did not**[44]. Changes to footways and traffic signals appeared to correspond with increased active travel more than changes to crossings[44]. In the UK, the National Institute for Health and Clinical Excellence (NICE) recommended creating and maintaining safe routes to school as one of the effective approaches to promoting physical activity through environmental changes[45].

Traffic calming

Traffic calming schemes generally comprise a mixture of changes to the road and / or the parking environment to reduce vehicle speed. A traffic calming scheme comprising of five speed cushions, two zebra crossings with railings and parking bays was implemented on Faifley Road in Glasgow, a main road which bisects an urban housing estate[46]. An evaluation of the scheme found that **20% of respondents said they walked more after implementation of the scheme**, and **13% said they allowed children to walk more**, both of which were corroborated by pedestrian count data which found large increases in pedestrian numbers of adults, children and pensioners[46]. The **perception of the road safety, traffic and general environment of the area improved**, with 12% of respondents stating that they allowed children to play outside more than before the traffic calming[46]. It was also found that respondents rated their physical health significantly more positively after implementation of the measures[46].

Public realm improvements

A number of schemes have been implemented in recent years to develop a more attractive public realm and streetscape in town and city centres. A key aim is often to improve the aesthetic quality of the area, ensuring a more pleasant experience for pedestrians and attracting private developers and retailers.

An example of such a scheme is in **Sheffield** (see Chapter 5). Sheaf Square and Howard Street are two elements of what is termed the 'Gold Route' in the city, completed in 2008. This was the creation of a network of improved streets and places from the train station, through the city centre and beyond[47]. These improvements resulted in **increased pedestrian movements from 3,174 to 8,700 (174%) between 2001 and 2008, and substantial vehicle flow decreases**[47].

Another example is in what was once referred to as 'Britain's worst street' - **Maid Marian Way in Nottingham**. This street has been adapted to make it more pedestrian friendly by remodelling the dual carriageway, and creating a high quality public realm characterised by new pedestrian crossings, increased pavement widths, planting and street furniture[47]. The scheme was completed in August 2004 at a cost of £2.5 million[38]. **Pedestrian counts increased 56%** on weekdays and 29% on Saturdays between 2003 and 2005[47], and **sale prices of flats in the immediate vicinity of the scheme have seen an annual growth rate of 8%** since implementation[38].

Exeter city centre has been revitalised through a phased city-wide improvement programme (see case studies below) including new retail space, lighting, paving, seating, creation of a boulevard, prioritisation of pedestrians and linking the day and night-time economies[40,48]. The scheme at Princesshay developed new retail space, but this was integrated with a network of public spaces and a high quality public realm. The programme started in 2000 with the development of Queen Street and has received over £4.5 million in public and private investment[48]. Generally, there has been around a **30% increase in pedestrian numbers**, and as stated in Chapter 2, Retail Zone A **rental prices have increased by £5 per square foot in Princesshay**[40]. Dundee City Council has also undertaken extensive works to improve their public realm and encourage new retailers into the city, through decluttering, resurfacing and improving paving and lighting. Although no formal evaluation has taken place, local businesses were very positive about the improvements with those not affected requesting the scheme be extended to their sections of the street[49].

Finally, **Kensington High Street** in London has also seen substantial improvements including enhancement of the pedestrian environment through pavement widening, new pedestrian crossings and decluttering (see Chapter 5)[50]. There is also a new 3m wide central reservation to create cycle parking and tree planting in the centre of the high street. The programme was completed in 2003 at a cost of £5 million[38]. Since implementation **vehicle speeds have reduced** and observations of pedestrian and driver behaviour suggest that users are more safety conscious and self-aware in their use of the space[50]. **Road safety has improved**, with a 40% reduction in collisions and a 59% reduction in pedestrian casualties[50]. An evaluation of the sale prices of flats within 200m of the scheme show **an annual growth rate of 12.9%** above that of the nearby area since implementation[38].

Mixed priority routes

Mixed Priority Routes (MPRs) are streets that have high traffic flows and a mix of frontage use, a mix of road users and a mix of parking and delivery vehicles. The Mixed Priority Routes Road Safety Demonstration Project in the UK aimed to reduce road casualty numbers, produce high quality streetscapes and achieve wider benefits. Schemes generally involved reducing road carriageway widths, increasing the number of crossing points (formal and informal), the use of high quality materials and street furniture and improved public transport infrastructure. Reduction of the speed limit to 20 miles per hour was included in some locations. Initially, ten MPRs were implemented across different towns and cities in England[36] followed by a further two in Brighton and Worthing[51]. In addition, two Inner City Road Safety Demonstrations (ICRSD) schemes were implemented in Birmingham; these involved less intensive changes and were lower in cost. The average cost per linear metre of MPR schemes was £3,300 (£700 for ICRSD schemes[36,51]). Evaluations of the MPRs generally found that:

- **Pedestrian numbers increased by 2% to 22%**[36]
- Pedestrian movement at crossings increased by up to 25%[36]
- **Vehicle speeds reduced**[36]
- There were small reductions in vehicle flows[36]
- **Noise pollution decreased** across the schemes[36]
- **Annual casualties reduced by up to 63%**, compared with a national reduction of 17%[51]
- The largest reductions in casualties occurred in the Norwich and Worthing (63%), Brighton (46%), Liverpool (41%), St Albans (38%) and Oxford (34%) MPR schemes and the two ICRSD locations in Birmingham (36% and 38%)[51]

In terms of economic benefits, the average annual rate of return across the ten MPRs was between 24% and 70%[51], which suggests that the MPRs are a cost effective measure to improve traffic safety and encourage pedestrian activity.

Shared use paths

Shared use paths are paths that are provided for pedestrians and cyclists and not permitted to be used by motorised transport. They provide additional route options for pedestrians (complementing pedestrian facilities on public roads) and often allow more direct connections between places than possible though using the public road network. They can be found within urban areas (connecting neighbourhoods) and outside urban areas (connecting urban areas to outlying countryside).

Shared use paths have been associated with **increased physical activity levels in users** in the US[52,53,54] of up to 98%[52,53,54]. Shared use paths appear to be particularly successful at encouraging local residents to take part in physical activity. For example, one study found that 23% of the respondents were new exercisers and 31% of these reported that this was their only form of exercise[53]. Similarly, the creation of a shared use path on a disused railway in Sydney, Australia led to an increase in the proportion of local residents using the route, from 1.6 to 5.6% of those surveyed[55].

Reallocation of space

Reallocation of space covers a range of interventions, including the removal or prioritisation of different users. This can be at a street, town or city level and may involve the restriction of vehicles to particular times of day (e.g. loading vehicles before 9.00am).

Copenhagen has seen a city-wide reallocation of space and pedestrianisation since 1962[56] (see case studies). This has involved a number of interventions including reducing vehicular traffic movement through reallocating road space from general traffic to buses and cycles, setting limits on through traffic, reallocating parking spaces to public open space by 2-3% annually, increasing the size of pedestrian areas and prioritising pedestrians and cyclists in the inner city[56].

Studies found that the **number of people taking part in stationary activities outdoors in Copenhagen has increased by more than three times between 1968 and 1995**[56], increasing opportunities for social interaction and fostering a sense of community. The total pedestrian movements also doubled initially and have been more stable in recent years. In addition, spaces that are of higher quality in terms of their location, materials and street furniture and design are used more than those of lower quality[56].

The Broadway Boulevard in Manhattan, New York (see case studies below) is another example of the reallocation of space. A substantial pilot programme has involved diverting traffic away from Broadway at Times and Herald Squares in order to transform these iconic destinations into pedestrian plazas[57]. **Pedestrian numbers have increased by 11% in Times Square and 6% in Herald Square** since the completion of the scheme, while despite an increase in vehicle traffic flows, journey times for taxis and buses have decreased by up to 15%, indicating a reduction in traffic congestion. In addition, the number of **injuries to pedestrians has decreased** by 35% and to motorists and passengers by 63%[57]. The scheme has experienced **broad public support** with 74% of residents of New York agreeing that Times Square has improved dramatically as a result of the changes[57].

These schemes demonstrate that the reallocation of space can provide a more welcoming walking environment, improve road safety and smooth traffic flow, as well as facilitating social interaction.

Shared spaces

A shared space has been defined as 'a street or place accessible to both pedestrians and vehicles that is designed to enable pedestrians to move more freely by reducing traffic management features that tend to encourage users of vehicles to assume priority'[58]. There have been a number of shared space schemes in the UK including **New Road, Brighton** (see case studies) and **Castle Street in Kingston-upon-Thames**. The improvements to New Road consisted of the redesign of a busy commercial street including the provision of seating, lighting and planting. Castle Street received £250,000 of funding for the transformation of the main link between the town centre and train station from a busy road with narrow pavements to a flat street with access restricted to pedestrians, cyclists and delivery vehicles and improvements to paving, lighting, planting and seating[39,58]. Another example comes from Drachten in the Netherlands, where an intersection was converted to a shared space in 2003[59] (see case studies) through the removal of traffic lights, the creation of a square with a roundabout and very limited road markings. **Increases in pedestrian footfall of 162% and 12% respectively** have been measured at New Road, Brighton and Castle Street, Kingston-upon-Thames[58].

Despite initial concerns, **no detrimental effect on the casualties from traffic collisions** have been found in shared spaces compared with more conventional street layouts[58]. In Drachten, the number of traffic collisions have decreased from 8.3 to 1.0 per year since the creation of the shared space[59], though broader public perceptions about traffic safety reflect the fact that users are more aware of potential hazards and are being more attentive when using the space[59]. Generally, the public are positive about shared space[58,59]. Despite, a 30% increase in traffic volume in Drachten the **traffic is moving more freely** since the creation of the shared space, with the **proportion of people perceiving congestion to be 'bad' in the location declining** from 66% in 2000 to 5% in 2005[59]. This improvement in traffic flow has not been at the expense of pedestrians; **both pedestrians and drivers have seen a 20 second reduction in their delay time**[59]. Schemes in Castle Street and New Road provided opportunities for stationary activities and users have been observed sitting, eating and reading in these spaces[58] demonstrating the increased potential for social interaction.

A partial cost-benefit analysis of Castle Street based on a willingness to pay for improvements to the walking environment suggested economic benefits of between £433K and £467K (in increased public transport fares over a 15 year period) equating to a cost-benefit ratio of between 1.7 and 1.9[39].

Home Zones are 'streets designed to be places for people and not just for motor traffic'[60] and typically include gateway features, 20 mph speed limits, echelon instead of parallel parking, humps and chicanes, shared surfaces, community areas, planting, street furniture, lighting and art. An evaluation of seven pilot Home Zone schemes, costing between £733 and £5,530 per property in England and Wales[60] and a further study on two schemes in Manchester and Nottingham[61] found that:

- **Vehicle speeds decreased by an average of 5 miles per hour** to speeds of less than 15 miles per hour[60]
- **Traffic flows decreased by around 25%** across the seven locations[60]
- **64% of residents were supportive** of the scheme[60]
- **73% of residents thought their streets were more attractive** as a result of the Home Zone, particularly as a result of new planting[60,61]
- **44% of residents felt that walking was more pleasant** since the scheme[60]
- Residents generally felt that **road safety had improved**[60,61], although concerns were expressed regarding the loss of pavements[61]
- Adults and children reported that they **spent more time outside of their home** since the implementation of the Home Zone[60,61]
- Residents had greater levels of **social interaction** with their neighbours, particularly in Manchester, both during the consultation for the scheme and following its implementation[61]
- 50% of residents in Manchester **felt safer** after the implementation of the Home Zone with the street lighting specifically mentioned as a key factor[61]

Mixed measures: improvements in the walking environment combined with other measures

The Sustainable Travel Towns initiative consisted of a package of 'Smarter Choice' measures in Darlington, Peterborough and Worcester. This consisted of a brand identity, a large-scale personalised travel planning programme, travel awareness campaigns, cycling and walking promotion, public transport and information marketing as well as school and workplace travel planning and workplace travel planning[62]. The initiative was primarily implemented between April 2005 and April 2009. Meanwhile, the town centre in Darlington was pedestrianised between summer 2005 and summer 2007 to create the Pedestrian Heart. The total budget was £10 million, which consisted of a revenue spend on walking and cycling of between £3 and £5 per head of the population and a capital spend on walking of between £1 and £5 per head of the population over the five years[62].

An evaluation of the initiative, based on household surveys, traffic count, pedestrian count and road collision data, found that:

- **Car driver trips by residents decreased by 9%** compared with a national trend of a 1% decrease
- **Average distances driven by car by residents decreased by 5-7%** compared with a national trend of a 1% decrease
- **Aggregate traffic decreased by 2-3%**, although decreases were greater in inner areas
- Surveys found that bus and cycle trips by residents increased by 10-22% and 26-30% respectively
- The number of **walking trips by residents increased by 10-13%** compared with a decreasing national trend
- **Average distances travelled on foot by residents increased by 18-27%**
- Pedestrian count data in Darlington and Peterborough corroborated the survey data
- **Walking and cycling to school increased by up to 7%**
- The **risk of injury** from traffic collisions per kilometre walked declined by a similar amount to the national trend
- Benefit-cost ratio – based on congestion benefits alone – was estimated to be 4.5[62]

A mixed measures scheme in a deprived housing estate in **Seattle (US)** involved sponsored walking groups, improved walking routes, information about walking options and advocacy for pedestrian safety[63]. This scheme was associated with increased walking levels among walking group participants from 65 to 109 minutes per day. There was a significant **increase in the proportion of respondents that reported being at least moderately active for at least 150 minutes per week from 62% to 81%**. There were also improvements in the general health of the respondents and in the number of neighbours they knew[63].

Living Streets' Step Out In London programme is similar to a mixed measures scheme as it aims to encourage walking in areas of London which have recently seen changes to their physical walking environment[64]. Activities included guided walks, workshops, outdoor games, treasure hunts and art projects. The initiative has been successful at promoting walking in participants, with 82% of those questioned saying that the activities have encouraged them to walk more[64]. **Nearly twice as many participants noticed the improvements to the walking environment compared with non-participants and more than three times as many were encouraged to walk more because of these improvements**[64].

Mixed measures schemes appear to offer significant benefits in terms of increased walking levels and are perhaps, due to their inclusion of measures to elicit behaviour change, also likely to result in health benefits. Unfortunately it is difficult to disaggregate the impacts of changes to the walking environment from those of softer measures to encourage walking and cycling.

Which characteristics of the built environment are beneficial for walking?

As well as reviewing interventions in the walking environment, it is also important to understand which characteristics of existing places seem to encourage walking, and have wider benefits. There is a wealth of information on the impacts of, for example, different urban densities, mix of uses and connectivity. There has also been research on more qualitative elements of walking environments, such as aesthetics and landscaping, to find out how important these elements are. This evidence is important as in some instances there may be opportunities to change existing places to improve their potential as walking friendly settings. In other instances this information can help when designing new streets and settlements.

Well-connected, high density and mixed use places

Generally, places displaying characteristics of walking friendly urban form are associated with a 25-100% increase in people's likelihood to walk. Areas that are more walking friendly are characterised by a range of different land uses, higher densities and street patterns that connect these different uses in a way that is easily negotiated on foot[65]. Given that 'neighbourhood walking' often accounts for a greater proportion of walking than 'walking outside the neighbourhood'[66], neighbourhood design and quality are crucial factors in the walking levels of the population as a whole.

A number of cross-sectional studies have examined the relationship between how walking friendly the urban environment is and how this relates to walking levels:

- In the US, those **living in areas with a greater population or housing density were around twice as likely to walk**[67,68]and have around **70% greater transport walking**[69] than those in areas with lower density

- In the US, **greater numbers of intersections[70] and access points in a neighbourhood, and smaller blocks were associated with greater the levels of walking**[71], with greater numbers of four-way intersections being associated with around 40% greater walking trips[68]. A greater number of intersections implies a greater degree of connectivity and more direct walking routes
- Studies from the US, Australia, Canada, England, Scotland and Austria have all found that walking level or **the likelihood of walking was greater in neighbourhoods with a greater mix of use or number of destinations**[14,15,32,72,73,74,75,76]. For example, in the US, an increase in the number of business types from 3 to 4 corresponded with a 24% increase in the number of walked trips[68], and in Australia[72] and Canada[73], those in neighbourhoods with a high number of destinations were at least 50% more likely to have a greater level of walking[72,73]. The study in Australia also found that the variety of destinations was important; a high variety corresponding to a 61% increase in walking compared with a low variety[72]
- In the US, **88% of children in a 'walkable' community walked to school at least sometimes compared with only 60% in a mixed-'walkable' and 17% in a non-'walkable' community**; they also walked to school more frequently[77]

Mix of use is a crucial factor in a walking friendly neighbourhood, as a mixture of land uses provides more potential destinations such as shops and services for transport walking. However, the type and quality of such destinations also influence walking levels in ways that vary between different groups:

- In England, women are 28% more likely to report not walking regularly if they felt that the local shops were of low convenience[74]. Similarly, the presence of local infrastructure corresponded with greater walking levels in the US[75] and Austria[14]
- Living close to parks and open spaces also corresponds with greater levels of walking; men in England and adults in Australia were around twice as likely to walk the recommended amount if they had better access to parks and open space[74,78] and parks were the most commonly walked to destination in a study in the US[76]

- In Scotland, those who felt their parks and open spaces were of good quality were 27% more likely to meet the recommended level of walking[32] and those who liked the facilities in their neighbourhood were 25% more likely to meet the recommendations through transport walking alone[14]. Conversely, those who felt the convenience of services in their neighbourhood was low or medium compared with high were between 10 and 20% less likely to meet these recommended levels of walking[14]

Considering all the studies that have examined the relationship between urban form and walking, mix of use has the strongest and most consistent relationship with walking. However, mix of use, density and connectivity are all important factors and in many ways are mutually reinforcing.

It is also worth noting that there was generally a stronger relationship between the walking-friendliness of the neighbourhood and transport walking, as opposed to recreational walking[14,67,71,73,79,80]. This is presumably because as a form of transport, walking will only be more attractive than other forms of transport if it is convenient and realistic; if there are destinations that can easily be accessed on foot.

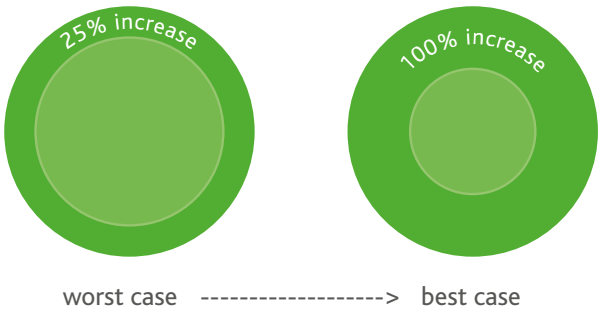
High quality places

The aesthetic quality of a place is the most consistently important factor in relationships between the public realm and walking, health and well-being. In contrast to urban form, which is a major factor in levels of transport walking, aesthetic quality appears to be more important in the relationship with walking for recreation or fitness than for transport.

Aesthetic quality has been assessed based on the presence of a number of characteristics (e.g. interesting or attractive features, good quality buildings, vegetation, high quality paving or surfacing) often in conjunction with management aspects, such as maintenance, to give a measure of the overall quality of a place. The relationships between aesthetic quality and walking can be summarised as follows:

- In Australia, men who perceived their neighbourhood aesthetics to be high were more than seven times more likely to achieve recommended levels of walking in their neighbourhood[81]
- In Australia, those in neighbourhoods with a high score based on the presence of pavements, shops and trees, the amount of traffic and access to attractive open space were more than twice as likely to achieve the recommended levels of walking[78]
- In the US, vegetation has been associated with greater levels of walking[71] and frequency of walking trips to local parks[76]
- In Scotland, those who liked the appearance of their neighbourhood were 12% more likely to walk for transport and 37% more likely to walk for fitness or pleasure[14]
- Overall, **urban walking friendly environments are associated with between 25 and 100% greater levels of likelihood of walking**

Increased likelihood of walking where urban neighbourhoods have walking-friendly characteristics



Unfortunately, it is difficult to disaggregate specific aspects of 'aesthetics' of the neighbourhood in order to determine which features are the most important.

Conclusions

This chapter has shown positive impacts of a number of interventions in the walking environment. From studies of completed projects and research, it has identified the relationships between the physical environment, walking levels and a host of other impacts. The key findings that can be drawn from this literature are:

- **Interventions in the walking environment can take many forms**. Key interventions currently being implemented in the UK and internationally include: shared spaces, reallocation of space, public realm improvements, shared use paths, mixed priority routes, speed limits, safe routes to schools, traffic calming and mixed measures.
- These interventions have a range of benefits which are common to many schemes. Overall, they are successful in:
    - Significantly **increasing pedestrian activity** (footfall)
    - **Improving safety**: they lead to fewer road casualties, injuries to pedestrians and traffic collisions
    - **Reducing vehicle speeds**: where the schemes set out to reduce speeds, they are successful, and this contributes to a more walking friendly environment
    - **Delivering social benefits**: these interventions increase opportunities for social interaction, lead to higher numbers of people taking part in outdoor activities and spending time outside their homes
    - **Delivering economic benefits:** the schemes have demonstrated, through increased house sale prices and retail rents in the local area, that individuals and businesses place an economic value on improved public realm
    - **Encouraging more physical activity**: this is particularly noticeable in, for example, increases in the proportion of children walking to school in schemes designed to elicit this outcome
    - **Reducing noise levels**
    - **Reducing the number and distance of car trips**, implying a modal shift away from the car to walking
    - **Providing attractive and popular places**: the public are positive about investments in the walking environment, and the schemes usually have the support of visitors and residents. People tend to report that investments in the walking environment lead to more attractive and safer places

- There are also a number of **characteristics of existing urban environments that encourage walking**. These tend to be places that are higher density, well connected, mixed use, and attractive (high quality).
- Overall, **aspects of walking friendly urban form are associated with between 25 and 100% greater levels of likelihood of walking**.
- The **aesthetic quality of a place** is the most consistently important factor in relationships between the public realm and recreational walking, health and well-being.

References'

[42] DfT. 2001. Urban Street Activity in 20 mph zones- Final Report to Department for Transport.

[43] DfT. 2010. Interim Evaluation of the Implementation of 20 mph Speed Limits in Portsmouth. Final Report – September 2010. Report to Department for Transport by Atkins, UK.

[44] Boarnet, M.G., Anderson, C.L., Day, K., McMillan, T., Alfonzo, M. 2005. Evaluation of the California Safe Routes to School Legislation: Urban form changes and children's active transportation to school. American Journal of Preventive Medicine 28(2S2): 134-140.

[45] NICE. 2008. Promoting and creating built or natural environments that encourage and support physical activity. NICE, London.

[46] Morrison, D.S, Thomson,H., Petticrew, M. 2004. Evaluation of the health effects of a neighbourhood traffic calming scheme. Journal of Epidemiology and Community Health 58(10): 837-840.

[47] CIHT. 2010. Manual for Streets 2: Wider Application of the Principles. Chartered Institution for Highways and Transportation, London.

[48] Personal communication with Paul Osbourne, Exeter City Council, 18th March 2011.

[49] Personal communication with Gregor Hamilton, Dundee City Council, 29th March 2011.

[50] Swinburne, G. 2006. Kensington High Street Road Safety Report. Royal Borough of Kensington and Chelsea.

[51] DfT. 2011. Mixed Priority Routes: Results Update and Cost Review. Report to Department for Transport by WSP UK, Birmingham.

[52] Wang, G., Macera, C.A., Scudder-Soucie, B., Schmid, T., Pratt, M., Buchner, D. 2004. Cost effectiveness of a bicycle/pedestrian trail development in health promotion. Preventive Medicine 38: 237-242.

[53] Gordon, P.M., Zizzi, S.J., Pauline, J. 2004. Use of a community trail among new and habitual exercisers: a preliminary assessment. Preventing Chronic Disease 1: 1-11.

[54] Evenson, K.R., Herring, A.H., Huston, S.L. 2005. Evaluating change in physical activity with the building of a multi-use trail. American Journal of Preventive Medicine 28(2S2): 177-185.

[55] Merom, D., Bauman, A., Vita, P., Close, G. 2003. An environmental intervention to promote walking and cycling—the impact of a newly constructed Rail Trail in Western Sydney. Preventive Medicine 36: 235-242.

[56] Gemzoe, L. 2001. Copenhagen on foot: thirty years of planning and development. World Transport Policy and Practice 7(4): 19-27.

[57] Department of Transportation. 2010. Green Light for Midtown evaluation report. New York City Department of Transportation.

[58] Department for Transport. 2009. DfT Shared Space Project. Stage 1: Appraisal of Shared Space. Report to Department for Transport by MVA Consultancy, UK.

[59] Noordelijke Hogeschool Leeuwarden. 2007. The Laweiplein. Evaluation of the Reconstruction into a Square with Roundabout. Noordelijke Hogeschool Leeuwarden / Verkeerskunde, Netherlands.

[60] Webster, D., Tilly, A., Wheeler, A., Nicholls, D., Buttress, S. 2006. Pilot Home Zone Schemes: Summary of the Schemes. TRL Report 654. Crowthorne: TRL Limited.

[61] Clayden, A., Mckoy, K., Wild, A. 2006. Improving residential liveability in the UK: Home Zones and alternative approaches. Journal of Urban Design 11(1): 55-71.

[62] Sloman, L., Cairns, C., Newson, C., Anable, J., Pridmore, A., Goodwin, P. 2010. The Effects of Smarter Choice Programmes in the Sustainable Travel Towns: Research Report. Report to the Department for Transport. Transport for Quality of Life.

[63] Krieger, J., Rabkin, J., Sharify, D., Song, L. 2009. High Point Walking for Health: Creating built and social environments that support walking in a public housing community. American Journal of Public Health 99: S593-599.

[64] Social Research Associates. 2010. Living Streets Step Out London After report. Social Research Associates, London.

[65] Williams, K., Dair, C. 2007. A framework of sustainable behaviours that can be enabled through the design of neighbourhood-scale developments. Sustainable Development 15: 160-173.

[66] Giles-Corti, B., Knuiman, M., Timperio, A., Van Niel, K., Pikora, T.J., Bull, F.C.L., Shilton, T., Bulsara, M. 2008. Evaluation of the implementation of a state government community design policy aimed at increasing local walking: Design issues and baseline results from RESIDE, Perth Western Australia. Preventative Medicine 46: 46-54.

[67] Forsyth, A., Oakes, J. M., Lee, B., Schmitz, K.H. 2009. The built environment, walking, and physical activity: Is the environment more important to some people than others? Transportation Research Part D 14: 42-49.

[68] Boer, R., Zheng, Y., Overton, A., Ridgeway, G.K., Cohen, D.A. 2007. Neighbourhood design and walking trips in ten US metropolitan areas. American Journal of Preventive Medicine 32(4): 298-304.

[69] Forsyth, A., Oakes, J.M., Schmitz, K.H., Hearst, M. 2007. Does residential density increase walking and other physical activity? Urban Studies 44:679-697.

[70] Hou, N., Popkin, B.M., Jacobs, D.R., Song, Y., Guilkey, D., Lewis, C.E., Gordon-Larsen, P. 2010. Longitudinal associations between neighbourhood-level street network with walking, bicycling, and jogging: The CARDIA study. Health and Place 16: 1206-1215.

[71] Forsyth, A., Hearst, M., J.M. Oakes, Schmitz, K.H. 2008. Design and destinations: Factors influencing walking and total physical activity. Urban Studies 45: 1973-1996.

[72] Bentley, R., Jolley, D., Kavanagh, A-M. 2010. Local environments as determinants of walking in Melbourne, Australia. Social Science & Medicine 70: 1806-1815.

[73] Gauvin, L., Riva, M., Barnett, T., Richard, L., Craig, C.L., Spivcock, M., Laforest, S., Laberge, S., Fournal, M-C., Gagnon, H., Gagné, S. 2008. Association between neighbourhood active living potential and walking. American Journal of Epidemiology 167(8): 944-953.

[74] Foster, C., Hillsdon, M., Thorogood, M. 2004. Environmental perceptions and walking in English adults. Journal of Epidemiology and Community Health 58: 924-928.

[75] King, W.C., Brach, J.S., Belle, S., Killingsworth, R., Fenton, M., Kriska, A.M. 2003. The relationship between convenience of destinations and walking levels in older women. American Journal of Health Promotion 1(1): 74-82.

[76] Tilt, J. 2010. Walking trips to parks: Exploring demographic, environmental factors, and preferences for adults with children in the household. Preventive Medicine 50: S69-S73.

[77] Napier, M.A., Brown, B.B., Werner, C.M., Gallimore, J. In press. Walking to school: Community design and child and parent barriers. Journal of Environmental Psychology.

[78] Giles-Corti, B., Donovan, R.J. 2003. Relative influences of individual, social environmental and physical environmental correlate of walking. American Journal of Public Health 93(9): 1583-1589.

[79] Riva, M., Gauvin, L., Apparicio, P., Brodeur, J.-M. 2009. Disentangling the relative influence of built and socio-economic environments on walking: The contribution of areas homogenous along exposures of interest. Social Science & Medicine 69:1296-1305.

[80] Taylor, L.M., Leslie, E., Plotnikoff, R.C., Owen, N., Spence, J.C. 2008. Associations of perceived community environmental attributes with walking in a population-based sample of adults with type 2 diabetes. Annuals of Behavioural Medicine 35: 170-178.

[81] Humpel, N., Owen, N., Iverson, D., Leslie, E., Bauman, A. 2004. Perceived environment attributes, residential location, and walking for particular purpose. Am J Prev Med 26(2): 119-125.

Chapter 4: How cost effective are investments in the walking environment?

This chapter reviews what is known about the value for money of public investment in the walking environment. Value for money of transport investments is usually considered through cost-benefit analysis, where an attempt is made to consider all of the direct and indirect, private and social monetary costs and benefits of investment. It may also be considered by cost effectiveness analysis, which assesses the cost of different options in achieving a specific objective. Investment in the walking environment can potentially bring about a wide range of beneficial impacts, including the following:

1. Improved user experience (often referred to as 'journey ambience')
2. Reduced road collisions
3. Reduced congestion, fuel and other costs
4. Reduced noise and air pollution
5. Reduced carbon dioxide emissions
6. Health benefits from a more physically active population
7. Greater accessibility to facilities and services
8. Increased social capital
9. Increased economic activity
10. Reduced public costs of providing transport infrastructure and services

The benefits identified above can accrue to 'users' (walkers, residents, visitors) of the enhanced environment (e.g. user experience); other individuals and businesses (e.g. reduced congestion); government (reduced infrastructure costs or reduced costs to the health service) or wider society (reduced greenhouse gases). Some of the benefits are strongly dependent on the number of users (improved user experience, health benefits) while others are dependent on the level of modal shift achieved (congestion, pollution, carbon dioxide emissions). A benefit not listed above is 'increase in the value of property in the vicinity of an investment'. This is not an additional benefit to those listed, but reflects how these benefits (in particular, user experience) are expressed through property values (see Chapter 2).

The studies that provide evidence on the value for money of investment in the walking environment are summarised in Table 1. None of these studies considers all of the benefits identified above and many only consider a single impact item. Examples are presented of ex-post (after the event) evaluations of investments, drawing upon before and after monitoring data, and ex-ante (before the event) evaluations where predictions have been made of outcomes of investment.

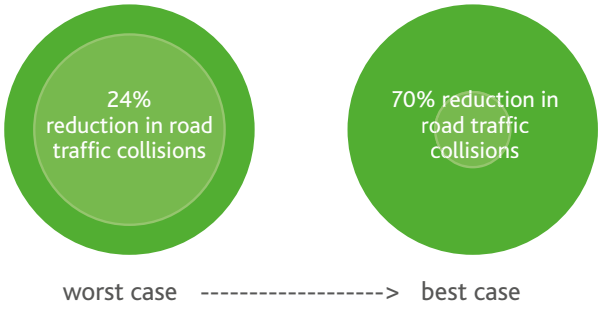
Ex-post evaluations of the benefits from investment in the walking environment

Comprehensive assessments have been made of the value for money of three walking and cycling schemes and three Links to Schools schemes, using DfT's official appraisal methodology[82]. These assessments have been made based on pre- and post-implementation usage data. The benefit-cost ratios of the six schemes were estimated to vary between 14.9 and 37.6 (Table 1). A breakdown is not provided of separate benefits to walkers and cyclists but walkers are in greater number than cyclists for five of the six schemes, so benefits to walkers should represent a significant proportion of total benefits. **One recommendation arising from this study would be to disaggregate benefits to walkers and cyclists in the evaluation of such schemes.**

The majority of scheme benefits (76% to 96%) arise from health benefits due to increased physical activity (reduced mortality) and from **journey ambience benefits**. Health benefits are sensitive to assumptions made about reduced risks of mortality from increased walking and the increased level of walking undertaken by scheme users. However, if these have been over-estimated in these assessments then this is likely to be compensated for by the omission of other potential health impacts (e.g. morbidity and mental illness benefits of physical activity). Journey ambience benefits are sensitive to the values that users are assumed to place on characteristics of their travel environment, obtained from market research.

More limited assessments of value of money have been made for **three investment programmes in the UK**. The average annual rate of return for the ten mixed priority route schemes has been estimated and **calculated – based on reductions in road traffic collisions alone – at 24%** (worst case) **and 70% (best case)**[51]. For the **Sustainable Travel Towns programme** (which comprised a range of measures including walking promotion; see Chapter 3) a benefit-cost ratio based only **on congestion benefits was estimated to be 4.5**[62].

Average rate of financial return on Mixed Priority Routes schemes, based on road collision reductions alone:



An ex-post cost-benefit analysis for **five walking and cycling trails in Lincoln, Nebraska (US)** only **considered reduced medical costs associated with being physically active**[84]. The number of people becoming physically active due to the trails was estimated based on a survey of trail users in 1998 (see Chapter 3). They took account of the construction and maintenance costs of the trails and user equipment and travel costs (to gain access to trails). **A benefit-cost ratio of 2.94 was estimated**.

Ex-ante evaluations of the benefits from investment in the walking environment

There are relatively few ex-ante studies from the UK, so most of the evidence is international. A comprehensive assessment of **value for money has been made of urban walking and cycling track networks in three Norwegian urban areas**[85]. Assumptions were made on the level of modal shift from car and public transport to walking and cycling. **Benefit-cost ratios of 2.9, 4.1 and 14.3 (Table 1) were obtained** with the benefit from decreased risk of premature mortality and severe disease contributing to two-thirds of total benefits in the two smaller urban areas and one half of benefits in the larger urban area (Trondheim). Reduced security costs and parking costs were relatively more important in Trondheim.

Table 1 Benefits considered in evaluations of walking investment

	Journey ambience	Road collisions	Congestion, fuel and other costs	Noise, air pollution	CO_2 emissions	Health benefits	Accessibility	Social capital	Economic activity	Public costs	Cost-benefit ratio
Ex-post											
Walking and cycling schemes[82]	✓	✓	Travel time savings		✓	Mortality, absenteeism					18.4-37.6
Links to schools[83]	✓	✓	Travel time savings			Mortality, absenteeism					14.9-32.5*
Mixed priority routes[51]		✓									24-70% (rate of return)
Sustainable travel towns[62]			Congestion								4.5
Walking and cycling trails[84]						Medical costs of inactivity					2.94
Ex-ante											
Urban walking and cycling network completion in Norwegian towns[85]	Reduced insecurity	Assumed unchanged	Travel time savings, parking cost savings to businesses	✓	✓	Mortality, severe disease, absenteeism				Reduced school buses, infrastructure costs	2.9-14.3
Increased walking and cycling in US[87]			Fuel savings		✓	Medical costs of inactivity					20
National US walking programme[88]						Coronary heart disease					Not reported
Sidewalk provision completion in Dane County, US[89]				Air pollution		Medical costs of weight gain/ obesity					1.87
Built environment modifications in Portland, US[90]						Mortality					Not reported
Walking associated with light rail transit in Charlotte, US[91]						Medical costs of weight gain/ obesity					Not reported
Physical accessibility improvements in St Albans[92]							Ability to reach town hall				No reported
Three street improvement schemes in London[39]	✓										0.1-1.9

*calculations of mortality in this study have been criticised[86], subsequent DfT reports use a revised method.

[86] Cavill, N., Kahlmeier, S., Rutter, H., Racioppi, F., Oja, P. 2008. Methodological Guidance on the Economic Appraisal of Health Effects Related to Walking and Cycling. WHO Regional Office for Europe, Copenhagen.

There have also been a number of **US studies** that have looked at hypothetical scenarios of increased walking. Two studies considered the **potential economic benefits of national initiatives**[87,88]. The first predicted the monetary benefits from fuel savings, carbon emissions reductions and increases in physical activity arising from increased walking and cycling scenarios in US[87]. They made assumptions about modal shift and trip length reduction. Total **monetary benefits estimated were $10.4 billion per year** for a 'modest' scenario (increase in mode share of walking and cycling from 10% to 13%). If the current level of federal funding of walking and cycling achieves these outcomes then there are implied annual benefits of 20 times the funding level. The second estimated the economic benefit of decreasing the proportion of the US population that is sedentary through a walking promotion programme[88]. A total estimated **cost saving of $5.6 billion per year** (1991 prices) was estimated to be achievable if 10% of Americans (25% of sedentary population) began a regular walking programme.

Three US studies have considered the potential benefits of local intervention in the walking environment[89,90,91], in the context of a marked lack of pedestrian infrastructure (e.g. lack of pavements) as well as concerns over general fitness and obesity in the US. The first study considered the complete provision of sidewalks in Dane County, Wisconsin, which was costed at $451 million and the impact was modelled to be an additional 0.097 miles walked/cycled per person per day. The additional walking/cycling was estimated to offset weight gain in 37% of the population and achieve a **total avoided cost of $90.9 million per year**. The additional of sidewalks was also estimated to lead to a reduction in motor vehicle miles travelled of 1.142 miles per person-day, which was valued at **$8.2 million in air pollution cost savings** based on published average unit costs for air pollution. A present value of benefits of $846 million (2002) and construction costs of $451 million led to a **benefit-to-cost ratio of 1.87 being estimated**[89].

The second study used data from a cross-sectional analysis of travel diary data for residents of **Portland, Oregon**, and found that population density, retail employment density, total employment density, number

of intersections within half a mile and a shorter distance from home to City Hall were all associated with more walking[90]. Scenarios were tested where 75th and 95th percentile values were used for these built environment characteristics instead of median values. It was assumed that these values would apply to 5,000 residents. The increases in walking associated with these scenarios were used to estimate the amount of residents moving from the most inactive tertile to the second tertile and health benefits were obtained based on the age-adjusted all-cause mortality risk ratio for moving between these tertiles. **Net present values generally in the range of $1-8 million were obtained for each of the potential built environment interventions**[90].

The third study predicted the **health benefits of a new Light Rail Transit (LRT) system in Charlotte**, North Carolina, based on estimating the number of obese people who will walk at least 30 minutes each day as a result of using LRT and the medical-related costs of obesity ($887 per year) and willingness to pay for weight reduction programmes ($787)[91]. They estimated **a saving of $12.6 million in healthcare costs over a nine year period of operation.** (set against total LRT construction **costs of $427 million**).

A UK study reports on the use of an information system tool developed to predict the numbers of people who gain access to destinations from walking environment improvements[92]. Applying it to the 65 and over population of St Albans, it showed the increase in the number of people who could reach the Old Town Hall as a result of four different measures (dropped kerbs at existing crossings, provision of crossings every 100 m, provision of wider pavements and provision of benches very 100 m). It predicted that **provision of benches would have the largest impact and be most cost effective at £180 per beneficiary**[92].

Further research in the **UK has investigated the value for money of public realm improvements in terms of user experience benefits** (journey ambience) and **property value increases**[39] (see Chapter 2). This used stated preference research with the public to obtain the values that people placed on different street quality improvements. The values derived were applied to three proposed schemes (shared space, pedestrianisation and Home Zones) to obtain overall journey ambience benefits. Present values were obtained for journey ambience (over a 15 year period) and compared to scheme costs to give benefit-cost ratios of **0.5-0.6 (shared space), 1.7-1.9 (pedestrianisation) and 0.1-0.2 (Home Zone)**[39]. The relatively low benefit-cost ratios in these cases are a consequence of only the benefits to the user experience being taken into account – excluding other benefits such as health and road safety.

Comparison to value for money of other transport investments

The section above demonstrates that improvements to the walking environment can offer significant economic benefits, and that the benefits generally outweigh the costs. However, the value for money of such schemes needs to be compared with investments in other forms of transport infrastructure.

Two studies have summarised the cost-benefit ratios of transport projects in the UK. The first[93], a summary of which is shown in Table 2, indicates **higher benefit-cost ratios for walking and cycling projects than other project types**. However, the average benefit-cost ratio for walking and cycling projects is based on only two projects.

Table 2 Summary of benefit-cost ratios from transport projects in the UK[93]

Sector	No. of projects	Average benefit-cost ratio
Highways Agency schemes	93	4.66
Local road schemes	48	4.23
Local public transport schemes	25	1.71
Rail schemes	11	2.83
Light rails schemes	5	2.14
Walking and cycling	2	13.55

The second study[94] derived benefit-cost ratios for different amounts of expenditure for ten different types of transport project. This study is perhaps more appropriate as it reports the range of cost-benefit ratios, instead of an average, and considers a broader range of types of project. Table 3 shows that **as expenditure increases for a particular project type, the benefit-cost ratios are likely to decrease**. The **highest value for money transport projects are smarter choices, pedestrian and cycle schemes, local safety schemes and some bus schemes** (especially bus priority schemes). This suggests that investment in the walking environment is likely to be of equal or better value for money than other transport projects.

Table 3 Cost-benefit ratios by quartile of expenditure in ten areas of policy[94].

Expenditure /£ billion	Cost-benefit ratios for different transport projects									
	Local safety	Smarter Choices	Cycling	Concessionary bus fares	Local bus	Local roads	New light rail	Highway Agency roads	Rail	Intelligent Speed Adaptation
0.125	50									
0.2		30	20							
0.25	30			6						
0.375	20									
0.4		15	10							
0.5	10			6	10	1.3				
0.6		10	5							
0.625	0									
0.75				6						
0.8		6	4							
1.0		0	0	12	4	1.1				
1.25							7			
1.5					3	0.6				
2.0					1.5	0.5				
2.5					0	0	4	1.5	6	12
3.75							2			
5.0							1.5	1.25	3	10
6.25							0			
7.5								0.7	1.5	8
10								0.6	1.2	6
12.5								0	0	0

A detailed comparison has been made of the impacts of different smarter choices measures in reducing car travel[35]. Smarter choices measures are initiatives to achieve behaviour change from car travel to other methods of travel, including walking. Table 4 presents the cost effectiveness of different smarter choice measures in terms of reducing car travel by 1,000 car kilometres. It also reports benefit to cost ratios:

Table 4 Summary of benefit-cost ratios from smarter choice measures in the UK[35]

	Cost of reducing 1000 car km.	Benefit-cost ratio
Personalised travel plans	£20 to £130	7 (not reported what benefits considered)
Walking groups	£740	Not reported
Walks information packs	£69	Not reported
Active travel to school	Varies	4.6 (based on health, congestion, carbon emissions)
Walking to work	£565	Not reported
Sustainable Travel Towns	£40	4.5 (based on congestion only)

Table 4 shows that larger-scale initiatives targeted at whole communities (personalised travel plans and Sustainable Travel Plans) are more cost effective than smaller-scale initiatives targeted at smaller groups (walking groups, Walking to Work). Similarly, an Australian review found that use of pedometers and mass media-based community campaigns are the most cost effective interventions, in terms of disability-adjusted life years (DALYS) arising from increased physical activity and are more cost effective than personalised travel plans, GP physical activity prescription campaigns, GP referral to exercise physiologist and internet based physical activity information[95]. The benefits demonstrated by these interventions could potentially have been increased by combining them with physical changes to the walking environment.

Conclusions

This Chapter posed the question 'how cost effective are investments in the walking environment?' Overall it found that:

- Investments in the walking environment are **good value for money compared with other transport investments**
- Investments in the walking environment are **good value for money** – even accounting for the fact that most **evaluations only consider a small number of potential benefits**. Cost-benefit analyses are underestimating the value of the walking environment, because very few studies have accounted for the impacts of increased walking on road casualties, congestion, fuel costs and other motorised travel costs, noise and air pollution, carbon dioxide and reduced public costs of providing for motorised transport. There are likely to be substantial benefits arising in these areas where investment in walking leads to modal shift
- The most **significant measured benefit of investments in the walking environment is better health from increased physical activity**, and again, this is despite the fact that the only part of the total health benefit has been assessed. UK and international studies have reported significant potential health benefits from relatively minor investments. (It is worth noting that research is currently being undertaken to develop the methodology used in UK transport appraisal for estimating the monetary benefits of improved health due to increased walking. It will be based on the World Health Organization's Health Economic Assessment Tool for cycling, HEAT)[86]
- **User experience (often referred to as journey ambience) is the second largest benefit**. This represents the improved travel experience of users of a walking environment
- **All the evidence reviewed of evaluations of walking environments showed positive cost-benefit ratios**, of up to 37.6
- **In comparison with other transport projects, investments in walking are value for money. As expenditure increases for projects the benefit-cost ratios tend to decrease. The highest value for money transport projects are smarter choices, pedestrian and cycle schemes, local safety schemes and some bus schemes**. This suggests that investment in the walking environment is likely to be at least, if not better, value for money than other transport projects

References

[82] DfT. 2010. Guidance on the appraisal of walking and cycling schemes. TAG Unit 3.14.1. Available from http://www.dft.gov.uk/webtag/documents/expert/unit3.14.php.

[83] Sustrans. 2006. Economic appraisal of local walking and cycling routes: Methodology. Available from http://www.sustrans.org.uk/resources/research-and-monitoring/economic-appraisal-of-cycling-and-walking-schemes.

[84] Wang, G., Macera, C.A., Scudder-Soucie, B., Schmid, T., Pratt, M., Buchner, D. 2005. A cost–benefit analysis of physical activity using bike/pedestrian trails. Health Promotion Practice 6 (2): 174-179.

[85] Saelensminde, K. 2004. Cost-benefit analyses of walking and cycling track networks taking into account insecurity, health effects and external costs of motorized traffic. Transportation Research Part A: Policy and Practice 38 (8): 593-606.

[86] Cavill, N., Kahlmeier, S., Rutter, H., Racioppi, F., Oja, P. 2008. Methodological Guidance on the Economic Appraisal of Health Effects Related to Walking and Cycling. WHO Regional Office for Europe, Copenhagen.

[87] Gotschi, T., Mills, K. 2008. Active Transportation in America: The Case for Increased Federal Investment in Bicycling and Walking. Rails to Trails Conservancy. Available from http://www.railstotrails.org/ourwork/advocacy/activetransportation/makingthecase/index.html.

[88] Jones, T.F., Eaton, C.B. 1994. Cost-benefit analysis of walking to prevent coronary heart disease. Archive of Family Medicine 3(8): 703-710.

[89] Guo, J.Y., Gandavarapu, S. 2010. An economic evaluation of health-promotive built environment changes. Preventative Medicine 50: S44-49.

[90] Boarnet, M.G., Greenwald, M., McMillan, T.E. 2008. Walking, urban design, and health: Toward a cost-benefit analysis framework. Journal of Planning Education and Research 27: 341-358.

[91] Stokes, R.J., MacDonald, J., Ridgeway, G. 2008. Estimating the effects of light rail transit on health care costs. Health and Place 14: 45-58.

[92] Mackett, R.L., Achuthan, K., Titheridge, H. 2008. AMELIA: A tool to make transport policies more socially inclusive. Transport Policy 15: 372-378.

[93] Dodgson. 2009. Rates of Return on Public Spending on Transport. Report 09/103 to Royal Automobile Club Foundation. Available from http://www.racfoundation.org/research/economics/Rates-of-return.

[94] Goodwin, P. 2010. Opportunities for improving transport and getting better value for money by changing the allocation of public expenditures to transport. Project Report. Commission for Integrated Transport. Available from http://eprints.uwe.ac.uk/13130/.

[95] Cobiac, L.J., Vos, T., Barendregt, J.J. 2009. Cost-effectiveness of interventions to promote physical activity: A modelling study. PLoS Medicine 6(7).

Case studies

Kensington High Street

Kensington High Street is a popular shopping street with both local and visiting traffic and an affluent residential hinterland. It is also a busy arterial route into central London. Thousands of people come into the area every day to work and shop, arriving mostly by tube and bus. These improvements aimed to achieve a coherent, uncluttered streetscape, easing movement for all users. Kerb build outs and lay-bys were removed and kerbs re-aligned to follow the building line along the 1.1km length of the High Street, creating a boulevard effect. The south footway was widened and a new 3m central reserve was achieved by reorganising traffic lanes to provide cycle parking and tree planting in the centre. New crossings were installed at significant points and existing ones re-designed to allow pedestrians to cross the road in one go – particularly beneficial to wheelchair users and those with prams. Materials were kept simple and street furniture reduced so that, for example, lighting columns also have mountings for traffic signals, bins and signs. Barriers were largely removed to 'liberate' users. Although the scheme was first proposed in 1995 it was not until a new Councillor was appointed that it became a reality, emphasising the importance of strong political leadership.

Objective.

The main objective of the scheme was to improve the quality of the public realm in order to maintain and enhance the vitality and viability of the High Street as a major shopping destination in the face of other competing retail developments. A key aim was to improve pedestrian movement along and across the road whilst also maintaining vehicle traffic flows.

Cost.

£5 million

Time period.

First proposed in 1995, a consensus was reached in 2000 and the works completed in 2003 over six phases.

Outcomes.

The street improvements have enhanced the quality of streetscape and the use of high quality materials has reinforced the image of the High Street as a premier shopping destination. Road safety has improved and collisions reduced. Vehicle speeds have reduced slightly and observations suggest that drivers are more aware of pedestrians. Similarly, pedestrians, able to cross safely at a wider range of places, seem to be more attentive in their use of the street.

In figures:

- During the three years after completion traffic collisions in the affected area reduced by more than 40%, with pedestrian casualties reducing by 59%. Latest figures indicate that this reduction has been maintained
- 12.9% growth in sale prices of flats within 200m of the scheme

Sources: Swinburne, G. 2006. Kensington High Street Road Safety Report. Royal Borough of Kensington and Chelsea; MVA. 2008. Valuing Urban Realm: Seeing Issues Clearly. Report for Design for London; CABE case study briefing; Personal communication with Shirley Long, Royal Borough of Kensingston and Chelsea, 18th 20th May 2011.

Sheaf Square and Howard Street, Sheffield

Photo: St BC, Wikimedia Commons

Sheaf Square and Howard Street are key parts of the 'Gold Route' linking Sheffield railway station to the city centre. Previously, arrival from the station was dominated by a disused tower block and poor crossings of a busy ring road. Demolition of the tower block and re-shaping of the station provided an opportunity to improve the public realm and create new crossing points on the ring road. This has transformed the route from the station and improved the setting of nearby Sheffield Hallam University. A new walking route from the station to Howard Street runs up a gentle slope between a water cascade and a giant steel sculpture reflecting the city's industrial heritage.

The success of the Gold Route project is due in large part to the strong leadership of the city council once the proposals had been extensively consulted on and agreed by a range of agencies and the public, especially those connected with the station and Sheffield Hallam University.

The historical character of the station and surrounding area has been enhanced whilst updating the public realm and making it more coherent and walking friendly.

Objective.

The aim of the Sheaf Square and Howard Street project was to improve pedestrian connections to the city centre, moving from an unpleasant, indirect route over a heavily trafficked ring road towards a pleasant and legible pedestrian route which created a clear and enjoyable sense of arrival in the city. Howard Street and Sheaf Square were redesigned to reinforce a major pedestrian axis and create a much better first impression of the city.

Cost.

£24 million (£11.1m EU Objective 1 funding, £6.8m DfT, £2.8m Yorkshire Forward, £3.3m variously from Sheffield Hallam University, private contributions, English Partnerships, Railway Heritage, private developers)

Time period.

Following agreement of the masterplan in 2000, works took place from June 2007 to August 2008.

Outcomes.

The regeneration of these two areas has resulted in a strong pedestrian connection between the key access point to the city and its centre. Good design reflects and celebrates the history of the city. Changes to and downgrading of the ring road and 'concrete collar' have been successful in enabling better pedestrian connections whilst avoiding the increased vehicle traffic congestion anticipated by some critics. Good leadership and a joined-up approach which linked other regeneration efforts at the station and partnerships with the Sheffield Hallam University produced the best possible result.

In figures:

- 7am-7pm pedestrian movement increased from 3,174 to 8,700 between 2001 and 2008 at Sheaf Street
- Vehicle counts reduced from 36,600 to 25,520 in the same period
- At Arundel Gate vehicles reduced from 24,000 in 1990 to 11,780 in 2010

Source: CIHT (2010) Manual for Streets 2: Wider Application of the Principles. Chartered Institution for Highways and Transportation, London.

Five Roads Home Zone, Ealing

The home zone proposal was initiated by residents due to concern about motor traffic intrusion, noise and air pollution and a lack of public space. The Five Roads area is residential, consisting mostly of Victorian terraced and semi-detached homes, with some newer flats. It is bounded by the railway line to the north, the busy Uxbridge Road to the south and through roads to the east and west, and suffered from excessive through traffic and competition for car parking from commuters and shoppers.

The scheme included gateway features at the ends of all entrance roads into the zone, a 20mph speed limit, road closure at one end of a through road, new planting and lighting and areas of shared surface. In addition, the layout was changed using echelon parking on alternate sides to create speed-reducing chicanes, a controlled parking zone was introduced and new surfacing was used to show the different road use zones.

Objective.

In developing the area as a home zone, the London Borough of Ealing hoped to reduce traffic speeds, increase opportunity for outdoor play and neighbourhood activity and improve both perceived and actual road safety.

Total cost.

£375,000

Time period.

Initial concerns were raised in 1998 and a residents' forum established. Consultation with officers and residents resulted in an agreed plan with works on site starting in 2001 and the launch of the completed works in 2004.

Outcomes.

Generally the public perception of the scheme was very positive in terms of traffic volume, speed and safety, air quality and the quality of the environment. These perceptions were corroborated by reductions in motor vehicle flow and speed.

In figures:

- 67% of respondents thought that all residents benefitted from the home zone
- 40% of respondents thought it had improved the friendliness of the neighbourhood
- 24% of respondents thought it made the area look better
- 72% of respondents thought vehicle speed had reduced and measured average vehicle speed had reduced from 19 to 16 mph
- 83% of respondents thought motor traffic volume had reduced and measured vehicle flows more than halved from 1400 to 668 per day
- 64% of respondents thought traffic danger to children had reduced
- 74% of respondents thought traffic noise had reduced
- 73% of respondents thought traffic pollution had reduced
- 50% of respondents thought walking was more pleasant, 20% said they spent more time outside the front of their home and 14% of children said they spent more time outside near the home

Source: Webster, D., Tilly, A., Wheeler, A., Nicholls, D., Buttress, S. 2006. Pilot Home Zone Schemes: Summary of the Schemes. TRL Report 654. TRL Limited, Crowthorne.

Wanstead High Street walking improvements

Photo: Transport for London

Wanstead High Street runs between two underground train stations approximately a mile apart. A bus terminus by the park at Christchurch Green separates the main residential areas from the High Street. There is also a school and library by the High Street. The High Street and its surrounding areas underwent significant improvements to the walking environment, including new pavement surfacing, accessible crossings, new street lighting on the main road and two crossing routes to the park, decluttering, improvements to street furniture and the installation of CCTV. Transport for London have supported this as part of a 'Key Walking Routes' initiative, linking important local destinations by improving the walking environment.

Objective.

To increase walking for short trips by taking a holistic approach to the whole area around the high street and enhancing walking routes to the two stations, bus terminus, school, library and high street.

Total cost.

£725,000 (60% Transport for London and 40% London Borough of Redbridge)

Time period.

2 year programme, fully completed by April 2009.

Outcomes.

The new lighting has meant that Christchurch Green has become a designated route to school. More accompanied children and older adults are using the park both during the day and after dark. The area has hosted a number of events organised through Living Streets' Step Out In London programme, including guided walks, treasure hunts and a mapping exercise with the local school.

In figures:

- Christchurch Green has seen a 122% increase in walking at night and a 75% increase in the winter late afternoon and early evening period
- 57% of the participants in Living Streets' Step Out in London project felt that the changes to the pedestrian environment had encouraged them to walk more

Source: Social Research Associates. 2010. Living Streets Step Out In London 'After' report. Social Research Associates, London.

Exeter City Centre

Photo: Exeter Council

Exeter has been revitalising its city centre with a series of improvements to the public realm. The pedestrian environment has been improved by both the removal of vehicle traffic and by traffic management and an increase in pedestrian and shared spaces (including opportunities for al-fresco café and restaurant seating). High quality paving (using natural stone), public art, seating, tree planting and lighting have been used. Permeability and connectivity in the city centre have been improved and the various schemes have allowed pavement cafés to develop, so enlivening the city centre. This has been a phased programme of enhancement including major development schemes, such as the mixed-use development of Princesshay, to create new retail space and reinvigorate the city centre through a connected pedestrian network of public spaces and a high quality public realm. The work has been a partnership between the City Council, Devon County Council and other stakeholders such as the Dean and Chapter of Exeter Cathedral and private developers.

Objective.

To both enhance the reputation of Exeter by developing a high quality destination, so encouraging visitors and investment, and to improve the well-being of all those who have an interest in the city centre including residents, businesses and cultural organisations.

Total cost.

Overall, Exeter City and Devon County Councils have invested £4.5m over 10 years.

The costs have been split over a number of sites starting with Queen Street in 2000 (£300K), Castle Street (£300K), High Street (£1.8m), Cathedral Yard and Broadgate (£540K), Princesshay (private development), Lower High Street (£500K), Cathedral Close (£467K), Paris Street, Sidwell Street (£800K) and Martins Lane in 2009 (£110K).

Time period.

2000-2010.

Outcomes.

Exeter City Council in partnership with Devon County Council have encouraged developers and high-end retailers to the city and created a revitalised city centre. Initial investment in the public realm of existing shopping areas meant that the vibrancy of the city was maintained during development of Princesshay and that these areas did not decline following the completion of the new retail development. The improvements to the public realm support the historical identity of the city and enhance St Peter's Cathedral as a focal point.

Princesshay has won a number of awards from the British Council for Shopping Centres, the International Council for Shopping Centres and the Royal Town Planning Institute, as well as winning the Best Medium-Sized Shopping Centre in Europe and the Retail Week Shopping Location of the Year awards in 2008.

Recent enhancements have taken place at Sidwell Street and New North Road as part of the plans to improve the environs for the development of the former Debenhams building as a John Lewis store.

In the future, enhancements will continue at Gandy Street and Northernhay Gate, with plans being pursued for enhancements to Central Station forecourt.

Photo: Exeter Council

In figures:

- Increase in footfall of around 30% between 2002 and 2010
- Increase in the price of zone A retail rent from £220 per square foot in 2006 to £225 per square foot in 2008 which have been maintained in Princesshay in 2009 compared with declining rents in towns in the region

Sources: Personal communication with Paul Osborne, Exeter City Council, 18th March and 20th May 2011; Landscape Institute. 2011. Why invest in landscape? Landscape Institute, London.

New Road, Brighton

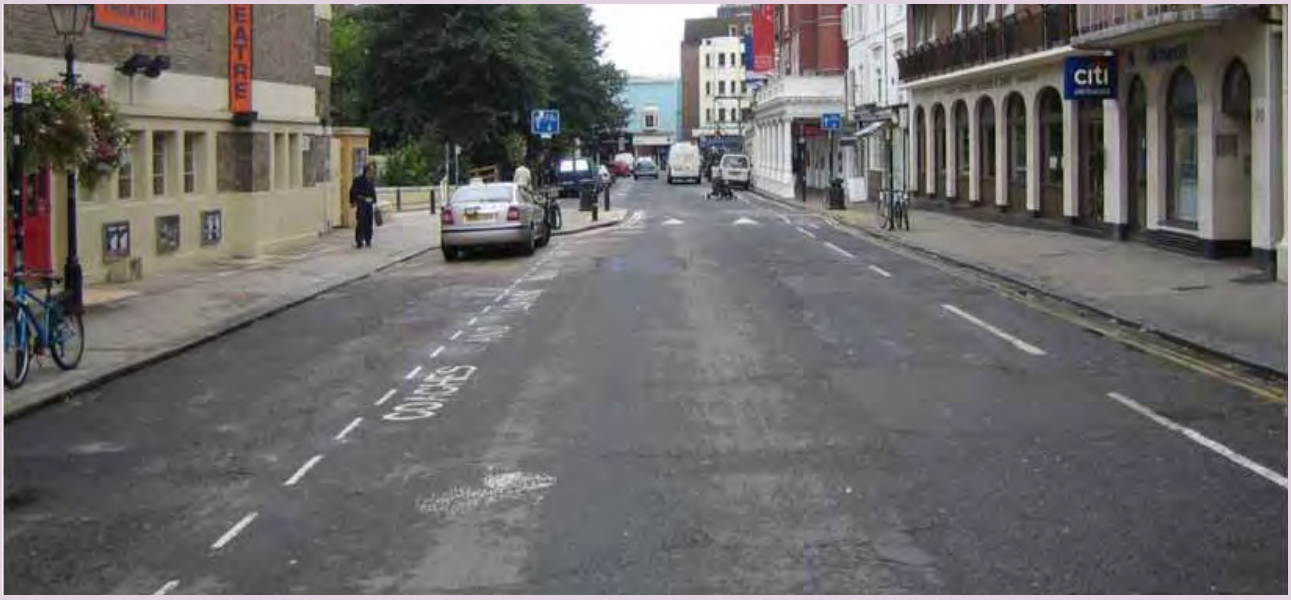


Photo: Gehl Architects

Photo: Gehl Architects

New Road is a busy commercial street with bars, restaurants, shops, a library and two theatres. Gehl Architects, Landscape Project and Stockley worked with Brighton and Hove City Council to redesign the road and create a shared space with high quality granite paving across the whole area. The use of a tactile strip of paving has ensured that the visually impaired are able to negotiate the space in safety. The area has been de-cluttered with road markings and signs all but removed. This has resulted in a pedestrian friendly environment without the need to apply formal restrictions to motor traffic. Seating and lighting have been used to ensure the space is attractive to travel through and spend time.

Objective.

To enable the street to fulfil its potential as a place.

Total cost.

£1.75 million

Time period.

2007

Outcomes.

The shared space at New Road has created an environment which is vibrant and welcoming. It has won numerous awards for urban design, including those from the Civic Trust and Landscape Institute. It has received overwhelming public support from both users and local businesses. Local restaurants and bars have invested in tables and chairs for outside their premises, enhancing the lively and social atmosphere. Local businesses feel that the shared space has improved the sense of community in the area, improving the perception of the road and the businesses on it by providing a better environment for customers.

In figures:

- 162% increase in pedestrian activity
- 93% reduction in traffic volume
- 600% increase in sedentary activities
- Reduction in traffic collisions from 3 in 2004 to 2006 to zero since completion in 2007
- Almost 100% of those questioned said they thought New Road was 'good', with 95% giving a score of above five (on a scale of -10 to 10) and nearly 50% a score of 9-10
- Almost 100% of those questioned said they would like to see more schemes like New Road, with around 90% giving a score of above five (on a scale of -10 to 10) and around 65% a score of 9-10
- Research participants from the business community unanimously agreed that the scheme had benefited their business
- New Road is now the 4th most popular place to spend time in Brighton
- The average amount those questioned were willing to donate to pay for a similar scheme was £35

Source: Personal communication with Jim Mayor, Brighton and Hove City Council on 29th March 2011; data from Brighton and Hove City Council and the CIVITAS Initiative.

Broadway Boulevard, New York

Photo: Jérôme, Wikimedia Commons

Broadway cuts through the length of Manhattan, creating a disruptive diagonal path through the midtown area. Characterised by complex intersections and insufficient pedestrian space, particularly at the iconic destinations of Times and Herald Squares, the area was congested for both vehicles and pedestrians. The pilot programme to reroute traffic away from Broadway at Times and Herald Squares simplified intersections and allowed the creation of pedestrian plazas through the two squares. Other changes included alterations to road geometry, shortening crossings and changes to parking regulations.

Objective.

To reduce traffic congestion and improve journey times whilst also improving safety, particularly of pedestrians who were often forced to walk on the road because there was not enough space for them. The removal of long crossings and awkward traffic movements created by the diagonal Broadway were aimed at improving safety. There was also the desire to make the key destinations of Times and Herald Squares into more pleasant walking environments and spaces for people to congregate.

Time period.

May to August 2009

Outcomes.

Vehicle traffic flows have increased, but despite this the travel times of taxis and buses have decreased by up to 15% and injuries to motorists and passengers have reduced by 63%. The expansion of pedestrian space and the resulting reduction of overspill footfall in to the road (for example, by 80% in Times Square) has reduced injuries to pedestrians by 35%.

The number of pedestrians travelling along Broadway and 7τη Avenue in Times Square has increased by 11% and at Herald Square pedestrian volume has increased by 6%.

The programme has received good public support with 74% of New Yorkers agreeing that Times Square has improved dramatically.

Source: Department of Transportation. 2010. Green Light for Midtown evaluation report. New York City Department of Transportation.

Melbourne city centre, Australia

Melbourne city has been undertaking a whole city renaissance to revitalise city life, transforming the city centre from an empty place where only workers go to a vibrant centre with a resident population and 24 hour destinations. Substantial changes to city centre from 1994 to 2004 included wider footways, more greenery, street art and usable 'laneways' (10 times more active and accessible lanes, alleys and arcades). In addition, the central area has seen an 830% increase in residents and a 275% increase in cafés.

Objective.

To revitalise the city centre area, bringing in more activity and more usable spaces that are attractive and pleasant to use.

Time period.

Initiated in the 1980s, improvements have been carried out over a 10 year time period from 1995 to 2005.

Outcomes.

Overall there has been a 39% increase in pedestrian traffic on weekdays and a 98% increase on weekday evenings, while weekend pedestrian traffic has increased by around 10%.

Stationary activities such as café use have also increased by 2-3 times.

Sources: Hayter, J.A. 2006. Places for People 2004: Melbourne, Australia by Gehl Architects and the City of Melbourne. Places 18(3): 28-32; City of Melbourne and Gehl Architects. 2005. Places for People Urban Quality Consultants. Gehl Architects, Copenhagen.

Copenhagen

Over the course of more than 30 years, Copenhagen has gradually transformed its city centre to an urban space where pedestrians and cycles are the most used forms of transport. The slow process of change has allowed people to get used to the new approach and planners to build on and learn from their experiences. Copenhagen has seen wide-scale pedestrianisation, the reduction of traffic lanes and prioritisation of cycles, as well as a gradual reduction in parking spaces by 2-3% annually and incremental increases in parking costs, all of which has helped to change the transport culture of the city. In addition, this has been complemented by improvements to the walking environment to encourage more than just 'necessary' walking and increase lingering and enjoyment of the space. Land made available by the removal of parking spaces has been transformed into public open space.

More recent initiatives have placed a greater emphasis on cycling as the main means of transport.

Objective.

To gradually change the city centre from car dominated to soft-traffic orientated, reducing vehicle traffic and increasing pedestrians and cycle activity whilst ensuring a high quality walking environment in the city.

Time period.

The first street was pedestrianised in 1962 and incremental change has been happening continually since this time.

Outcomes.

A fourfold increase in street stationary activity between 1968 and 1995 in the pedestrianised spaces demonstrates an evolution from just walking to other outdoor urban recreation. As more space has been made for walking so more space has also been needed for pausing as people choose to sit, use cafés or enjoy entertainment.

The incremental process of change has been instrumental in acceptance of the re-orientating of the city centre away from vehicular traffic. Pedestrian movements doubled during the initial phases of pedestrianisation but have been more stable in recent years. Car traffic has also remained stable in the city centre, in contrast to the greater urban area where car traffic has increased rapidly.

Pedestrian activity accounts for 80% of all traffic in the city centre.

Sources: Gemzoe, L. 2001. Copenhagen on foot: thirty years of planning and development. World Transport Policy and Practice 7(4): 19-27; Copenhagen Traffic Department. 2010. Traffic in Copenhagen. City of Copenhagen.

Drachten, The Netherlands

A busy junction in the town of Drachten comprised of the usual traffic signals, multiple car, bus and cycle lanes, pedestrian crossings and the associated signs and road markings. The junction was unattractive to users, characterised by traffic congestion and a poor safety record. The junction was transformed into a shared space through the creation of a public square with water features and lighting, the replacement of traffic lights with a central roundabout and the use of informal pedestrian crossings and very limited road markings.

Objective.

To create a high quality public space on a busy junction; reducing traffic congestion and improving traffic safety.

Time period.

2002 to 2003.

Outcomes.

Traffic collisions decreased from 8.3 per year in the period 1994 to 2002 to 1 per year in 2004 and 2005.

Delays for vehicles and pedestrians have decreased by around 20 seconds, despite a 30% increase in traffic volume. The majority of pedestrians and cyclists were observed crossing the junction without pausing.

Generally, public perception for the shared space is good; the feeling is that users are behaving more safely and spatial quality have improved and those rating congestion as bad has decreased from 66% to 5%.

Sources: Noordelijke Hogeschool Leeuwarden. 2007. The Laweiplein. Evaluation of the Reconstruction into a Square with Roundabout. Noordelijke Hogeschool Leeuwarden / Verkeerskunde, Netherlands; Hamilton-Bailie, B. 2008. Shared Space: Reconciling people, places, traffic. Built Environment 34(2): 161-181.

Conclusions

This report has made the case for investment in the walking environment. It has set out the evidence on the benefits of walking friendly places, and indentified their cost effectiveness. It has also presented a number of case studies of successful schemes which have been tested and evaluated.

Figure 2, below, provides a matrix of evidence showing specific sources of the findings presented.

IMPROVEMENTS TO THE WALKING ENVIRONMENT

Evidence Cost-benefit analysis	Increased pedestrian numbers	Increased walking levels	Improved physical health	Increased road safety	Reduced congestion	Increased social interaction	Ambience	Improved air quality	Reduced CO_2 emissions	Reduced noise pollution	Increased property prices
Speed limits		Portsmouth		Liverpool Manchester Portsmouth			Liverpool Manchester Portsmouth				
Safe routes to school		California	Links to Schools	Links to Schools			Links to Schools				
Traffic calming	Faifley Road, Glasgow	Faifley Road, Glasgow	Faifley Road, Glasgow	Faifley Road, Glasgow			Faifley Road, Glasgow				
Public realm improvements	Maid Marian Way, Nottingham Gold Route, Sheffield Exeter			Kensington High Street	Kensington High Street						Maid Marian Way, Nottingham Exeter Kensington High Street
Mixed priority routes	Demonstration Projects			Demonstration Projects						Demonstration Projects	
Shared use paths	DfT Walking and Cycling Scheme case studies	Nebraska North Carolina West Virginia	DfT Walking and Cycling Scheme case studies	DfT Walking and Cycling Scheme case studies			Norway DfT Walking and Cycling Scheme case studies	Norway	Norway DfT Walking and Cycling Scheme case studies	Norway	
Reallocation of space	Copenhagen Broadway Boulevard, New York			Broadway Boulevard, New York Home Zones	Broadway Boulevard, New York	Copenhagen Home Zones	Home Zones				
Shared spaces	New Road, Brighton Castle Street, Kingston-upon-Thames			Drachten, The Netherlands	Drachten, The Netherlands	New Road, Brighton Castle Street, Kingston-upon-Thames					

Figure 2. Matrix of evidence from case studies of interventions in the walking environment, showing where cost-benefit analyses have also been conducted.

The benefits of walking friendly environments and walking

The benefits of walking friendly environments and walking to both 'people' and 'place' are extensive and far-reaching.

- Walking has significant **physical and mental health benefits**: higher levels of walking are associated with lower risks of mortality (mainly through reduced risk of cardiovascular disease and cancer). Walking helps prevent obesity; diabetes; high blood pressure and can also improve self-worth, mood and have a positive impact on self-esteem. It is also linked with reductions in anxiety and depression
- **Specific groups such as children and older people** who are often more reliant on their local neighbourhoods can gain significant health benefits and independence through walking
- **Residents of walking friendly neighbourhoods** (in terms of density, connectivity, quality, greenery etc.) are less likely to be depressed, and more likely to have better physical and mental health
- Investments in walking environments can help alleviate the significant societal and economic **costs related to poor health**
- Walking and walking friendly environments have **social benefits**. They contribute to increased social interaction, the development of social capital and increased safety (and perceptions of safety)
- **Perceived levels of safety affect how much people walk**. People walk more when they feel their neighbourhood is safe, well maintained and lively. Localised investments to improve perceptions of safety will encourage people to walk more, with resulting benefits for health and social interaction
- **The environmental benefits** of walking friendly environments are largely related to shifts from other modes. Reductions in carbon emissions and, noise and improvements in air quality are potential benefits
- Investments in walking environments have **significant economic benefits**. They can increase the value of residential and commercial properties, and increase rental income. They can also support local economies by attracting new businesses and events
- **The public and retailers are willing to pay**, to varying degrees, for improvements to the walking environment

What makes a good walking environment?

- **Interventions in the walking environment can take many forms**. Key interventions currently being implemented in the UK and internationally include:
    - Speed limits
    - Safe routes to schools
    - Traffic calming
    - Public realm improvements
    - Mixed priority routes
    - Shared use paths
    - Reallocation of space
    - Shared spaces
    - Mixed measures

- These interventions have a **range of benefits which are common to many schemes**. Overall, they are successful in:
    - Significantly **increasing pedestrian activity** (footfall)
    - **Improving safety**: they lead to fewer road casualties, injuries to pedestrians and traffic collisions
    - **Reducing vehicle speeds**: where the schemes set out to reduce speeds, they are successful, and this contributes to a more walking friendly environment
    - **Delivering social benefits**: these interventions increase opportunities for social interaction which can facilitate the development of social capital. They can also lead to higher numbers of people taking part in outdoor activities and spending time outside their homes
    - **Delivering economic value**: the schemes have increased the sale prices of nearby homes and increased retail rents
    - **Encouraging more physical activity**: this is particularly noticeable in, for example, increases in the proportion of children walking to school
    - **Reducing noise levels**
    - **Reducing the number and distance of car trips**, implying a modal shift away from the car to walking
    - **Providing attractive and popular places**: the public are positive about investments in the walking environment, and the schemes usually have the support of visitors and residents. People tend to report that investments in the walking environment lead to more attractive and safe places

- There are also a number of **characteristics of existing urban environments that encourage walking**. These tend to be places that are **higher density, well connected, mixed use, and attractive (high quality)**
- Overall, **urban walking friendly environments are associated with between 25 and 100% greater levels of likelihood of walking**
- The **aesthetic quality of a place** is the most consistently important factor in relationships between the public realm and recreational walking, health and well-being

How cost effective are investments in the walking environment?

- **Investments in the walking environment are good value for money compared with other transport investments**
- Investments in the walking environment are **good value for money** – even accounting for the fact that most **evaluations only consider a small number of potential benefits**. Cost-benefit analyses tend to underestimate the value of the walking environment, because very few studies have accounted for the impacts of increased walking on road casualties, congestion, fuel costs and other motorised travel costs, noise and air pollution, carbon dioxide and reduced public costs of providing for motorised transport. There are likely to be substantial benefits arising in these areas where investment in walking leads to modal shift
- The most **significant measured benefit of investments in the walking environment is improved health from increased physical activity**, and again, this is despite the fact that only part of the total health benefit has been assessed. UK and international studies have reported significant potential health benefits from relatively minor investments

- **User experience (often referred to as journey ambience) is the second largest benefit.** This represents the improved travel experience of users of a walking environment
- **All the evidence reviewed of evaluations of walking environments showed positive cost-benefit ratios**, of up to 37.6
- **In comparison with other transport projects, investments in walking are value for money. The highest value for money transport projects are smarter choices, cycle and pedestrian schemes, local safety schemes and some bus schemes.** This suggests that investment in the walking environment is likely to be at least, if not better, value for money than other transport projects

Critique of the evidence reviewed and recommendations for further research

Although a large amount of research and case study evidence now exists, there are still some key gaps in knowledge about walking friendly environments. There are also a number of weaknesses with some existing research that should be highlighted. Reflections on the material used in this review can be summarised as follows:

- Some evaluations have been problematic methodologically, using inappropriate methods, sample sizes or timescales to allow robust evaluation to take place
- The statistical analysis in some studies is not robust enough to be certain of the results presented (we have indicated where this is the case)
- Evaluations often do not maximise the potential of the data they have collected. For example, data are often collected on respondents' characteristics in evaluation studies, for example on age and gender, but little is made of these data in the evaluation either in terms of looking at the differences between particular groups or adjusting any analysis to take account of these characteristics
- Data are often incomplete and this can give the impression that the reporting may be biased
- Many evaluations are too focussed on pedestrian count data without the implications of greater pedestrian numbers being assessed in terms of changes in individual walking activity, physical activity and the use of other means of transport
- Changes in pedestrian numbers have often been measured in the immediate vicinity of an intervention without any measurement of changes in adjacent areas (there may be a transfer of pedestrians or walking between locations)
- Surveys carried out retrospectively, or those reliant on self-reported data, may be subject to unreliable memory recall or social desirability bias
- Often walkers and cyclists are evaluated, or least reported together, and they need to be considered separately
- Cross-sectional studies are generally most robust in terms of data collection, statistical analysis and interpretation but cannot attribute causality; therefore more robust longitudinal studies are needed of cities or initiatives

Given the above issues, the following recommendations for further research are made:

- More long-term monitoring should be carried out for case study schemes to assess changes in social and economic activity
- Robust estimates of the increased amount of walking (and ideally, the increased total physical activity) that occurs as a result of a scheme should be assessed. It is recommended that detailed research is undertaken of case study schemes to assess the impact of walking investment on the amount of walking undertaken (this requires measurement of both aggregate walking levels and the changes in the amount that individuals walk) so that health benefits can be accurately assessed and this used to inform policy. This will require surveys in the intervention catchment area rather than pedestrian counts
- Research should be carried out to validate values obtained from stated preference research. If users place high value on environmental qualities then it would be expected that an improved street environment will attract more users and lead to increased social and economic activity. There is some evidence for this, but more robust data would support the case
- More research needs to be done on changes in travel behaviour and the wider impacts of such changes that occur as a result of investing in the walking environment

Appendix A: References

Accent. 2006. Valuing Urban Realm: Business Cases for Public Spaces. Technical Report to Transport for London. Available from http://urbandesign.tfl.gov.uk/Valuing-Urban-Realm/Project-History-(1).aspx.

Araya, R., Dunstan, F., Playle, R., Thomas, H., Palmer, S., Lewis, G. 2006. Perceptions of social capital and the built environment and mental health. Social Science & Medicine 62: 3072-3083.

Ashcroft, P., Davis, A., Ginger, M., Heat, H., Miller, I., Roper, A., Skinner, B., Warren, N. 2011. Soft measures - hard facts: The value for money of transport measures which change travel behaviour. A Review of the Evidence. Available from http://www.swpho.nhs.uk/resource/item.aspx?RID=81967.

Bellair, P.E. 1997. Social interaction and community crime: Examining the importance of neighbour networks. Criminology 35(4): 677-703.

Bentley, R., Jolley, D., Kavanagh, A-M. 2010. Local environments as determinants of walking in Melbourne, Australia. Social Science & Medicine 70: 1806-1815.

Berke, E.M., Gottlieb, L.M., Moudon, A.V., Larson, E.B. 2007. Protective association between neighborhood walkability and depression in older men. Journal of the American Geriatric Society 55: 526-533.

Boarnet, M.G., Anderson, C.L., Day, K., McMillan, T., Alfonzo, M. 2005. Evaluation of the California Safe Routes to School Legislation: Urban form changes and children's active transportation to school. American Journal of Preventive Medicine 28(2S2): 134-140.

Boarnet, M.G., Greenwald, M., McMillan, T.E. 2008. Walking, urban design, and health: Toward a cost-benefit analysis framework. Journal of Planning Education and Research 27: 341-358.

Boer, R., Zheng, Y., Overton, A., Ridgeway, G.K., Cohen, D.A. 2007. Neighbourhood design and walking trips in ten US metropolitan areas. American Journal of Preventive Medicine 32(4): 298-304.

Bowling, A., Barber, J., Morris, R., Ebrahim, S. 2006. Do perceptions of neighbourhood environment influence health? Baseline findings from a British survey of ageing. Journal of Epidemiology and Community Health 60: 476-483.

Brown, B.B., Cropper, V.L. 2001. New urban and standard suburban subdivisions: Evaluating psychological and social goals. Journal of the American Planning Association 67(4): 402-419.

CABE Space. 2007. Paved with Gold: The real value of good street design. CABE Space, London.

Cavill, N., Kahlmeier, S., Rutter, H., Racioppi, F., Oja, P. 2008. Methodological Guidance on the Economic Appraisal of Health Effects Related to Walking and Cycling. WHO Regional Office for Europe, Copenhagen.

Centre for Mental Health. 2010. The economic and social cost of mental health problems in 2009/10. The Centre for Mental Health, available at http://www.centreformentalhealth.org.uk/pdfs/Economic_and_social_costs_2010.pdf.

CIHT. 2010. Manual for Streets 2: Wider Application of the Principles. Chartered Institution for Highways and Transportation, London.

Clayden, A., Mckoy, K., Wild, A. 2006. Improving residential liveability in the UK: Home Zones and alternative approaches. Journal of Urban Design 11(1): 55-71.

Cobiac, L.J., Vos, T., Barendregt, J.J. 2009. Cost-effectiveness of interventions to promote physical activity: A modelling study. PLoS Medicine 6(7).

Williams, K., Dair, C. 2007. A framework of sustainable behaviours that can be enabled through the design of neighbourhood-scale developments. Sustainable Development 15: 160-173.

Dempsey, N. 2008. Does quality of the built environment affect social cohesion? Urban Design and Planning 161: 105-114.

Department of Transportation. 2010. Green Light for Midtown evaluation report. New York City Department of Transportation.

DfT. 2001. Urban Street Activity in 20 mph zones- Final Report to Department for Transport.

DfT. 2008. Mixed Priority Routes Road Safety Demonstration Project: Summary Scheme Report. Report to Department for Transport by WSP UK, Birmingham.

DfT. 2009. DfT Shared Space Project. Stage 1: Appraisal of Shared Space. Report to Department for Transport by MVA Consultancy, UK.

DfT. 2010. Guidance on the appraisal of walking and cycling schemes. TAG Unit 3.14.1. Available from http://www.dft.gov.uk/webtag/documents/expert/unit3.14.php.

DfT. 2010. Interim Evaluation of the Implementation of 20 mph Speed Limits in Portsmouth. Final Report – September 2010. Report to Department for Transport by Atkins, UK.

DfT. 2011. Mixed Priority Routes: Results Update and Cost Review. Report to Department for Transport by WSP UK, Birmingham.

Dodgson. 2009. Rates of Return on Public Spending on Transport. Report 09/103 to Royal Automobile Club Foundation. Available from http://www.racfoundation.org/research/economics/Rates-of-return.

Evenson, K.R., Herring, A.H., Huston, S.L. 2005. Evaluating change in physical activity with the building of a multi-use trail. American Journal of Preventive Medicine 28(2S2): 177-185.

Forsyth, A., Hearst, M., J.M. Oakes, Schmitz, K.H. 2008. Design and destinations: Factors influencing walking and total physical activity. Urban Studies 45: 1973-1996.

Forsyth, A., Oakes, J. M., Lee, B., Schmitz, K.H. 2009. The built environment, walking, and physical activity: Is the environment more important to some people than others? Transportation Research Part D 14: 42-49.

Forsyth, A., Oakes, J.M., Schmitz, K.H., Hearst, M. 2007. Does residential density increase walking and other physical activity? Urban Studies 44:679-697.

Foster, C., Hillsdon, M., Thorogood, M. 2004. Environmental perceptions and walking in English adults. Journal of Epidemiology and Community Health 58: 924-928.

Foster, S., Giles-Corti, B., Knuiman, M. 2010. Neighbourhood design and fear of crime: A social-ecological examination of the correlates of residents' fear in new suburban housing developments. Health & Place 16: 1156-1165.

Gauvin, L., Riva, M., Barnett, T., Richard, L., Craig, C.L., Spivcock, M., Laforest, S., Laberge, S., Fournal, M-C., Gagnon, H., Gagné, S. 2008. Association between neighbourhood active living potential and walking. American Journal of Epidemiology 167(8): 944-953.

Gemzoe, L. 2001. Copenhagen on foot: thirty years of planning and development. World Transport Policy and Practice 7(4): 19-27.

Giles-Corti, B., Donovan, R.J. 2003. Relative influences of individual, social environmental and physical environmental correlate of walking. American Journal of Public Health 93(9): 1583-1589.

Giles-Corti, B., Knuiman, M., Timperio, A., Van Niel, K., Pikora, T.J., Bull, F.C.L., Shilton, T., Bulsara, M. 2008. Evaluation of the implementation of a state government community design policy aimed at increasing local walking: Design issues and baseline results from RESIDE, Perth Western Australia. Preventative Medicine 46: 46-54.

Goodwin, P. 2010. Opportunities for improving transport and getting better value for money by changing the allocation of public expenditures to transport. Project Report. Commission for Integrated Transport. Available from http://eprints.uwe.ac.uk/13130/.

Gordon, P.M., Zizzi, S.J., Pauline, J. 2004. Use of a community trail among new and habitual exercisers: a preliminary assessment. Preventing Chronic Disease 1: 1-11.

Gotschi, T., Mills, K. 2008. Active Transportation in America: The Case for Increased Federal Investment in Bicycling and Walking. Rails to Trails Conservancy. Available from http://www.railstotrails.org/ourwork/advocacy/activetransportation/makingthecase/index.html.

Guo, J.Y., Gandavarapu, S. 2010. An economic evaluation of health-promotive built environment changes. Preventative Medicine 50: S44-49.

Hamer, M., Chida, Y. 2008. Walking and primary prevention: a meta-analysis of prospective cohort studies. British Journal of Sports Medicine 42: 238-243.

Heesch, K.C., Burton, N.W., Brown, W.J. 2010. Concurrent and prospective associations between physical activity, walking and mental health in older women. J Epidemiol Community Health (2010). doi:10.1136/jech.2009.103077.

Hou, N., Popkin, B.M., Jacobs, D.R., Song, Y., Guilkey, D., Lewis, C.E., Gordon-Larsen, P. 2010. Longitudinal associations between neighbourhood-level street network with walking, bicycling, and jogging: The CARDIA study. Health and Place 16: 1206-1215.

Humpel, N., Owen, N., Iverson, D., Leslie, E., Bauman, A. 2004. Perceived environment attributes, residential location, and walking for particular purpose. Am J Prev Med 26(2): 119-125.

Jones, T.F., Eaton, C.B. 1994. Cost-benefit analysis of walking to prevent coronary heart disease. Archive of Family Medicine 3(8): 703-710.

Kelley, G.A., Kelley, K.S., Tran, Z.V. 2001. Walking and resting blood pressure in adults: A meta-analysis. Preventive Medicine 33: 120-127.

Kelley, G.A., Shelley, K.S., Tran, Z.V. 2004. Walking, lipids, and lipoproteins: a meta-analysis of randomised controlled trials. Preventive Medicine 38: 651-661.

Kim, J. 2007. Perceiving and valuing sense of community in a New Urbanist development: A case study of Kentlands. Journal of Urban Design 12(2): 203-230.

King, W.C., Brach, J.S., Belle, S., Killingsworth, R., Fenton, M., Kriska, A.M. 2003. The relationship between convenience of destinations and walking levels in older women. American Journal of Health Promotion 1(1): 74-82.

Krieger, J., Rabkin, J., Sharify, D., Song, L. 2009. High Point Walking for Health: Creating built and social environments that support walking in a public housing community. American Journal of Public Health 99: S593-599.

Landscape Institute. 2011. Why invest in landscape? Landscape Institute, London.

Lee, L-L., Watson, M.C., Mulvaney, C.A., Tsai, C-C., Lo, S-F. 2010. The effect of walking intervention on blood pressure control: a systematic review. International Journal of Nursing Studies 47:1545-1561.

Legrand, F.D., Mille, C.R. 2009. The effects of 60 minutes of supervised weekly walking (in a single vs. 3-5 session format) on depressive symptoms among older women: Findings from a pilot randomized trial. Mental Health and Physical Activity 2: 71–75.

Leslie, E., Cerin, E. 2008. Are perceptions of the local environment related to neighbourhood satisfaction and mental health in adults? Preventative Medicine 47: 273-278.

Leyden, K.M. 2003. Social capital and the built environment: the importance of walkable neighbourhoods. American Journal of Public Health 93(9): 1546-1551.

Luengo-Fernández, R., Leal, J., Gray, A., Petersen, S., Rayner, M. 2006. Cost of cardiovascular diseases in the United Kingdom. Heart 2006;92:1384–1389.

Lund, H. 2002. Pedestrian environments and sense of community. Journal of Planning Education and Research 21: 301-312.

Mackett, R.L., Achuthan, K., Titheridge, H. 2008. AMELIA: A tool to make transport policies more socially inclusive. Transport Policy 15: 372-378.

Mackett, R.L., Lucas, L., Paskins, J., Turbin J. 2005. The therapeutic value of children's everyday travel. Transportation Research Part A 39: 205-219.

Mason, P., Kearns, A., Bond, L. In press. Neighbourhood walking and regeneration in deprived communities. Health & Place.

McAuley, E., Blissmer, B., Katula, J., Duncan, T.E., Mihalko, S.L. 2000. Physical activity, self-esteem, and self-efficacy relationships in older adults: A randomized controlled trial. Annals of Behavioural Medicine 22(2):131-139.

McDonald, K.N., Oakes, J.M., Forsyth, A. In press. Effect of street connectivity and density on adult BMI: results from the Twin Cities Walking Study. Journal of Epidemiology and Community Health.

McPherson, K., Marsh, T., Brown, M. 2007. Tackling Obesities: Future Choices - Modelling Future Trends in Obesity and the Impact on Health. 2nd Edition. Government Office for Science, London.

Mehta, V. 2009. Look closely and you will see, listen carefully and you will hear: Urban design and social interactions on streets. Journal of Urban Design 14(1): 29-64.

Merom, D., Bauman, A., Vita, P., Close, G. 2003. An environmental intervention to promote walking and cycling—the impact of a newly constructed Rail Trail in Western Sydney. Preventive Medicine 36: 235-242.

Mønness, E., Sjølie, A. N. 2009. An alternative design for small-scale school health experiments: does daily walking produce benefits in physical performance of school children? Child: care, health and development, 35(6): 858-867.

Morrison, D.S, Thomson,H., Petticrew, M. 2004. Evaluation of the health effects of a neighbourhood traffic calming scheme. Journal of Epidemiology and Community Health 58(10): 837-840.

Murphy, M.H., Nevill, A.M., Murtagh, E.M., Holder, R.L. 2007. The effect of walking on fitness, fatness and resting blood pressure: A meta-analysis of randomised, controlled trials. Preventive Medicine 44: 377-385.

MVA. 2008. Valuing Urban Realm: Seeing Issues Clearly. Report for Design for London. Available from http://urbandesign.tfl.gov.uk/Valuing-Urban-Realm/Project-History-(1).aspx.

Napier, M.A., Brown, B.B., Werner, C.M., Gallimore, J. In press. Walking to school: Community design and child and parent barriers. Journal of Environmental Psychology.

Noordelijke Hogeschool Leeuwarden. 2007. The Laweiplein. Evaluation of the Reconstruction into a Square with Roundabout. Noordelijke Hogeschool Leeuwarden / Verkeerskunde, Netherlands.

Riva, M., Gauvin, L., Apparicio, P., Brodeur, J.-M. 2009. Disentangling the relative influence of built and socio-economic environments on walking: The contribution of areas homogenous along exposures of interest. Social Science & Medicine 69:1296-1305.

Roe, J., Aspinall, P. 2011. The restorative benefits of walking in urban and rural settings in adults with good and poor mental health Health & Place 17 (2011) 103-113.

Ross, C.E., Jang, S.J. 2000. Neighborhood disorder, fear, and mistrust: The buffering role of social ties with neighbors. American Journal of Community Psychology 28(4): 401-420.

Saelensminde, K. 2004. Cost-benefit analyses of walking and cycling track networks taking into account insecurity, health effects and external costs of motorized traffic. Transportation Research Part A: Policy and Practice 38 (8): 593-606.

Sloman, L., Cairns, C., Newson, C., Anable, J., Pridmore, A., Goodwin, P. 2010. The Effects of Smarter Choice Programmes in the Sustainable Travel Towns: Research Report. Report to the Department for Transport. Transport for Quality of Life.

Social Research Associates. 2010. Living Streets Step Out London After report. Social Research Associates, London.

Stokes, R.J., MacDonald, J., Ridgeway, G. 2008. Estimating the effects of light rail transit on health care costs. Health and Place 14: 45-58.

Stronegger, W.J., Titze, S., Oja, P. 2010. Perceived characteristics of the neighbourhood and its associations with physical activity behaviour and self-rates health. Health & Place 16: 736-743.

Sugiyama, T., Leslie, E., Giles-Corti, B., Owen, N. 2008. Associations of neighbourhood greenness with physical and mental health: do walking, social coherence and local social interaction explain the relationships? Journal of Epidemiology and Community Health 62: e9.

Sustrans. 2006. Economic appraisal of local walking and cycling routes: Methodology. Available from http://www.sustrans.org.uk/resources/research-and-monitoring/economic-appraisal-of-cycling-and-walking-schemes.

Sustrans. 2006. Shoppers and how they travel. Information Sheet LN02. Sustrans, Bristol.

Swinburne, G. 2006. Kensington High Street Road Safety Report. Royal Borough of Kensington and Chelsea.

Talen, E. Sense of community and neighbourhood form: An assessment of the social doctrine of New Urbanism. Urban Studies 36(8): 1361-1379.

Taylor, L.M., Leslie, E., Plotnikoff, R.C., Owen, N., Spence, J.C. 2008. Associations of perceived community environmental attributes with walking in a population-based sample of adults with type 2 diabetes. Annuals of Behavioural Medicine 35: 170-178.

Tiesdell, S., Oc, T. 1998. Beyond 'fortress' and 'panoptic' cities – towards a safer urban public realm. Environment and Planning B: Planning and Design 25: 639-655.

Tilt, J. 2010. Walking trips to parks: Exploring demographic, environmental factors, and preferences for adults with children in the household. Preventive Medicine 50: S69-S73.

Wang, G., Macera, C.A., Scudder-Soucie, B., Schmid, T., Pratt, M., Buchner, D. 2004. Cost effectiveness of a bicycle/pedestrian trail development in health promotion. Preventive Medicine 38: 237-242.

Wang, G., Macera, C.A., Scudder-Soucie, B., Schmid, T., Pratt, M., Buchner, D. 2005. A cost–benefit analysis of physical activity using bike/pedestrian trails. Health Promotion Practice 6 (2): 174-179.

Webster, D., Tilly, A., Wheeler, A., Nicholls, D., Buttress, S. 2006. Pilot Home Zone Schemes: Summary of the Schemes. TRL Report 654. Crowthorne: TRL Limited.

Wood, L., Frank, L.D., Giles-Corti, B. 2010. Sense of community and its relationship with walking and neighbourhood design. Social Science & Medicine 70: 1381-1390.

This project has been supported by Travel Actively, a consortium of leading walking, cycling and health organisations committed to providing opportunities for 1.8 million people to become physically active through active travel by 2012.

Design: www.origin8creative.co.uk

www.livingstreets.org.uk
info@livingstreets.org.uk

University of the West of England
BRISTOL

Department of Planning and Architecture, Faculty of Environment and Technology, University of the West of England, Bristol BS16 1QY