
The Pedestrian Experience

EXECUTIVE SUMMARY

The New Zealand Government Policy Statement (GPS) on Land Transport 18/19 – 27/28 has a significant focus on the increased uptake of active modes such as walking and cycling.

The GPS includes increased investment in footpaths and cycleways to support access to, and uptake of, active travel modes as well as the creation of public places that integrate aspects of the transport network, particularly walking and cycling, can help to make safer, attractive and accessible urban environments that allow land use and transport to work better together. The GPS states that enabling more people to use active modes and public transport can also contribute to improved health outcomes as people regularly incorporate active travel into their daily life, increasing levels of physical activity.

As such, it is an increased priority to understand pedestrian behaviour and experience better; why or why not people walk, what encourages walking and what hinders it, and importantly, what research gaps need to be filled to answer these questions. The purpose of this literature review is to provide some answers to these questions by bringing together a disparate literature on pedestrian experiences, behaviours, needs and barriers to walking.

Pedestrian experience is not easily captured as it is shaped by who is walking, why they are walking, where they walk, and their attitudes and beliefs etc. While there are consistencies in the literature in terms of what encourages and discourages walking from an individual perspective, there is also an underrepresentation of the full extent of human diversity in much of what is available, it is important this gap is remedied. There are also inconsistencies across literature in what is measured, and there is almost no literature available on rural pedestrians.

However most importantly, as both literature and observation show, there is a disparity between the many available design guidelines for accessible pedestrian environments and the real world physical barriers still faced by pedestrians. Therefore the question of pedestrian experience is an important one, as it can help to shape the streets in a way that will encourage more people to enjoy them as pedestrians.

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INTRODUCTION

The purpose of this review is to bring together some of the findings from the disparate literature on pedestrian experience to inform planning or service delivery within the New Zealand Transport Agency (NZTA). A better understanding of pedestrian needs will inform efforts to promote the use of walking as an economical and healthy part of more people's lives. This review considers pedestrian experiences, behaviours, needs and barriers to walking, where possible from the direct perspective of the user. Individuals may have extremely different incentives and barriers to participation as a pedestrian, be they physical, psychological, social, or environmental.

In New Zealand, people have been walking less and less¹. According to the household travel survey 2015-2017 (Ministry of Transport) on an average day, 81 percent of people in New Zealand report no walking. On days when people walked, nearly half reported walking for a total of fewer than 20 minutes that day. More than half of travel time is spent driving. This creates concerns not only about the negative environmental effects of driving, but also about New Zealand's growing obesity epidemic, to which sedentary lifestyles contribute. The rising urban car dependency has also negatively affected taking care of pedestrians² needs (Monterde-i-Bort & Methorst, 2010) continuing to discourage walking for many.

Numerous studies have shown that enhancing the ability of individuals to travel via non-motorized modes can potentially lead to improved outcomes in public health, safety, and economic development; promote resource efficiency; strengthen inclusive neighbourhood relations; and bolster public transit services. Good walking conditions have been connected to a high life quality (Bein et al. 2004 and Kaufmann et al. 2005).

While priority is given to New Zealand literature when possible, a scarcity of pedestrian experience/behaviour literature from New Zealand means that the literature is international. Gaps or limitations in the available literature are acknowledged. Further research in the area of pedestrian experience in the New Zealand context, would be a useful future gap to fill.

BENEFITS OF INCREASING PEDESTRIAN PARTICIPATION

"Investing in footpaths, when combined with other initiatives, has been associated with boosts in the local economy, financial savings from transportation-related costs, and increases in the overall quality and value of homes and businesses. Given the connections between increased physical activity and the prevention and control of epidemic chronic diseases (as well as decreased depression, prevention of falls, and better cognitive function in older adults), there are also future savings expected in healthcare costs. Savings gained through using footpaths instead of roadways can equate to higher disposable income to invest in local goods, services, and entertainment" (Duncan et al., 2013). Transport policies should take into account the benefits to society and to individuals of walking as a transport mode.

¹ Caveat: There is no universal standard for mobility and safety data on walking. This has several consequences. See appendix 5 for an overview of this topic.

² The accepted definition of pedestrians in the "Pedestrian Quality Needs" project is: any person who walks or spends time in public space, without any special requirements related to special forms of walking is a pedestrian, for example, people who run, or enjoy the areas outside urban areas, such as mountaineers. This includes children whose toy is a form of transportation and people with disabilities who use various forms of moving aids (sticks, crutches, wheelchairs or scooters with 3 or 4 wheels) (Vukmirovic, 2010).

Economy

In addition to direct benefits to the citizens of the region, there are indirect benefits, such as the contribution that non-motorized travel can make to the local economy by supporting tourism and quality development. Pedestrian-friendly conditions improve the commercial and cultural vibrancy of communities and help create a safer and more pleasant environment. Once visitors arrive in a community, they often explore it by walking and cycling, so an environment that is friendly to walking/cycling can enhance visitors' experiences. Some trail networks are actually destination tourist attractions, bringing hundreds or thousands of visitors, and thousands or millions of dollars annually to a community (Browand, Delaney, Goodrich, Omatete and Trace, 2011). Research has shown that people tend to move to cities with plentiful amenities. Edward Glaeser, a professor at Harvard University and one of the foremost academics on the subject, has found that cities with lots of urban amenities tend to grow faster (Glaeser, Kolko & Saiz, 2000). According to a study by the Transportation Research Board, urban young adults without children make decisions about where to live primarily based on whether a city is "easy to get around," with "plenty of public transit options available."

Millennials are an important group to attract and retain as residents. Though millennials are a diverse generation, some general trends have emerged regarding their transportation preferences. In the US they are walking, biking, and taking public transportation significantly more than people their age did a decade ago. For millennials in large cities, walking is the most commonly used form of transportation, with 79% getting around on foot a few times a week or more (Harris, Johnson & Wales, 2015). A guiding principle for developing millennial-friendly transportation should be to connect neighborhoods and cities to each other and make them accessible in as many ways possible: on foot, by bike, via public transit, and by car, whether public, private, or shared. The cities that attract these individuals are what KPMG describe as "Magnet cities" (<https://assets.kpmg.com/content/dam/kpmg/pdf/2015/03/magnet-cities.pdf>).

Good pedestrian facilities don't just encourage economy builders to a city, walkability may more directly beget economic growth. A report by the Auckland council found that there is a positive and statistically significant association between walking and estimated labour productivity within the Auckland city centre. Locations that are more walkable tend to have higher productivity. This relationship is robust with the inclusion of controls for (estimated) industry composition at a building level, suggesting that it does not simply reflect the fact that higher-productivity industries choose to locate in more walkable places. The point estimate suggests that a 10 per cent increase in walking EJD is associated with a 5.3 per cent increase in productivity.

Not surprisingly high walkability leads also to strong commercial activity. A research project by BECA (2013) investigated the economic impacts of transport and road space reallocation in shopping areas located in central cities and along major transport corridors in New Zealand. The data shows that sustainable transport users account for 40% of the total spend in the shopping areas and account for 37% of all shoppers who completed the survey. The data indicates the pedestrians and cyclists contribute a higher economic spend proportionately to the modal share and are important to the economic viability of local shopping areas.

The study also identified that retailers generally overestimate the importance of on-street parking outside shops. Shoppers value high-quality pedestrian and urban design features in shopping areas more than they value parking and those who drive are willing to walk to the shopping precinct from other locally available parking areas. This indicates that improving alternative modes and more efficient parking management may deliver financial benefits to the retail centre, as well as economic benefits to wider society.

Health

There is a large body of literature on the health benefits of walking, and the evidence is relatively well consolidated. Consequently, this review will only touch on it briefly. According to the U.K. Department of Health (2004 in Basbas, Konstantinidou, Moreno Ribas, 2010), physical activity is associated with health. The efficacy of the suggested levels of physical activity: is obtained in bouts of moderate intensity of 20-60 minutes but short bouts (10-15) have also induced a significant health changes according to experimental works. Aerobic forms of exercises are the most consistent in its results (walking, jogging). The recommendation is to walk “briskly” 30 minutes per day, five days per week

McCormick Cagney Rankin and Auckland University of Technology (2008) looked to give a monetary value to the health benefits of active modes. The study notes that there is a growing awareness that traditional economic evaluation methods tend to undervalue the wider public health benefits provided by active transport modes, which include walking, cycling, and their variants, such as skates and scooters. The literature review identified five diseases for which there is robust evidence of relative risk reduction from increased physical activity. The evidence is strongest for chronic diseases, especially CVD, cancer (colon, breast and lung), type 2 diabetes and depression. The value that was arrived (per km) at for walking was: low \$3.53; medium \$4.27; high \$5.01. The resulting range of values is considered to be a robust reflection of potential health benefits that can be achieved through transport projects that increase participation in active modes

WHAT IS THE PEDESTRIAN EXPERIENCE?

Due to the increasing attention to the pedestrian-friendly walking environment, walkability - a measure of how friendly an area is to walk - has been increasingly studied. However, walkability has been studied mainly in terms of ease and safety of walking although the walking environment has various functional aspects to a pedestrian as well as walking (Jeong et al, 2017). It is difficult to reflect various experiences of the pedestrian as a concept of walkability. Pedestrian experience is a concept that expands the concept of walkability to mirror diverse experiences of pedestrians (Proceedings of the 2nd Asian Conference on Ergonomics and Design, 2017). In much of the literature there is the recognition that pedestrians are not, and should not, be treated as a homogenous group for whom the same walking route is the same experience. There is recognition that physical ability, social roles and economic constraints play a part in the experience of being a pedestrian (Hodgson, Page, Tight, 2004, ITS working paper). As such, the pedestrian experience is dependent upon numerous qualitative factors that are not addressed in customary level-of-service analyses.

Heterogeneous Pedestrians

The criteria used to categorise different types of pedestrian are not always consistent but, generally, pedestrians are divided by their abilities. The abilities can be divided into four groups: physical, psychomotor, sensory and cognitive abilities (Monterde-i-Bort & Methorst 2010). It is considered that pedestrian have different needs according to their abilities and, according to their abilities, pedestrians differ widely. The difference in children’s height and cognitive abilities is equally important as the decrease in the speed of reflexes, and hearing and visual quality of the elderly. Ability can also vary during pedestrian travel, such as when one becomes encumbered by shopping during a journey. As well as individual needs, those pedestrians that are travelling as a group are often thought to have different needs and interests.

Main pedestrian distinctions to study behaviour and experience are as follows:

Gender

There is some evidence that male and female pedestrians have different perceptions, needs and interests, Sharples and Fletcher (2000) for example, claim that evaluations of different crossing facilities vary by age and gender. For example, Ferenchak (2016) found that when crossing a road, Male waiting time is approximately half of female waiting time, and males are twice as likely to cause conflicts with motor vehicles. Intuitively this finding has some degree of truth as the needs and interests of male and female pedestrians vary just as their societal roles of men and women may still vary, for example more women than men work part-time and carry shopping and use buses.

During the last few decades there have been investigations that have studied the interrelationship between mobility and gender, showing different travel patterns between women and men, motivated largely by the reasons behind these trips (Hanson & Hanson, 1980; Gordon, Kumar & Richardson, 1989, Rosenbloom & Burns, 1993). Overall, women make more trips than men, except for work trips, in which case it is men who perform the highest number of trips (Olmo & Maeso, 2013). Olmo and Maeso-Gonzalez (2016), found that females tended to be more flexible in their mode choice in urban Andalucía, compared with the almost static modal choice (private transport) of men.

A 2016 study (Ghani, Rachele, Washington, and Turrell), found that of the 7,866 Brisbane participants, on average, women were more likely to engage in walking for recreation at moderate and high levels, however, this varied significantly across neighbourhoods. This suggests that neighbourhood-level factors differentially influence the walking behaviours of men and women. Identifying these factors should be a priority for future research to better understand the needs of individuals.

A study by Hinckson E, Cerin E, Mavoa S, et al; looking at associations between objectively determined neighbourhood 'walkability' attributes and accelerometer-derived sedentary time (ST) by sex, city or type of day in 48 neighbourhoods across four cities in New Zealand (August 2008 to October 2010) found no main effects of "walkability" on sedentary time (i.e., street connectivity, residential density, land-use mix, retail footprint area ratio). They did however find an interaction suggesting retail proximity reduced sedentary behaviour for women.

Men, older participants and more highly educated participants engaged in significantly more sedentary time than their counterparts. For example, compared with participants with less than secondary schooling, those who completed tertiary education accumulated 41.7 more minutes of sedentary time per day. Being employed, living with a partner (as opposed to being single) and not being of Asian or Māori/Polynesian ethnicity were associated with lower levels of sedentary time. On average, participants from Wellington accumulated less sedentary time than those from other study sites.

Personal perception of abilities is also important as they influence behaviour. There are also differences between older men and women. Older women more often express a need to be safe and have doubts about their own abilities, while older men more often indicate that they feel sure about their own estimations of traffic (Bernhoft & Carstensen, 2008).

Age

The age of a pedestrian impacts on both their physical ability, and their feelings about the road environment and its safety. Age is an important consideration for pedestrian needs – the very young and old tend to have less mobility, they are also the most vulnerable to injury (and the most likely to be injured) and as a mode

share youth (5-24 years old) and the elderly (75+ years old) spend a bigger proportion of their time walking compared to other age groups (Household travel survey, 2015-17, MoT).

There are significant differences between the older and younger people for the conditions of importance for the pedestrians' route choice. For example, a higher proportion of the older pedestrians find the presence of a pavement on their route most important for their route choice, whereas the most important conditions for the younger group are a fast and direct route (Bernhoft & Carstensen, 2008). It seems like that younger pedestrians have a stronger need for a fast route and absence of obstacles (poor footpaths, difficult crossings etc.) to slow their progress.

Children

The participation of younger children as pedestrians is largely adult driven – trips to school, recreation and accompanying daily activities such as shopping, are the largest reason children spend time on as pedestrians. However children also use footpaths and road areas as places of play. They are both vulnerable and high-risk pedestrians and have limited capacity to understand the complexity of the traffic environment (Gunnarsson, 2001).

Sandals (1968) demonstrated that most of the children up to an age of 8-9 years are unable to understand traffic rules, and they may not yet know the difference between right and left. They also feel anxiety for motor traffic outside their homes and on school routes. Children have reduced ability compared to adults due to their developmental immaturity and lack of experience (Vukmirovic, 2010).

Performing the task of walking in road traffic is influenced by various physical and cognitive stages of development of the children (see **Appendix 1** for a comprehensive list of age related pedestrian abilities):

- o Three and four-year olds are not able to differentiate whether a car is moving or standing still.
- o Only at the age of four children realise that an approaching car is getting bigger.
- o Children under ten may not be able to tell by noise from which direction a car is coming.
- o Approximately at the age of ten children are able to tell the speed and distance of an approaching car.
- o At twelve the field of vision is fully developed and children are able to employ their peripheral vision to see cars coming from various directions.
- o In average children under ten are smaller than cars. Being smaller than cars limits the ability to overview the road traffic sufficiently.

Children often hesitate when crossing the road on their own: where is the best place to cross, does the car driver see me, do I see the car driver, is the car far away enough etc. In addition, the main difference to adults is that children move playfully. They hop and bounce along, jump, wheel objects, kick ball in front of them, pick up papers or other things from the ground etc. Children do a lot of things at the same time and the task of walking is secondary (Ausserer, Risser, Kaufman, Barker, Johansson & Leden, 2010).

The needs of young pedestrians have as much to do with supervision and education as the pedestrian environment. The behaviour and beliefs of parents is potentially one of the most important factors that influence children's pedestrian risk, yet it has not been well studied. A survey of over 2,000 parents by Rivara et al. (1991) found that, although 94% thought 5- to 6-year-olds were too young to cross residential streets alone, one third allowed their kindergarteners to do so. Dunne et al. reported that parents of 5- to 8-year-olds greatly overestimated their children's pedestrian skills. In a qualitative study with 32 parents in the United Kingdom, mothers' fear of speeding traffic was one of the main concerns, and a majority drove their children to school even though they would have preferred that their children walked. All of the mothers interviewed could relate stories of real accidents and "near misses." Another British study of 2,000 parents of

school-aged children found that 90% were very or extremely worried about traffic danger and about the fear of abduction. In school?

Timperio, Crawford, Telford & Salmon (2004) examined associations between perceptions of the local neighbourhood (traffic density, road safety, strangers, traffic lights/ crossings, sporting facilities and public transport) and walking and cycling among children as a means of transport. Parents reported their child's (five-to six-year old and ten- to twelve-year-olds). Ten- to twelve-year-olds were also asked their perceptions of traffic, strangers, road safety and sporting venues, and their perceptions of their parent's views on these issues. Results showed that parental beliefs about the local neighbourhood were related to five- to six-year-old children's walking or cycling. Also, it appeared that a perception of limited public transport was a significant predictor of walking and cycling among five- to six-year-old girls. For ten- to twelve year- old children, multivariate logistic regression analyses showed that boys whose parents believed there were no lights or crossings for their child to use were 60% less likely to walk or cycle.

Timperio, Ball, Salmon, Roberts, Giles-Corti & Simmons (2006) examined personal, family, social, and environmental correlates of active commuting to school among children. Self-administered questionnaires were completed by parents, and the older children from 19 elementary schools in Melbourne, Australia. Results showed that among both age groups (5- to 6-year-old and 10- to 12-year-old children), negative correlates of active commuting to school included parental perception of no lights or crossings for their child to use. Troped et al. (2003) results showed that three perceived environmental variables (presence of streetlights, enjoyable scenery, and neighbourhood footpaths) and one objective environmental variable each showed associations with transportation-related physical activity.

A better understanding of parents' perceptions of the pedestrian risks to their children, the walkability of their neighbourhoods, and their current child pedestrian safety practices (e.g., supervision, child skills training) could contribute much needed information for development of targeted prevention messages and interventions.

Adolescents and teens

By high school and college, exposure changes and new risks can occur. Many walk under conditions of low light for example, and spend the majority of time unsupervised.

Behaviour in traffic is most influenced by values and norms of the particular road user. The perception of risk plays an important role in this. Most groups have a pronounced sense of danger, leading to a defensive attitude to traffic. Young people aged 12 – 25 are an exception to this. They feel that nothing much can happen to them. They estimate the chance of being caught out by dangerous traffic behaviour as low (Methorst, 2003) which can in turn may influence some risky behaviour as pedestrians.

Psychosocial factors appear to be the biggest driver for adolescent participation in walking. Transport and Passive Transport to Various Destinations in Flemish Older Adolescents (Verhoeven, Simons, Van Dyck, Van Cauwenberg, Clarys, De Bourdeaudhuij, et al., 2016). More social modelling and a higher residential density were positively associated with walking to school and walking to other destinations, respectively. Social norm, social modelling and social support were the most consistent psychosocial factors, this indicates that it is important to target both older adolescents and their social environment in interventions promoting active transport. Walking together with siblings or friends has the potential to increase uptake.

A follow-up study (Simons, De Bourdeaudhuij, Clarys, De Cocker, de Geus, Vandelanotte, et al., 2017) indicated that more college educated compared to non-college educated young adults participated in cycling and public transport, but cycle time and public transport trips were longer and passive transport trips were shorter in non-college compared to college educated working young adults. It is likely that these trends may

be generalizable to walking behaviours as well. This suggests that educational levels should be taken into account when promoting healthy transport behaviours in working young adults.

Seniors

It is perhaps not surprising that, with an ageing population, older pedestrians a topic which has elicited attention in public health and transport/urban design spheres. For example, in its 2007 Concept Series the Glasgow Centre for Population Health noted that “improved opportunities for walking in the local community have particular social inclusion benefits for the elderly and for those with mobility difficulties”. Three themes which emerge from the literature reviewed here are: the role of the built environment in preventing functional mobility of older people (in particular the risk of falls); the importance of walkable environments as a means of enabling older people to maintain functional mobility, and; the need for interventions which also address both the emotional or psychological barriers to functional walking (e.g. fear of falls).

Keeping older people mobile as pedestrians is an important aspect of maintaining independence and a good quality of life. For short trips, walking can offer the same spontaneous ability to travel that is provided by the car. But, at least in Britain since 1985, older people have been reducing the distance they walk. Furthermore, older pedestrians are very vulnerable to injury and death in traffic accidents and are more likely to die of their injuries (accounting for a quarter of fatalities), a fact likely to reflect their greater physical fragility.

For older people walking may not be as natural as for young people. The vision and hearing deteriorate, the kinetic movability degrades, information cannot be quickly absorbed, decisions and actions are delayed as a result. In addition, older people get sooner tired than younger people (see Limbourg 1999). In general, older people become less agile and their reaction time increases. Not surprisingly, crossing roads is one of the major deterrents to older pedestrians, and older and disabled pedestrians benefit from policies that reduce traffic volumes and traffic speeds.

The age-related deficiencies appear at different ages for different people, and people differ in their awareness of their own deficiencies. For example, Holland and Rabbitt (1992) argued that, because of reduced information processing capacity, older adults may be less efficient than younger adults at monitoring their own performance, less aware of their mistakes, or less able to remember making mistakes (Oxley et al., 2001). A problem especially for elderly pedestrians is falling down caused by slippery, uneven surface, especially in winter climate (Gunnarsson (ed.), 2001).

"Assisted walking", using mobility aids such as powered wheelchairs and scooters on footpaths, is common for elderly pedestrians. Provided the local environment is suitable, in good weather these provide a realistic alternative to driving for local trips. Some problems for pedestrians, such as hills, narrow or uneven footpaths, and crossing roads, affect everyone, though people with disabilities and the elderly are most affected. Facilities for pedestrians should be looked after. Older pedestrians can't use footpaths if there are big irregularities and the surface is not even (Methorst, 2003).

Measures to improve pedestrian safety for older pedestrians include (OECD, 2001):

- Separating the pedestrians from vehicles, for example by providing a footpath;
- Pedestrian only areas where possible;
- Reduce traffic volumes, by directing traffic away from areas of high pedestrian activity and from residential areas;
- Reduce traffic speeds;
- Provide pedestrian crossings;
- Provide street lighting;

- Improve infrastructure (e.g., Kerb extensions to minimise time on road; Bollards to stop parked vehicles blocking footpath (and to narrow traffic lanes); traffic calming to reduce vehicle speeds; Speed tables at pedestrian crossings, across side roads, at junctions; Provide median pedestrian refuges; Adequate footpath widths).

As well as safety, comfort is a factor for older pedestrians. The results from the EU-project SIZE (www.factum.at/size-project) showed that senior citizens wish more possibilities to sit down and have a rest. Frequent seating possibilities on footpaths make it possible to cover longer walking-distances. When people sit on a bench they can observe the environment, look at people walking, running or strolling by, and they can establish social contacts through small-talks which may help feeling more connected to society. Senior citizens also wished a more attractive environment with zones with a maximum speed of 30km/h or even lower, traffic islands and enlargement of footpaths at crossings (De Jong, Kaufman, Roivas, Rocakova, 2010).

However, it is also worth noting that elderly people have acquired a great deal of traffic insight and traffic experience during their lives, and therefore manage to estimate reasonably well what others can or cannot do. It is true that impaired visual faculties make it more difficult to estimate travelling speeds, but they compensate for that by building in wider safety margins. A problem may be that they do not always remember what has changed in the traffic system over the years, especially as regards the rules and the increasingly hectic nature of traffic.

Disabled

Almost one in four New Zealanders were identified as disabled in 2013, according to the New Zealand Disability Survey by Statistics New Zealand. Virtually all individual with disabilities are pedestrians at one time or another. Indeed, people with disabilities are more likely to be a part of the pedestrian group, since some physical limitations can make driving difficult. People with disabilities hold jobs, attend school, shop, and enjoy recreation facilities. Anyone can experience a temporary or permanent disability at any time, due to age, illness, or injury. Being more physically active is particularly important for disabled people because it can improve quality of life and health outcomes related to existing conditions and reduce the risk of secondary health conditions.

Disabilities can be divided into three categories: mobility, sensory, and cognitive disabilities (Vukmirovic, 2010). See Appendix 2 for the main categories of disability. The main challenge when planning for disabilities is to prevent someone to become 'architecturally disabled' (De Jong, Kaufman, Roivas, Rocakova, 2010) because of the way public space has been designed. However, there is a risk of grouping heterogeneous groups in to homogeneous ones. The group of people with impairments is very diverse and includes wheelchair users, people with reduced or lacking vision, hearing-impaired persons and mentally disabled. But also, other groups have to be counted with like those who are permanently or temporarily disabled, people with on artificial limb, sticks or other walking aids. However, because this group is so heterogeneous there are sometime conflicting needs concerning infrastructure (De Jong, Kaufman, Roivas, Rocakova, 2010). Wheelchair users for example prefer a footpath without any curbs. On the other hand, blind or vision impaired persons need these curbs for orientation (Thomas, 2006). From user point of view, it is therefore important that design is logical and transparent, so they know what to expect. In an inclusive design the needs of all possible road users are taken into consideration (De Jong, Kaufman, Roivas, Rocakova, 2010).

The physical environment should not have obstacles that prevent or make moving in space difficult for persons with disabilities. The present traffic and transport system and subsystems take account in practice of a fictive 'standard person', who has a certain shape, fulfils certain minimum and maximum dimensions, has a certain degree of agility and muscle strength and possesses certain minimum skills, such as being able to see, hear, feel, think, speak, read, communicate non-verbally, walk, hold something, pick something up and so on (Methorst, 2003). Design deficiencies frequently can be overcome by an agile, able-bodied person. However,

what can seem to be a relatively minor factor in the pedestrian environment, such as pavement cracking, can actually cause people with a physical or visual impairment a lot of extra effort and trouble to surmount. Pedestrians who need aid walking (walking stick, walker) will choose the route with the least amount of resistance. This doesn't need to be the shortest route, but it is the most even, the least risky and the route with the most pause possibilities. Pedestrians who need walking aids will preferably cross at signalled crossings. But they are often afraid that the light will turn red too soon.

As a basic principle which has to be sought in shaping the environment, is to create an unbreakable chain of movement (Vukmirovic, 2010). By accomplishing this, each person should be able to move normally to any desired destination. The establishment of an unbreakable chain of movement should improve access (Vukmirovic, 2010). The solutions are typically focussing on taking away barriers for specific groups, like ramps for wheelchairs and tactile guidelines for blind and sight impaired. (De Jong, Kaufman, Roivas, Rocakova, 2010).

Looking specifically at the experience of the mobility handicapped pedestrian (visually impaired (3), mentally disabled (2), disabled (1), hearing impaired (1), elderly (1), and children (1)) via interview and diary analysis, Jeong, Han, Kwahk, Park, Lee, Park, Kim, Jang and Jeong (2017) uncovered the following pedestrian experience principles to improve the experience of the mobility handicapped:

Walkability	Affect	Safety	Sociability
Accessibility	Pleasant	Public security	Equality
Efficiency	Friendly	Traffic safety	Consideration
Informativeness	Neatness	Facility safety	Communication
Flexibility	Stability	Public health	Watching others
Learnability	Novelty		

Jeong et al. (2017) propose that these principles differ from previous studies in that they cover not only pragmatic perspectives but also hedonic ones including affect and sociability as well as walkability and safety, so cover a more diverse perspective.

Walkability means the degree to which pedestrians can walk comfortably. Affect refers to emotions and images that pedestrians feel from the walking environment. Safety means the degree to which a pedestrian is not at risk. Finally, sociability refers to the degree to which pedestrians meet the fundamental needs of social life.

Other groups

Pedestrian categories do tend to overlap depending on the activities and abilities of the individuals. Other groups of pedestrians can be extracted from the larger categories, but their size and characteristics are not extensive enough to be separated. For example, we can distinguish smokers, pet owners, people who consume food in motion, people in groups, people who listen to music or talk on a mobile phone while moving. Given the kind of action performed during the walk, some of the abilities may be limited (less attention when talking on a phone, limited hearing when listening to music, reduced speed of walking during the consumption of food, etc (Vukmirovic, 2010).

Some studies (see, for example, Timperio et al., 2006; Timperio et al., 2004) have found correlations between socio-economic status and active commuting, although in different ways. Children (particularly boys) of high socio-economic backgrounds were more likely to cycle or walk to parks, playgrounds and to school than children of medium socio-economic status. However, walking or cycling to friends' houses was highest

among boys of low socio-economic status compared to the other groups. Likewise, Sehatzadeh et al. (2011) showed a strong negative correlation between car ownership and walking in general. Killoran et al. (2006) also point out that lack of access to a car often necessitates an increase in walking, including walking to public transport. Stinson & Bhat (2004) found that injury and illness was the factor most likely to stop people from cycling, though a high proportion of those respondents were cycle commuters. Aldred & Woodcock (2008) pointed out that physical disability can be a barrier to active transport, but more serious physical disability may prevent the use of a car, becoming, in a car dependent environment, a barrier to participation in the wider community.

In addition, studies have found that children from low-income backgrounds are more likely to experience higher levels of exposure to the road environment and a higher incidence of accident involvement (see Living Streets, 2001; Bly, Dix and Stephenson, 1999). Furthermore, it is believed that ethnicity may also impact on walking needs and patterns although there is little research in this area.

Of course, there are many ways to group pedestrians, for example, Ovstedal and Ryeng (2002) grouped pedestrians based on their comfort priorities uncovered in interviews. They found four main types:

- For the easy-going pedestrian the weather is important as well as to find her way easily. The typical easy-going pedestrian is a younger person.
- For the pedestrian seeking security away from traffic the important factors are safety, noise level, comfort and traffic conditions. The typical security-seeking pedestrian is a busy, middle-aged woman on a shopping trip, and she likes to walk.
- For the pedestrian seeking fresh air, space and light, it is important whether the surroundings are open or narrow. The typical pedestrian seeking air, space and light is an elderly woman going on a walk in the evening.
- The pedestrian seeking social pleasure stresses the presence of others, the presence of places to sit and to be able to meet requirements, as well as the condition of the street surface. The typical social pedestrian is an elderly person doing shopping in the downtown area during the daytime.

The researchers noted that “Making a better walking environment means taking into consideration the needs of the different pedestrians”.

Purpose and Destination of Trips

Not only the person who is performing the walking but also the purpose of the walking trip affects the way how the task of walking is performed and experienced. People can be grouped by particular types of trips or destinations - for example, commuting to work and school. Trips with certain purposes can be divided into trips to work, shopping trips, trips to the doctor, accompanying trips, education, visiting (friends and relatives), leisure and recreational trips.

Walking is more than simple locomotion. Walking can be hastening, marching, strolling, sauntering, dawdling or ambling depending on the purpose. Purpose can dictate needs (Ausserer, Risser, Kaufman, Barker, Johansson & Leden, 2010). Active transport walking tends to be somewhat faster than recreational walking, as befits its more purposeful nature. Active transport walks, however, tend to be shorter in both time and duration, with a median time duration of only six minutes.

On trips differ when we take children to school, accompanying friends etc. it is necessary to take care not only of ourselves but also of the child or friend's safety too. We might choose a longer but safer or more attractive route (detour through a park, crossing only at traffic lights or zebra crossings). This implies taking more time for the trip. When pushing a pram there will be more hindrances like stairs, narrow footpaths and crowds of people etc. In subways the walkers may look for a lift.

Walking trips are often combined with the use of public transport. This intermodality affects the way how the combined trip is performed (e.g. is there a wheelchair access? are there low floor busses on this line?). It is very important that transport enterprises consider all their customers, not only public transport users but also pedestrians. (Ausserer, Risser, Kaufman, Barker, Johansson & Leden, 2010)

Interlinked with purpose are the destinations we are walking to. Travel for goods and services (shopping) is the most common travel purpose, both for all modes (33.0%) and for active transport walking (34.4%). Travel to/ from work is the second-most frequent, with 16.8% for all modes and 18.5% for active transport walking. These two travel purposes account for 52.9% of all active transport-walking travel episodes. Active transport walking also shows high modal splits for education, restaurant meals, 'other personal activities' (e.g. eating not at a restaurant, visit to a public washroom, or no explanation given), 'other socializing' (i.e. non-residential social entertainment such as visiting a bar), and sports and entertainment. Cerin et al. (2007) found that "proximity of workplace" emerged as the most significant contributor to transport-related walking, and monthly frequency of walking to work as the most significant contributor to total transport related walking. Interestingly, however, the effect of proximity of workplace was significant for women but not for men.

Home is both the most common origin and destination walking, and the most common purpose is travel-to-shop rather than travel-to-work. Most walks are to non-home locations, such as retail establishments and offices. Particularly important are restaurants and bars, grocery stores, shopping centres, banks, and other services. All major destinations show strong distance-decay effects: most walks are shorter than 600 m, and very few exceed 1200 m. The assumption employed in the walkability literature, that one should restrict the 'neighbourhood of opportunity' to walking destinations within 1000 m of the home, is seen to be well justified. However, a planning policy focus on the walker's home neighbourhood is revealed as questionable, since a number of walking trips do not originate from the home. The relationship between urban land-use patterns and walkability may therefore require some rethinking (Millward, Spinney, Scott, 2013).

Most of the major destinations relate to commercial activity, in stores or offices. Particularly important are restaurants and bars, grocery stores, shopping centres, banks, and other services. Of lesser importance are fast foods, drug stores, private recreation facilities, sports retail, hotel/motel, department stores, and variety stores. Walking is a particularly popular travel mode for hotels/ motels (14% of trips), and also for shopping centres/malls, restaurants/ bars, and banks. It is not popular for department stores, private recreation (ironically), other services, or grocery stores. Mean distances to commercial destinations are mostly around 0.6 km, but those to banks and shopping centres, are 0.75 or higher. Access to destinations has been shown to be positively correlated with walking for transport (Frank et al., 2003; Handy et al., 2002).

Giles-Corti and colleagues (Giles-Corti et al., 2005) have noted that, in an attempt to explain walking for transport, the type and mix of commercial destinations (e.g., grocery store, restaurant, and post office) may be more important than the mere presence of commercial destinations. For example, it is plausible to assume that residents will visit grocery and supermarkets more often than a local bookshop or restaurant. Some support for this contention has been found in a recent study of older women where objective measures of walking (pedometer counts) were positively associated with presence of department, discount or hardware stores within walking distance from home but not with presence of a post office, restaurant, bar or pub (King et al., 2003).

Importantly, the utility and frequency of use of particular destinations is also likely to vary across socio-demographic groups. Restaurants and cafes may be more pertinent to younger people, hardware stores to male residents, and schools and playgrounds to parents of younger children. The mixture of uses most likely to stimulate walking will thus be unique for different populations.

Discussion of pedestrian categories

Different people are attracted by different things, go different places, have different needs, and make different contributions to the urban environment. There needs to be consideration of equity not only across travel modes, but within the pedestrian group. Equity in transportation seeks fairness in mobility and accessibility to meet the needs of all community members. Improving the ability of traditionally underserved communities to travel safely and conveniently via walking or wheeling is essential to achieving a sustainable, equitable transportation system that can provide options in how people access jobs, schools, health care services, faith entities, social gatherings, and other destinations.

Ensuring that roadway facilities can be accessed by everyone is a cornerstone of equitable transportation planning. While beyond the scope of this paper to discuss in detail, there are many existing resources that highlight the importance of "universal design"—or roadway design that accommodates roadway users of all ages and ability levels—and provide guidance on how it can be achieved e.g. Pedestrian planning and design guide (NZTA). However, guidelines are only useful if implemented

WHY CHOOSE TO WALK?

The experience of walking means that the individual is in interaction with the environment and with other users. The needs of individuals differ but can be broken into the 5 C's: connected, convenient, convivial, conspicuous and comfortable (London Planning Advisory Committee, 1996). Preconditions such as weather conditions, public space and aesthetics, are considered of special interest for pedestrians (Kaufman, Papaioannou, Blaszczyk, de Almeida, (2010).

These factors can be generally grouped into two kinds of arguments in the choice to walk: spatial and person dependent (Vukmirovic, 2010).

Spatial

Spatial aspects include the suitability of the environment for walking, orientation and safety. Predictability and reliability are also important. Suminski, Poston, Petosa, Stevens & Katzenmoyer (2005) examined the relationships between features of the neighbourhood environment (functional, safety, aesthetics, destinations) and walking for transportation, walking a dog, and walking for exercise. They found that for women neighbourhood safety was positively associated with walking for exercise and walking a dog.

Different users are influenced differently by the environment to become pedestrians. For example, Dr. Monir Moniruzzaman, a Bangladesh-born post-doctoral research associate at the University of Toronto, Canada, identified factors in our built environment that encourage seniors to walk. The results showed that walking for seniors is more prevalent on streets that have marked crosswalks, highly connected and marked footpaths, mixtures in land uses and low traffic volumes – and less prevalent on streets dominated by single residential homes or vacant land and with a lot of traffic (International transport forum media release, 2016). However, for youth pedestrians, these features are less important.

The availability of shops, services and other crowd pullers and the distance to and between these spots are essential. Ball, Bauman, Leslie, & Owen (2001) investigated relationships between environmental aesthetics, convenience (i.e. access to facilities), walking companions and walking for exercise. Logistic regression analyses of self-report data showed that people reporting a less aesthetically pleasing or less convenient environment were less likely to report walking for exercise in the past two weeks. Addy, Wilson, Kirtland et

al. (2004) from their study evaluating perceived social and environmental supports for physical activity, that having access to footpaths, and using malls were associated with regular walking.

Comfort is important, especially for elderly and people with a disability. When people feel that there is a lack of comfort (for example people think they will get wet or run in to obstacles) this is a decisive argument not to walk. However, many studies that measured weather, aesthetics, and walking found a positive relationship with walking in general. This means that people reporting that weather is not inhibiting their walking and that when the neighbourhood is nice people are more likely to walk. In addition, facilities for walking seem to be more important for walking than destinations in the neighbourhood.

The findings from a 2006 Sports and Recreation New Zealand and the Cancer Society of New Zealand survey (n = 8000) the environmental factors which encouraged active modes (particularly walking) are:

- Mixed land use
- Density
- Number of intersections
- Open public spaces

Recreation activity has been found to be associated to there being places to exercise in the community, reporting more facilities and destinations within a 5-minute walk, and more attractive features of the neighbourhood were associated with recreational activity (Hoehner, Brennan Ramirez, Elliott, Handy & Brownson, 2005). Hoehner et al. (2005) found that perceiving more destinations within walking distance of one's home and perceiving neighbourhoods free from garbage, litter, or broken glass, and well maintained were associated with transportation activity.

Kari (2016) asked participants to describe their pedestrian experience in their own words. According to the open descriptions provided by the participants of this study, the three factors that affect the most their pedestrian experience are convenience, surroundings and safety.

The most commonly mentioned factor influencing the pedestrian experience was the convenience of the route. The second most mentions came about items related to the surroundings around the walking route. These comments were mainly written from a positive point of view: natural space, views and landscape as well as the public spaces in the area were all seen positively influencing the pedestrian experience. Amount of space on the paths and noise especially caused by car traffic were some of the main motives for unpleasant utility walking according to the participants.

Person

Person dependent arguments include distance to destination, motive, attitude, perception and suitability of walking (or availability of other options) (Vukmirovic, 2010). There is, in particular, a large amount of literature on people's attitudes and perception and how they influence walking.

Looking at the relationships between individual variables and walking. Darker, Larkin & French (2007) provided a rich and detailed account of participants' experiences and attitudes of walking. Results showed that participants did not value walking as a form of exercise and reported that walking is not a goal in itself but primary a form of transport. Walking also influenced psychological well-being through associated social benefits. For most of the participants, a walk could serve as a medium for sharing experiences, seeing scenery and enjoying companionship. In addition, the environmental context of the walk was important. Walking in cities was not seen as pleasant as walking in the countryside due to the busyness and the noise of cars in the cities.

Participants saw walking as a chance to relax and relief stress. The traditional focus of walking promotion campaigns concerns beliefs about the benefits of walking on health, but it appears that people engage in healthy behaviour for reasons other than to be healthy. It was concluded that campaigns aimed at promoting walking should focus more on the experiences of psychological benefits from walking itself, such as the pleasure of shared experience and the psychological benefit of respite from the world, in addition to beliefs about health.

Anable & Gatersleben (2005) examined how users of different travel modes evaluate their daily commute to work on various instrumental and affective attributes, such as cost, freedom, and predictability. Results showed that work journeys are experienced very differently depending on the mode used. Generally, it appeared that car and especially non-motorised journeys (cycling and walking) were evaluated most positively and journeys by public transport most negatively. Journeys by bike or on foot scored high on affective aspects such as no stress, relaxation and freedom compared to journeys by car and especially public transport. Journeys on foot score highest on relaxation.

Giles-Corti & Donovan (2002) examined perceptions of the neighbourhood environment and walking by the socio-economic status of area of residence (SES). They found that perceiving the neighbourhood as being attractive, safe, and having interesting walks was associated with walking for recreation. Similarly, Humpel, Owen, Iverson, Leslie & Bauman (2004) examined associations of perceived environmental attributes (weather, aesthetics, accessibility, and location) with walking for different purposes. Results showed that positive perceptions about the aesthetic nature of the environment, reporting weather as not inhibiting, and perceiving a beach or lake within walking distance were associated with neighbourhood walking. McGinn, Evenson, Herring & Huston (2007) discovered that people who perceived hills as not being common in their neighbourhood were more likely to engage in walking and cycling for transport than those who reported hills were common in their neighbourhood.

WHERE WE CHOOSE TO WALK

Summary

Pedestrians cross a mix of land types, to multiple destinations. Virtually every trip by car and public transport is preceded and followed by some walking. Walking is the key to intermodality. Whatever the purpose of their movements or trips, pedestrians require continuity of the network they are allowed to use. A fully comprehensive walking network will encompass:

- The road corridor, enabling pedestrians to travel along and across roads
- Routes over land available for public use, such as along coast and river margins and through parks, transport interchanges and car parks
- Private land, such as on immediate approaches to and exits from buildings and car parks.

Route choices are affected by a number of features. The most important one is distance. Other relevant quality factors are physical access: safety, accessibility, attractiveness, and comfort. Additionally there are 'soft factors': trip purpose, personal fitness and moods. There are trade-offs between distance and quality (Monterde-i-Bort & Methorst 2010).

The trip chaining work by O'Fallon and Sullivan (2005) describes the reformulation of the LTSA's 1997/1998 NZ Household Travel Survey trips database into trip chains and tours. It found that 98% of walking tours are less than 10km in total and 83% are less than 4km. Walton and Sunseri (2007) undertook a New Zealand

study on attitudes to walking of people who live less than 1km from a park-and-ride facility, which found that a reasonable walking distance to the station is perceived to be 820m. Destination

Evidence on associations between characteristics of the built environment and transport-related walking is growing (Transportation Research Board, 2005). Previous literature reviews indicate that environmental designs and urban forms could play a very crucial role in pedestrian travel behaviour. A proper design of facilities can encourage walking without compromising safety and convenience (Sisiopiku & Akin, 2003). For example, a tunnel is an example of a route characteristic. More women than men find it dangerous to walk in a tunnel and will actively avoid them. Younger women also appreciate requirements as street lighting more than younger men and feels more troubled by parked cars when crossing the road (Bernhoft & Carstensen, 2008). The needs that can be derived from these requirements are the needs for visibility and conspicuousness.

Studies have shown that there are two factors concerned with the network of the footpaths that influence route choice; the first is whether the footpath is part of a network providing good connections and access to services and the other is whether the facility (footpath or crossing etc.) is implemented according to the desire lines of pedestrians. Sharples and Fletcher (2000) found in their study that in those locations where a crossing facility was not on the desire line pedestrians chose not to use it.

Pedestrians can be assumed to minimise their physical efforts as far as their intention is to move from A to B and apart from running for exercise and walking along. To the extent that this is true, it has consequences for their strategic choices, tactical choices and operational choices. In tactical sense, pedestrians usually choose the shortest route and do not want to spend extra time on the trip. With respect to route choice, pedestrians have a clear preference for the shortest route. This preference is quite far-reaching. They are prepared to leave the paved paths for this (Methorst, 2003). Pedestrians also have a preference to walk on the same side of a footpath as the destination (Methorst, 2003).

Research to the use of shopping routes showed that 84% of the people choose the shortest route, 8% doesn't know another route and 12% choose the route because of its attractiveness (Voet-gangervereniging 2001).

There are a number of factors influencing route choice that are not particularly well represented in the literature, namely those associated with attracting people to particular routes. Existing studies, such as those mentioned, have considered and tried to estimate the impact of factors singly (Sharples and Fletcher, 2000) but there is little evidence on how they interact. It is also difficult from the literature to get a sense of which factors are the most important in determining route choice. For example, familiarity clearly influences route choice to a degree, but it is largely missing from the literature. Also very few studies measure factors in a same way. Factors most frequently considered are distance or journey time, security, road traffic, urban form, pedestrian environment, effort, weather, positive beliefs.

BARRIERS TO WALKING

Summary

Although everyone is at some time a pedestrian, there are those who prefer other modes of transport, or who want to walk, but are put off walking by factors such as the environment, personal safety fears, weather and the like.

Cleland, B.S., Walton, D., Opus International Consultants, 2004 undertook a literature review on the reasons people give for not walking and cycling. Lack of consistency between studies made it difficult to reach conclusions on the relative importance of reasons. However, possible important reasons included:

- Distance
- Time
- Carrying things
- Health/physical factors
- Effort
- Weather
- Benefits of car use

Data from a telephone survey by Thomson (2009) of 2,000 residents of North Shore, Auckland revealed a strong negative correlation between distance and transport-related physical activity. Despite 56% of respondents living between two and five kilometres from their workplace reporting that they could access their workplace by active transport, only 9% actually chose one of those modes. In contrast, more than 30% of respondents living between one and two kilometres used active transport to get to work, and almost half of those who lived within one kilometre.

Similarly, Sullivan and O'Fallon (2006), perceived factors encouraging active modes (especially walking) include: mixed land use, density, number of intersection, open public spaces. Perceived barriers to partaking in active modes include inadequate street lighting, heavy traffic, lack of cycle lanes/paths, and nuisance dogs.

According to Walton and Sunseri (2007) who measured attitudes to walking of people who live less than 1km from a park-and-ride facility in urban New Zealand, factors thought to influence the uptake of walking such as time, distance, fatigue, carrying goods and concern for crime, are not real impediments to the walking journey. Only four factors were found to be real impediments: factors such as weather; the belief that park-and-rides are appropriately used by people who live close; the availability of a car; and the belief that a park-and-ride provides convenience, best predict whether someone will walk or drive to the station. The key question is why cars are used instead of a normal walking trip, when car dependency is clearly broken by using a public transport. Their recommendations include: to improve definitions and methodologies concerning walking mode types; where possible, improve rain shelter infrastructure by providing better shelters and covered walkways; establish a mechanism to make park-and-rides less convenient to those with the ability to walk who live less than 1km away from the facilities.

Research on the barriers to active travel in Palmerston North, involving a literature review and a survey of staff employed at Palmerston North City Council and Massey University's Manawatu campus found that the most significant barriers to walking were weather, the need to transport heavy/ bulky items, the time involved, lack of enthusiasm/ motivation, physical effort and the need to transport children. The most significant barriers to cycling were safety, infrastructure, time, convenience, and transporting heavy/bulky loads.

In Palmerston North approximately 80% of people drive to work with just under 9% walking or jogging to work in 2013 and 5.9% cycling to work. As with other urban areas where there is residential development in the peri-urban area, and an ageing population, it is likely that the percentage walking to work will decline.

Survey respondents reported the same barriers that have been identified in previous New Zealand studies and in many overseas studies. Of the reported barriers to walking, weather was the most commonly mentioned, with 62.5% of respondents reporting that it was a main consideration. Also significant were the need to transport bulky or heavy loads (43.1%), needing to transport children (33.9%) and lack of motivation (33.4%). Significantly, those respondents who reported never walking for transport were much more likely to

report that walking “took too long” (46.4%, compared to 32% of non-regular walkers and 28.1% for regular walkers). However, very few people (28) reported never walking for transport. The geographic data suggests an association between walking activity and location, with higher rates of walking in areas close to the city centre. Most frequently mentioned barriers were weather, the need to transport heavy/bulky items, the time involved, lack of enthusiasm/motivation, physical effort and the need to transport children. However, there is also interesting feedback that challenges perceptions of some factors (Cheyne, Imran, Scott and Tien, 2015).

A study on *Walking and Driving Cultures in Auckland* (Bean, 2006) found that, while there were many positive perceptions about walking in Auckland, many factors were deemed to be unpleasant for walking:

- Unsafe for pedestrians, especially children
- Unsafe for personal security
- Many women felt unsafe walking at night
- Some men also feared for their personal safety when walking at night
- Pervasive personal security fears for children
- Distance and time too great
- Weather, topography unpleasant or challenging
- Retail design
- Walking is considered as ‘alternative’ or ‘other’

A report by the Illawarra Active Transport Taskforce (2007), using a well promoted online survey found that the most significant barrier to active transport was distance. Related to distance is the greater time it takes to cover a given distance, since both cycling, and walking are often substantially slower modes than private transport. Similarly, in two qualitative studies (Kent, 2014; Mann & Abraham, 2006) investigating reasons why motorists were resistant to changing modes (compared to public transport in these articles), a perceived lack of time was frequently cited by respondents. Another commonly cited reason for taking motorised transport was the perceived need for the motor vehicle for secondary tasks. Mann and Abraham (2006) reported that participants often cited utilitarian purposes for needing the car (such as dropping children to school), although when alternative methods were pointed out to them, respondents revealed a strong affective attachment to driving.

The number and significance of barriers increases significantly for those who have cognitive, mobility, or age-related disability. The social model of disability says that disability is caused by the barriers that exist within society and the way society is organised. These barriers fall into three distinct areas (physical, attitudinal and organisational) which discriminate against people with impairments and exclude them from involvement and participation in daily activities. Physical barriers include inaccessible footways and crossings, buildings and services. Barriers created through people’s attitudes include discrimination, low expectation and prejudice. Organisational barriers are best exemplified through inflexible policies, practices and procedures – disabled people are most likely to mention modified hours or days or reduced work hours as an organisational adjustment that has or could help them into work.

Consideration also needs to be given to the door-to-door journey and the links between buildings, streets, and public transport services. People with different mobility and accessibility needs are more at risk of community severance, consequently, an inclusive, accessible outdoor environment is one that allows an older person to travel from their home to any chosen destination without risk or worry (Living Streets UK, 2016).

The following sections will look more closely at some of the commonly cited barriers to walking:

- Poor design

- Lack of comfort
- Safety – traffic, shared spaces, crossings, security
- Attitudes and social factors.
- Barriers which prevent walking to school

Poor design

Pedestrians and bike riders often find themselves facing a built environment that is hostile to non-motorized transport. Communities have focused transportation investments towards moving vehicles more efficiently throughout our region. As a result, many roads are not designed or maintained to accommodate pedestrians and cyclists. This environment reduces travel choices, and helps facilitate an “automobile dependency” that contributes to increased traffic congestion, higher road and parking facility costs, increased consumer costs, and greater environmental degradation (Browand, Delaney, Goodrich, Omatete and Trace, 2011). Adequate pedestrian and cycling conditions are essential to guarantee all users a minimal level of mobility.

To date the majority of road networks and urban developments have been designed primarily for vehicles and little consideration was given to pedestrians and cyclists. This was justified by the belief that most of the trips are made by vehicular means of transport. Thus, implicitly the mobility of vulnerable road users and their physical health is suppressed more than other users of the road network. As it was mentioned above, pedestrians’ mobility is restrained by inadequate infrastructure such as:

- Inadequate or absent pavements.
- Inadequate or absent pedestrian crossings.
- Inadequate or absent ramps and special infrastructure for disabled.
- Inadequate connection with Public Transport nodes.
- Inadequacy or absence of special infrastructure for people with disabilities such as blind persons (i.e. in many cases vehicles are parked on the special surface on the pavement which is dedicated to the movement of blind people).
- Inadequate or absent pedestrian information systems, etc.
- Lack of lightings, traffic signs, telephone boxes, benches, street furniture, trees, footpath café, etc. (Basbas, Konstantinidou, Moreno Ribas, 2010)

Inappropriate infrastructure is a problem for all road users, and not only for specific groups. The lack of pavements, narrow footpaths, potholes and other obstacles etc. are only some examples which make walking difficult, unpleasant and dangerous. Furthermore,

senior citizens and impaired people especially express that the missing of toilets and places to rest (benches etc.) in public space has a negative influence on their decision to walk or the time spend outside and on their mode choice in general. They would rather take the car than walk in unpleasant environment. Badly designed crossings are also criticized. (De Jong, Kaufman, Roivas, Rocakova, 2010)

Lack of comfort

The feeling and degree of comfort is dependent on the *surroundings*, the *situation* and the *individual*. Comfort includes factors which promote well-being and a feeling of comfort in the pedestrian when using the crossing. Examples are: the state of the surfaces of roads and footpaths, cleanliness (de Araujo & de Camargo Braga, 2008), waiting time, space available while waiting to cross, number of pedestrians at the crossing, one-way or two-way street, state of the road surface (de Araujo & de Camargo Braga, 2008).

A problem for pedestrians is 'narrow and crowded passages caused by too narrow pavements and walkways (also mixed with bicycles), or by obstacles and barriers on the pavement and walkways, e.g. parked cars, poles, rubbish bags, traffic signs, advertising signs, construction material (Gunnarsson (ed.), 2001). Pedestrians require an obstacle-free pavement or walkway because they need convenience. Another problem is the 'poor information on current position, important destinations, safe walking routes etc. caused by unclear signs, lack of landmarks' (Gunnarsson (ed.), 2001). Pedestrians need that information. Persons who are not familiar with an area have to look for clues themselves: Is this the right way? Are there any info points? Is this the fastest way? Often pedestrians are steered towards their target by sign posts put up for car drivers. In addition to pedestrian guidance systems the existing traffic signs must be adapted to the needs of pedestrians. (Ausserer, Risser, Kaufman, Barker, Johansson & Leden, 2010).

In the Living Streets UK study on disability and mobility (2016) noted above, obstructions, in particular advertising boards, wheelie bins and parked cars, were commonly encountered and made walking difficult. Like problems crossing the road, obstructions on the pavement could put pedestrians at risk (e.g. by having to step onto the carriageway to go past a parked car). The experience of wheelchair bound participants was that obstructions could make the difference between moving and waiting for an obstruction to be moved. The expectation that there would be obstructions could be enough to prevent a disabled person going out.

The provision of toilets and seating can encourage walking journeys. This is supported by data from a cross-sectional survey of 284 people aged 65 and over which found that the presence of seats, toilets, cafés and shelters in neighbourhood open space were significant predictors of the time participants spent outdoors (Sugiyama, Ward Thompson, & Alves, 2008). However, for disabled pedestrians in a focus groups (Living Streets UK, 2016) it was highlighted how in their experience "accessible" toilets can be too small for their wheelchairs and facilities that are supposed to be available are often locked.

Pedestrians also require that the footpath is clean. No mud, splash, puddles, dog mess, trash or litter on the pavement. Besides that (especially) older pedestrians need resting seats and meeting places. This also has to do with the need for convenience and comfort.

Safety

Common to many of the cited studies is the belief that the car offers a greater level of personal security and that aspects of walking or cycling make them relatively "unsafe" as a means of travel. Interviews of 1092 pedestrians across 6 European countries found that agree that the feeling of safety and security was the most important factor for them when being out walking. The correlation analysis did also give the highest correlation between the feeling of safety and security and the feeling of comfort, indicating that the feeling of safety and security is the most basic condition for the feeling of pedestrian comfort (Ovstedal and Ryeng, 2002).

Kari (2016) found that mentions of safety divided between the lighting in the area and the routes, traffic safety, fear of falling or tripping and the general feeling of safety. The great majority of the statements about safety had a negative tone: the participants seemed to see their concerns about safety having a clear influence on their walking experience.

From an empirical perspective it is just as important to make the distinction between two types of risk that are important for pedestrians: the risk of being involved in an accident and the risk of falling victim to a criminal offence, violence or threats. It is the latter that is most important for walking behaviour (Fyhri, Hof, Simonova, de Jong, 2010). The condition of the pavement also had a direct impact on individual's confidence walking outdoors as uneven surfaces were associated with the fear of falling. Conflict between different road users emerged as both a physical and attitudinal barrier. Cyclists and the use of mobility scooters on the pavement were an annoyance because they can be hard to hear and move fast.

It must also be highlighted that non-traffic accidents such as falls also constitute an important part of the safety problem of pedestrian, which is often not reported and not well known. Only a very limited number of countries have gathered data on this issue. It is found that, compared to traffic accidents there are 3 to 9 times as many pedestrians severely injured (admitted to hospital) in falls. Around 80% of pedestrian severe injuries are due to falling and, since the impact force when falling is lower than the impact of a moving vehicle, the count for pedestrian fatalities is substantially lower: 1 of every 3 pedestrian fatalities were due to falling. Most (more than 85%) of the accidents happen in urban areas on footpaths, roadways and cycle ways. (Monterde-i-Bort & Methorst 2010)

Research carried out in 2008–2010 (Opus, 2010) examined non-motor vehicle injuries to pedestrians through a structured interview survey. The highest proportion of trips and falls (34%) was sustained while stepping over a kerb. A further 18% were caused by irregularities in the path or road surface. Factors that amplified the severity of injuries included the road or path surface, pedestrians' inattention, type of footwear worn, and whether walking or running. Two main issues were identified from the study. These were: (1) people tripped and fell more often on poorly maintained surfaces as opposed to poorly designed areas, and (2) the severity of the injuries is directly related to the surface. The study recommends improving the definition of kerbing in key pedestrian areas and improving the maintenance regime of footpaths and roads used by pedestrians, such as crossings.

A qualitative study by Living Streets UK (2016) found that the most commonly identified barriers to walking for those with a range of learning and mobility impairments was crossing the road. This should not be surprising because crossings connect pedestrian routes, they intersect with vehicular traffic and are the point at which pedestrians are most vulnerable walking. Having enough time to cross, not finding a safe place to cross the road, signalised crossings that do not work, and the absence of dropped kerbs were all mentioned.

Safe, however, does not only refer to the objective safety of pedestrians (e.g. the risk of getting injured) but to the subjective safety, too. How safe do pedestrian feel themselves while walking or crossing a street? Safety concerns have been found in several studies (see, for example, Bean, Kearns & Collins, 2008; Pucher, Dill & Handy, 2010) to be one of the principal barriers to people participating in active transport. However, according to Fyhri, Hof, Simonova, de Jong, 2010 perceived safety don't play as large a role in the decision to walk as some studies may suggest, however, once the pedestrian has made the strategic decision to walk, perceived safety plays a larger role. Pedestrians who are afraid of crime and threats tend to exhibit more behavioural adaptations, like choosing another route, than pedestrians who are not afraid. Perceived risk of accidents tends to have less of a direct impact on behaviour (Fyhri, Hof, Simonova, de Jong, 2010). The feeling of insecurity in subways for example might be the cause for dangerous crossings on the road (Ausserer, Risser, Kaufman, Barker, Johansson & Leden, 2010).

Good information on the actual conditions of pedestrians' mobility and safety and better information on their own perceived difficulties and wishes can help to detect what are the basic needs to be met, so the most vulnerable road users can easily choose to walk more frequently. The city and all its spaces must be accessible (accessibility norms) for all the citizens, independently of their age and different characteristics. The space they have to use when they walk out of towns also has to be easy, attractive and safe. (Cabello, Sanchez, Martin, de Goede, van der Horst, Conde, & Romay, 2010)

Traffic safety

Road traffic is also given as a factor in choosing not to walk. The level of traffic has been identified as deterring many pedestrians. Small details of the pedestrian environment would have an impact on the decision to walk when compared to such factors as personal security and the time available, but there are some studies that suggest that the quality of the footpath and other facilities for pedestrians influence the decision to walk (Pedestrian's Association, 2000; Hass-Klau, Dowling and Nold, 1994). The particular factors identified in the studies are cleanliness, including the presence of litter, rubbish, dog dirt and the condition of

the pavement. The weather often comes up in the lists of factors that people find significant in the decision to walk.

Road safety for pedestrians is given a great deal of attention in the literature. The road is frequented by a variety of users – drivers, public transit vehicles, cyclists, and pedestrians. However, as each of these users, there are many obstacles, which typically involve the other users getting in the way. This is most common for drivers – since the typical road design is oriented towards easy mobility for cars, drivers have adjusted to a culture of innate entitlement for the road. This makes it more difficult for pedestrians and a cyclist to get around, less likely for people to use transit, and increases the likelihood for a collision.

The urban expansion, the motorization, the work and shopping concentration in the city's outskirts have caused a constant increase in the travelling distances. Therefore, walking is getting more and more difficult and dangerous. (Cabello, Cabello, Sanchez, Martin, de Goede, van der Horst, Conde, & Romay, 2010)

Many studies have shown that the volume, speed and proximity of motorised traffic has been shown in many studies have strong associations with people's sense of safety in the traffic environment, and consequently in their decision to engage in active transport (see, for example, Mackie, 2009; Ministry of Transport, 2005, 2008;) to. A Ministry of Transport (2008) guide for local authorities on promoting walking and cycling points out that they are not dangerous activities in and of themselves, but that they usually take place adjacent to large volumes of fast moving traffic, something which parents are particularly conscious of. The location of busy roads has been shown in a number of other studies to have a strong influence on parents' decision to allow their children to walk or cycle to school (see, for example, Badland, Schofield & Garrett, 2008; Badland et al., 2009; Garrard, 2010). For pedestrians in particular, crossing busy roads without appropriate crossings increases the risk to personal safety and has been identified as a deterrent to walking (Taylor, 2009). The group identified by Killoran et al. (2006) to be most at risk are children and the elderly. Speed of the motorised traffic has to be adapted to the pedestrians' needs. The smaller the difference in speed between the various road users the better will pedestrians enjoy walking. 30 km/zones are one possible solution. (Ausserer, Risser, Kaufman, Barker, Johansson & Leden, 2010).

It is especially important that children have enough time to cross the street. For the majority of pedestrians the time is more than adequate, but children need more time (Yauch & Davis; 2008). A major concern of pedestrians is that with signalized crossings they do not have enough time to cross the street (Carsten et al., 1998). Older people as well have not enough time to cross the street. 81% reported insufficient time to cross (Langlois et al., 1997). The time they have to cross the street is not sufficient because older people walk slower (Yauch & Davis, 2001, LaPlante & Kaseser, 2004, Fitzpatrick et al., 2007). Less than 1% of the New Haven pedestrians aged 72 years and older had a normal walking speed (Langlois et al., 1997). Also, pedestrians who are in a wheelchair or have difficulty walking may not have enough time to cross the street (Yauch & Davis, 2001).

One study found that 'with respect to turning vehicular traffic, half of the respondents complained that turning vehicles do not respect pedestrians that attempt to cross at signalized intersections during green. This has been, also, verified by field observations. In most cases pedestrians and right- or left turning vehicles share the same green phase with pedestrians. This situation is cited as a reason for pedestrians choosing to cross the road at locations other than signalized intersection cross-walks during green (Sisiopiku & Akin, 2003).

Conversely, Beca (2011) found that at traffic signals, pedestrians are often accommodated in a way that causes the least amount of interruption to the motorised traffic, and signal cycle times can be long, leading to excessive pedestrian waiting times. This can lead to frustration, causing pedestrians to violate the signals and use their own judgement to cross, resulting in safety risks. Similarly, a study by MWH Limited (2010) analysed pedestrian behaviour and safety before and after the installation of a trial countdown timer at the intersection of Queens Street, Bunny Street and Margaret Street in Lower Hutt in July 2007. The results were

compared with the 2006/07 trial at the Queen Street/Victoria Street intersection in Auckland CBD and showed very different results. The Auckland city trial indicated that, if placed in suitable locations, pedestrian countdown signals were associated with pedestrian behaviour change that enhanced safety. This study in Lower Hutt demonstrated that the observed pedestrian safety decreased as the percentage of both late starters and late finishers increased.

Returning to the Palmerston North survey, As well as the main concerns (weather, the need to transport heavy/bulky items, the time involved, lack of enthusiasm/motivation, physical effort and the need to transport children), infrastructure and urban form featured in comments by respondents such as not enough crossing time at the “green man” lights, the amount of time it takes to cross a roundabout, poor pavements, and lack of shelter. Risky and inconsiderate motorist behaviour was also mentioned. Respondents frequently referred to the need for better quality pavements; this is critical for older pedestrians and those with young children or a disability. As well, respondents highlighted the need for better provision for pedestrians and cyclists at signalised intersections and other crossings. However, it must be noted that the needs of pedestrians are not uniform, and long “green man” time is supportive of older and mobility impaired pedestrian needs. Singapore provides an example of providing for both, it introduced in October 2009, the Green Man + scheme, which allows senior citizens and pedestrians with disabilities more green man time to cross the road when they tap their senior citizen concession or Green Man + cards on the card reader on the traffic light pole. In May 2012, LTA extended the scheme to 256 pedestrian crossings in 15 housing estates, including 6 additional locations within some estates based on public feedback (<https://www.lta.gov.sg/content/ltaweb/en.html>).

A feeling of insecurity in traffic can be a serious problem for many people. This can stop them from going out. ‘On the other hand, it seems likely that an excessive feeling of security (a false sense of security) may cause accidents. Road users feel too safe and underestimate the risks involved in many situations. Most road users want to feel safe, and when they do so, they tend to think that the risk of accident is negligible’ (Elvik, 2000).

There is a need for safety requires factors which reduce conflict between pedestrians and vehicles. Examples are: traffic lights, a police presence, the width of the carriageway (Penna de Araujo & Gnecco de Camargo Braga, 2008), road width, vehicle speed, visibility (being able to see vehicles and be seen), lighting conditions, and guardrails (Penna de Araujo & Gnecco de Camargo Braga, 2008).

Children and senior citizens complain about reckless car drivers and express their wish that car drivers should be more polite, careful and more considerate towards pedestrians. Whereas senior citizens adapt their behaviour and wait at crossings until a car stops for them, children’s parents develop their own strategies against reckless car drivers. They decide to bring their children by car to school and therefore cause more car traffic, especially around schools, which raises the risk of accidents. (De Jong, Kaufman, Roivas, Rocakova, 2010).

Shared spaces

A safe pedestrian network includes minimising conflicts between pedestrians and all other road users. Mixed cycle and pedestrian paths for example should be avoided as several studies pointed out because they increase the potential for conflicts between cyclists and pedestrians (see Wunsch, Haindl & Ausserer, 2007).

Pedestrians are not the only groups on the streets. The reality is that they have to share the streets (and pavements) with drivers, cyclists, roller skaters etc. These other groups can influence the perception of safety of the pedestrians. Older pedestrians find it dangerous to walk when there are cyclists or roller skaters on the pavement (Bernhoft & Carstensen, 2008). In the younger group a significant higher proportion of men (than women) feel troubled by cyclists and roller skaters on the pavement (Bernhoft & Carstensen, 2008).

Conflict between pedestrian and bicycles (or other non-motorized wheeled transport) can occur on the following facilities (reducing conflict, Queensland Transport):

- shared paths: off-road facilities designed to be shared by pedestrians and bicycle riders
- separated paths: off-road facilities where separate paths are designated for pedestrians and bicycle riders and each signed respectively
- footpaths: paths beside a road principally designed for foot traffic
- roads: bicycle riders and pedestrians might share road space at the edge of a road when no footpath is provided. There are plenty of tools available for reducing this conflict, however – especially for elderly pedestrian – the presence can feel (and be) threatening and reduce the desire to walk in these areas.

Crossings

Discussion about crossing behaviour could be a review on its own due to the enormity of literature on the subject. Indeed, it has already been mentioned many times in the current review. As such, it will only be touched on briefly here. A study by Tanaboriboon and Jing (1994) compared signalized intersection pedestrian crossings to overpass and underpass counterparts and concluded that users preferred the signalized crossings to the overpass or underpass crossings. The authors also reported that the pedestrian crossing compliances with pedestrian signal at two study locations were 70% and 57% (Sisiopiku & Akin, 2003).

Waiters at signalized pedestrian crossings were asked why they waited. 'Danger/fear/safety' was cited as a reason for 45% of the sample, 'high traffic volume' was mentioned by 21% and 20% of the sample always waited (Keegan & O'Mahony, 2003). The walkers were asked what their main reason was for not waiting. 32% thought it was safe to cross, 31% of the sample was in a hurry/late/never wait/habit/hate waiting and 20% was impatient (Keegan & O'Mahony, 2003).

Other studies also confirm time-related reasons for unsafe crossings. Forsythe and Berger (1973) found that 'a need to hurry or a desire to keep moving was the main reason behind the lack of compliance with pedestrian signals (Sisiopiku & Akin, 2003). The main reason on which pedestrians make a decision to cross at a non-designated crosswalk is convenience (42%) while time-savings were of major importance to 27% of the respondents (Sisiopiku & Akin, 2003).

Security

There is much literature on personal security and walking. Certain behaviours have been identified as making people feel unsafe in particular the presence or absence of other people and particular types of people. Studies have found that women and men often feel unsafe if there are groups of men in the vicinity, but women also feel unsafe if there are solitary men around (Crime Concern, 1997). Certain public spaces are associated with certain types of people and specific behaviours, for example, the centre of towns and the public transport system (stations, bus shelters) later in the evening are associated with drunken groups of young men and both men and women find these intimidating and plan routes to avoid those situations. Greater feelings of safety are associated with familiar places, which can also have an impact on route choice. The level of street lighting is cited in most studies as an important factor in determining route choice for pedestrians at night. People have expressed fears about their personal safety when walking and take care to avoid places that they think are more dangerous than others.

The footpath experience is only enjoyable if users feel safe. Footpaths should be appropriately lit at night. Where the ground plane is well surfaced, it can eliminate tripping hazards. Facing building entries and windows toward the footpath can help walkers feel that other people are nearby and can make the footpath feel more interesting and walking distances seem shorter.

Adding residential units to the mix in downtown commercial areas increases the likelihood that an area will be populated after regular office hours. Restaurants and similar establishments that support residential populations can help footpaths stay active during the day and into the evening, keeping “eyes on the street (shaping footpath experience).

Pedestrian only areas, while providing a sense of security from traffic during the daylight hours, paradoxically, can feel more dangerous at night. In Parramatta, the Mayor, David Borger, said the council was considering handing the pedestrian mall, which lies between Macquarie and George streets, back to motorists because it had become unsafe at night. "In the daytime it's like a packed game at Parramatta Stadium, it's full of people, but at night-time ... the place is dead," he said. "Safety is also an issue. The local police and people who use the mall at night would like it to be more active" (2005, reported <https://www.smh.com.au/national/pedestrian-mall-likely-to-give-way-to-motorists-20050916-gdm2u1.html>).

Fears about personal safety are one factor that has been identified explicitly in empirical work as influencing both pedestrian route choice and mode choice. Studies have shown that some people do not walk because they are frightened about being attacked (Crime Concern, 1997, Hamilton 2000). Complex social trends have affected children's activities and particularly walking over the past twenty years. In recent years parents and guardians have come to fear that children will be attacked and abducted by strangers whilst in the street which has led to a restriction on children's freedom to play out. In addition, there have been growing fears about the danger of road traffic that has meant that many more children are being escorted when they go out and not allowed to make journeys on their own. Hillman, Adams and Whitelegg (1990) found that parents restricted their children's freedom more because of their fears about road traffic than their fears about strangers assaulting their children. One result of these changes in perceptions and in the use and perceptions of time is that more and more parents are deciding that their children should be driven rather than walked to school (Bradshaw and Jones, 2000). This will be covered more fully later in the review. Incivility actually seems to have a large impact on the transport system. Using the transport system by any mode involves a person in social interaction with other users. This social interaction involves implicit, unacknowledged agreements about what is considered to be polite or rude behaviour (both verbal and non-verbal) between people using the transport system.

Attitudinal and Social Barriers

Often overlooked, but very important, are individuals' attitudes and emotional response to the different travel modes. In almost all cases, the social and attitudinal variables have been found to be associated with physical activity.

Following qualitative interviews with commuters in Sydney, Kent (2014) identified five reasons people preferred to drive, even when alternative modes could be shown to take an equal time: (i) the comfort of the car, (ii) the extension of private space that it allows, (iii) the sense of autonomy, (iv) the flexibility, and (v) the reliability that the car allows, in terms of not having to coordinate with bus timetables. In a similar study, Mann & Abraham (2006), in a UK study, also identified personal space, sense of autonomy, driving pleasure and perceived greater utility of private cars as the reason for non-participation in active travel.

Thomson (2009) reported that parental conformity was a strong factor in allowing children to use active transport. Heinen et al. (2013) found that the expressed opinion of colleagues regarding the appropriate mode of travel to work was strongly correlated with rates of car and bicycle commuting. Closely related to that is the individual's impression of different status afforded to cyclists and pedestrians relative to motorists. An element in the social exclusion felt by participants in the research by Rose et al. (2009) was the sense of social status afforded by car use. The final barrier, which is closely linked to the safety element (see

section 2.3 above), is that due to the greater vulnerability of pedestrians and cyclists, transport users must rely on others to ensure their safety.

Addy et al. (2004) classified respondents according to physical activity levels and walking behaviours. They found in their study that perceiving neighbours as being active was associated with regular walking. Ball et al. (2001) concluded that respondents, particularly women, reporting no company or pet to walk with were less likely to walk for exercise or recreation.

Duncan and Mummery (2005) investigated the associations between demographic, psychosocial, and environmental variables with self-reported physical activity and self-reported participation in recreational walking. They found that, when adjusting for age, gender income, educational level, and BMI, high levels of social support for activity were associated with recreational walking.

Troped et al. (2003) attempted to identify environmental correlates of both recreational and transportation-related physical activity among a community sample of adults. From the results of their survey they concluded that social support for physical activity from family and friends was positively associated with recreational physical activity.

Timperio et al. (2004) examined associations between perceptions of the local neighbourhood and walking or cycling for transport among children. They found no associations between parents' concerns about strangers and children's walking or cycling in the neighbourhood. Timperio et al. (2006) investigated aspects of the social and physical neighbourhood environment that may influence children's active commuting to school. They concluded from their study that parents' perceptions of few other children in the neighbourhood for their child to play with were associated with less active commuting to school.

Stahl, Rutten, Nutbeam, Bauman, Kannas, Abel, et al. (2001) examined the relationships between reported physical activity (not walking specifically), and the extent of perceived support for physical activity in the physical and policy environment (e.g. facilities, programs and other opportunities) and in the social environment. Respondents were categorized as active or inactive according to self-reported physical activity. They found that those who perceived low social support from their personal environment (i.e. family, friends, school and workplace) were more than twice as likely to be sedentary compared to those who reported high social support from their personal environment.

The studies that measured companionship and social support found a positive relationship with walking in general, for recreation, exercise and transport. This means that people who report having someone to walk with and that they are encouraged by friends and family are more likely to walk. Companionship, social support as well as social modelling (having partner/friend/ family participating in some type of physical activity) are all important for pedestrian activity.

For pedestrians with learning disabilities (and stroke survivors and wheelchair users too) subjective personal safety and feeling safe is a big factor in whether to walk. Being called names by other pedestrians (and in one case being the victim of an opportunistic theft) resulted in some participants of the Living Streets UK study (2016) feeling of vulnerable, and it reduced their confidence going outside. Conversely, the sociability of walking was a key motivation for walking. Specific attitudinal barriers for those with disabilities included fears of conflict with cyclist; concern over walking being painful or tiring fear of falling, fear of falling; and lack of interest or motivation.

Barriers to walking to school

Analysis of New Zealand travel survey data by Keall, Chapman and Howden-Chapman (2009) over the period 1989-2006 showed a disturbing trend nationally of increasing use of cars, accompanied by large decreases in

cycling and walking for children aged 5-14. This trend raises concerns not only about the negative environmental effects of driving, but also about New Zealand's growing obesity epidemic, to which sedentary lifestyles contribute.

Further to this, as noted in MoT's Household Travel Survey fact sheet, the health implications for children and the timing of school travel within the morning peak make it a topic of interest. Particularly when the results from the most recent Household Travel Survey show that the number of primary school children being driven to school remains significantly high and twice the number of those who walk to school.

The number of children who are taken to school by car has increased considerably in the western world. Many parents have decided that it is best to take their child to school by car, because this enables them to transport their child in safety almost to the school gate. However, increased motor traffic in the immediate vicinity of the school poses an increased danger to those children who travel to school on foot or by bicycle. (De Jong, Kaufman, Roivas, Rocakova, 2010)

Because a lot of parents are afraid that their children will be involved in an accident, they drive their children to school. This typical pattern has different consequences for children's development ranging from getting too little exercise to causing additional risks for those "remaining" children who still walk to school (Steiner, Cirder, Betancourt, 2006). But it also means that children have less time to spend in public space with other people and their peers. (De Jong, Kaufman, Roivas, Rocakova, 2010)

The Otago Medical School research (Burt et al, 2005) of primary school children in Dunedin found that factors rated most important in influencing parents' decision to let their child walk to school were crossing roads; traffic speed; health benefits of walking; and stranger danger. The biggest barrier for children walking to school was found to be road safety. This calls for measures such as the introduction of speed limit zones and speed bumps around school areas. The strongest positive predictor to walking to school is the distance they live from their schools. The shorter the distance; the high the probability of walking to school. This highlights possible ramifications for educational policies that have resulted in small schools being closed or merged with other schools.

Similarly, according to Burt, R. Chow, K. Donohue, R. Sani, H. Taylor, K. Towns, C. Yelavich, S (2005) factors rated most important in influencing parents' decision to let their child walk to school were crossing roads; traffic speed; health benefits of walking; and stranger danger. They also found that females were less likely to walk than males and their parents were more concerned about stranger danger and the availability of a walking companion. Children in year 1-3 were less likely to walk than those in year 4-6 and parents of younger children thought road safety issues were more important. Maori and Pacific Island children were more likely to walk to school than NZ European children. These results were statistically significant even when controlled for other factors such as school decile, car ownership etc. The biggest barrier for children walking to school is road safety. This calls for measures such as the introduction of speed limit zones and speed bumps around school areas.

A cross sectional survey in two Australian cities (Melbourne and Perth), indicate that a higher level of walking was associated with lower levels of socioeconomic status. Analysis showed the strongest predictor of walking activity was school type (government vs independent), and after adjusting for this, lower car ownership, non-English-speaking background and lower occupational category were associated with walking to school, while a different set of predictors – age, sex and maternal education – were associated with unaccompanied crossing of streets. There was little difference in overall walking levels between boys and girls, but boys were significantly more likely to cross streets unaccompanied (National Centre for Chronic Disease Prevention and Health Promotion, 2002).

The study by Merom et al (2004) of active commuting to school among primary school children in New South Wales found that children's active commuting to school, even if household is within walking distance, is significantly influenced by their parent's travel mode to work, especially if the parent is also car dependant,

and if the father is responsible for taking the children to school. Involving fathers in school-related travel may increase likelihood of regular walking. Frequent walking also related to child's level of independence and parent's belief in health benefit of walking as a form of travel. Workplace and school travel plans both advocated.

A New Zealand study undertaken by O'Fallon and Sullivan (2005) considered trip chains involving the travel of children to and from school, both from the perspective of the children going to school and, in the cases where the children were passengers in a vehicle in Auckland, Wellington, and Christchurch, the vehicle driver, found that:

With respect to driver trip chains to school in the three main centres, they determined that:

- 27% had the sole purpose to drive a child or children to school and 56% ended at work or their own place of education.
- 25% of the home to school segment of all chains (regardless of purpose) were less than 1.4 km –an easily walk-able distance; 50% were less than 2.5 km (i.e. walk- or cycle-able).

For driver trip chains from school, they established that:

- 59% start from home and 34% start from work.
- 69% do not have any other purpose than to pick up their child/children and either accompany them to a child-related activity or take them home.

This information highlights some reasonably obvious targets for encouraging mode shift, such as those who drive home immediately after dropping off or picking up their child at school and who thus have no other reason for being on the road at that time. Such drivers make up around a quarter (27%) of the total children driven to school and probably even more of those driving children from school. For many of these journeys, the distance between home and school is eminently “walk-able”, suggesting that other factors may be causing these parents to drive.

It also highlights the fact that primary school children (5-12-year olds) are the ones who are most commonly driven to and from school, whereas 13-17-year-old urban dwellers are commonly driven to school but use a different mode to travel home. This suggests that targeting for school travel initiatives should focus on primary schools for both journeys. With high schools, there is probably a need to be more selective as to where school travel initiatives are undertaken

There is a need for further research to be done in several areas including delineating the role of ethnicity and socio-economic status in children walking to school.

RESEARCH GAPS

It is interesting to note what is not in the literature as what is. The main research gaps and considerations are:

Recognition of pedestrian diversity

There is a need to consider greater pedestrian diversity in the literature, and for planners to be aware that pedestrians are not a uniform group, but individual people with different needs and desires. Generally, pedestrians are divided by their abilities but literature accounts for various pedestrian groups in an inconsistent manner (see next section), and variation with the groups is not well accounted for. For example,

the group of people with impairments is very diverse and includes those with physical disabilities (temporary and permanent), people with reduced or lacking vision, hearing-impaired persons and mentally disabled. However, because this group is so heterogeneous there are sometime conflicting needs concerning infrastructure (De Jong, Kaufman, Roivas, Rocakova, 2010), for example, adaptations to make the pedestrian environment more accessible for one group can also be problematic. For example, tactile paving helps blind and partially sighted people to navigate but is a trip-hazard for stroke survivors who have problems lifting their feet. Even with 'able' pedestrians ability and needs can also vary during a pedestrian travel, such as if someone is accompanied by children, carrying luggage, consuming food, beverages or cigarettes, or using phones or headphones (Vukmirovic, 2010). There are also the needs of accompanying people to be considered (e.g. children on prams or on scooters) (Ausserer, Risser, Kaufman, Barker, Johansson & Leden, 2010). This demonstrates the need to consider the accessibility of pedestrian environment while avoiding a focus on any one pedestrian group.

If diversity is not properly accounted for it becomes a question of equity. There needs to be consideration form equity not only across travel modes, but within the pedestrian mode. Equity in transportation seeks fairness in mobility and accessibility to meet the needs of all community members. Improving the ability of traditionally underserved communities to travel safely and conveniently via walking or wheeling is essential to achieving a sustainable, equitable transportation system that can provide options in how people access jobs, schools, health care services, faith entities, social gatherings, and other destinations.

The majority of literature on pedestrians is from the perspective of urban planning or group studies, and more focus needs to be given to the diverse needs of the individual. People are heterogeneous and vary in their responses to place. Some like forests, others like deserts, others like manicured back yards, and others like bustling city streets. Some people constantly change their minds. A person's "place in the world," including socioeconomic status, sense of efficacy and opportunity, and cultural heritage, affects the experience of place. A full understanding of the effect of places on people requires an understanding of human variability. There is no shortage of guidelines on how to recognize, design, and build a good place however what "good" is may not always reflect individual experience (Frumkin, 2003).

The literature relies too heavily on survey snapshots of asset focused information; however, pedestrian experience is fluid - familiarly, wellness, mood, and different activities and contexts can all play a role in how pedestrians find the experience of walking or of place – not just the state of the asset. Newer planning frameworks such as the Healthy Streets Framework (Saunders, 2017) emphasise hedonic factors as well as the built environment. The Healthy Streets framework sets out 10 Healthy Streets Indicators which describe the key ingredients for an easy and pleasurable environment. This is a positive step; however, this framework it is still asset centric and as such may miss the individual preferences of pedestrians. The framework also relies on aggregated information, which may ignore the voice of minority groups and lead to formulaic - and potentially redundant - approaches.

There is a need for broader qualitative approaches to pedestrian experience research, because this enables a more open and in-depth exploration of issues people face and allows patterns to emerge. It's not just if the streets are good enough but how people feel when choosing to walk on them, and what influences this. A possible example of this are the Community Street Reviews which are an assessment of the walkability of a route from the point of view of the users. The reviews embrace a holistic approach, including wider social factors. While the reviews still have a focus on place, they do consider the individuals perceptions - how they feel when walking a particular route (NZTA, 2009).

A broader understanding of the decisions taken by the pedestrians has to include information on aspects such as the effect of ageing or mood on their walking decisions, their concerns about security or the impact of economic and weather conditions for example. The social values will also influence the choices people make in relation to the transport they use to go to work, to school, to get to their leisure and sport activities. (Cabello, Cabello, Sanchez, Martin, de Goede, van der Horst, Conde, & Romay, 2010). There is, in particular, a

lack of published peer reviewed evidence relating to the experience of people living with a broad spectrum of physical, sensory, intellectual and behavioural conditions. Research literature has focused on ageing and age-related mobility problems instead. Also underrepresented is the experience of those who do not walk.

Consistency of measures used for walking

There is no universal survey standard for mobility and safety data on walking. Sets of data between research reports are only roughly comparable. Definition of words (trip, journey, period of time considered) can change between countries (Monterde-i-Bort & Methorst 2010).

Internationally, in addition to national level information, there are local or regional web pages with non-standardised mobility data. These kinds of data are usually tailored to the project or to the local problem, and therefore hard to compare with other situations.

In the field of Road Safety, the survey is the method most widely used to know about user's personal opinions, perceptions of needs, or self-reported difficulties with regard to mobility and safety. There is a huge disparity in the kind of data, periodicity and number of subjects considered in these studies.

In all cases, but especially in relation to the most vulnerable groups of pedestrians (5 to 11 years old children and elderly people of 75 years and older) information is needed on their movements, motives and other influential factors, the same way that information on car drivers is obtained in actual mobility surveys. With regard to safety statistical data, additional research is needed to fill the gaps. (Cabello, Cabello, Sanchez, Martin, de Goede, van der Horst, Conde, & Romay, 2010)

To gain more insight and knowledge on pedestrians' needs and preferences it is important to develop high quality universal standards concerning pedestrian behaviour research. Besides the need for the collection of more data, universal standardized methods would make it possible to compare situations between countries. In order to compare and integrate data, a common terminology regarding pedestrian issues should also be developed and accepted. These measures will provide a huge amount of informative data and only then will it be possible to exchange information and to learn from the best practices. (Cabello, Cabello, Sanchez, Martin, de Goede, van der Horst, Conde, & Romay, 2010)

Consideration of the rural-urban divide

A particular gap in the literature is the rural pedestrian. Studies focus almost exclusively on urban pedestrian environments. The need to increase physical activity in urban and rural communities remains both a priority and a challenge and is coupled with the need for better understanding as to how different environment attributes in urban and rural areas may facilitate walking participation (Berry, Coffee, Nolan, Dollman and Sugiyama, 2017). Rural streets, and long distances may not be conducive to walking, but it is a problem that needs to be considered. In the studies that do exist, there has been consistent evidence for differences in physical activity participation between those living in rural/remote and urban areas.

Telephone surveys of 2402 adults over 18 years (Berry et al., 2017) was conducted to determine walking behaviour and perceptions of neighbourhood walkability. A greater proportion of respondents reported no walking in rural (25.8%) compared to urban areas (18.5%). Compared to urban areas, rural areas had lower walkability scores and urban residents reported higher frequency of walking. The association of perceived walkability with walking was significant only in urban areas. These results suggest that environmental factors associated with walking in urban areas may not be relevant in rural areas. More research is required to understand the environment attributes that are associated with walking behaviour in rural areas

An Australian (Berry, Smith, Ullah, and Dollman, 2016) study demonstrated the differences in walking for transport and recreation by remoteness, with those in inner and outer regional areas walking less for transport and those in very remote/remote areas walking less for recreation relative to those in the major city. Regional and gender differences in walking participation indicate that interventions to increase walking participation in rural and remote areas need to be tailored to accommodate geographic location and differing preferences of men and women.

Overall, a disturbingly high proportion of respondents reported doing no walking for any purpose, regardless of where they lived. Men living in remote/very remote South Australia were less likely to walk for transport compared to those in the major city and there was a clear gradient of lower recreational walking with increasing remoteness. On the other hand, women in inner and outer regional areas were less likely to walk for transport than women in urban areas. The results also supported a greater motivation towards recreational walking in women irrespective of geographical location.

There is also some confusion as to the inner versus the fringe city dweller experience of walking. Pinnacle Research & Policy Ltd Ian Wallis Associates Ltd analysis of 2006 NZ census data found that inner city residents were more likely to walk and less likely to drive, for any trip purpose, than residents living elsewhere in Auckland/Wellington cities and metropolitan areas. Inner city residents also had demonstrably fewer vehicles per adult in the household. The data indicated that, on their own, neither the population nor employment density of major New Zealand cities appeared directly correlated with the choice of mode for the journey to work.

APPLICATION OF PEDESTRIAN GUIDANCE AT STREET LEVEL

The rationale for much of the literature noted in the paper is that there is a disparity between the many available design guidelines for accessible pedestrian environments and the real world physical barriers still faced by pedestrians. For this reason, research that looks at diverse needs not only needs to be undertaken, it needs to find expression on the streets.

There is a great deal of guidance available to good pedestrian centric urban planning. However, people in New Zealand are making fewer trips on foot (Ministry of Transport). Given this and the large number of barriers cited (discussed later) which prevent pedestrian participation, it would appear this guidance has not yet found expression on the streets. The streets are still traffic centric in design on the whole. Level of service There is a disparity between design guidelines for accessible pedestrian environments and the real world physical barriers faced by disabled people. Instead of relying on the guidance to provide formulaic solutions, it is important to think about who the users are and what barrier (physical or otherwise) is being addressed. To do this there needs customer level information on walking decisions that provide a deeper understanding of individual and environmental context from day to day and place to place. If one stage of a journey is problematic (e.g. catching a bus) it may compromise the whole trip and remove an opportunity for functional walking outdoors.

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APPENDIX 1

Pedestrian behaviours and abilities by age

Taken from Vukmirovic, 2010

Infants and Toddlers (ages 0 to 5)

At this age, walking skills are just being developed and the children require constant parental supervision. Infants and toddlers have very limited abilities, and feature the following characteristics:

- ☒ They are learning to walk.
- ☒ They are developing peripheral vision and depth perception.
- ☒ They are impulsive and unpredictable.

Young Children (ages 5 to 7)

At a young age, children have unique abilities and needs. Since children at this age vary greatly in ability, it is important for parents to supervise them and make decisions on whether their child is ready for a new independent activity. Children in this age range tend to be:

- ☒ Impulsive and unpredictable,
- ☒ Limited in their peripheral vision (a sound source is not easily located),
- ☒ Limited in training/lacking in experience,
- ☒ Thrilled or excited by close calls,
- ☒ Short and therefore hard to be seen by drivers,
- ☒ Susceptible to darting or dashing out into the intersection,
- ☒ Likely to copy the behaviour of adults.

Preteens (ages 8 to 12)

By middle school years, children do have many of their physical abilities developed but still lack experience and training. Now there is greater desire to take risk. Preteens generally:

- ☒ Lack experience,
- ☒ Walk and ride a bicycle more often than before and at different times (which increases the possibility of crashing),
- ☒ Ride more frequently under risky conditions (high traffic),
- ☒ Lack positive role models,

Cross the street at riskier locations,

- ☒ Get involved in more conflict situations with other traffic participants,
- ☒ Have a sense of invulnerability that makes them more willing to take chances.

Teens (ages 13 to 17)

- ☒ Are very active, can go long distances, and visit new places,
- ☒ Feel invincible,
- ☒ Lack experience and training,
- ☒ Are capable of travelling at higher speeds,
- ☒ Will overestimate their abilities on hills, curves, etc.
- ☒ Attempt to use bicycles, in-line skates, etc., based on practices carried over from youth.
- ☒ Are willing to experiment with alcohol and drugs

Adults (19 to 40)

These adults are highly competent in traffic and capable of perceiving and dealing with risk in most circumstances. Some use bicycles for commuting and utilitarian trips, while others use bicycles primarily for recreation. This group is generally:

- ☒ Active and fully aware of the traffic environment,
- ☒ Comprises only 1–4 percent of bicycling population in most communities,
- ☒ Tend to be very vocal and interested in improving traffic conditions.

Middle-Aged Adults (41 to 65)

During this stage of life, many pedestrians experience slower reflexes necessary to observe, assess, and respond to traffic conditions.

Besides these characteristics, the behaviour of this group of pedestrians will generally depend on other factors such as interest, professional orientation, employment status, income, etc.

Elderly 65+

The elderly are usually defined as people of 65 years and older. With regard to walking elderly people of 80 years and older is a much more functional definition.

Based on characteristics and abilities of pedestrians in this category, we can recognize certain variations. They are a consequence of the gradual decline of physical and cognitive functions, which are quite visible after 75 years of life. Bearing in mind that these changes could affect any or several categories of abilities

(physical, psychomotor, sensory or cognitive); older pedestrians generally exhibit the following characteristics and behaviours (U.S. Department of Transport, 2009):

Walk more in older years, especially for exercise/independence,

☒ May have reduced income and therefore, no car,

☒ All experience some reduction in vision, agility, balance, speed, and strength,

☒ May have further problems with hearing, extreme visual problems, and concentration,

☒ Have the tendency to focus on only one object at a time,

☒ Have difficulty hearing vehicles approaching from behind,

☒ All have greatly reduced abilities under low light/night conditions,

☒ May overestimate their abilities,

☒ Have a higher fatality rate than other pedestrians do, when involved in collisions with motor vehicles (Table 7)

APPENDIX 2

Categories of disability

Mobility-impaired pedestrians

Mobility-impaired pedestrians are commonly thought of as using devices to help them to walk, ranging from canes, sticks and crutches to wheelchairs, walkers and prosthetic limbs. However, a significant proportion of those with mobility impairments do not use any visually identifiable device. (Vukmirovic, 2010)

Sensory-impaired pedestrians

Sensory impairment is often mistaken as being a complete loss of at least one sense, but a partial loss is far more common. (Vukmirovic, 2010)

Wheeled pedestrians

Wheelchair and mobility scooter users can legitimately use the pedestrian network, but in many ways, their characteristics are very different from those of pedestrians who walk. This means that the network has to function differently when considering these users. (Vukmirovic, 2010)

Mentally impaired pedestrians

Category of persons with disabilities includes people with mental disorders. These people have restrictions in all categories of skills, but the most of them are related to the psychomotor and cognitive abilities. These damages may result in poor orientation in space, the impossibility of understanding the signals and information, the inability of fast reactions, inadequate assessment of traffic, (Vukmirovic, 2010)

People with mobility impairments include those who use wheelchairs, crutches, canes, walkers, orthotics, and prosthetic limbs. However, many people with mobility impairments do not use assistive devices. Characteristics common to people with mobility limitations include substantially altered space requirements to accommodate assistive device use, difficulty in passing over soft surfaces, and difficulty in passing over surfaces that are not levelled. (Vukmirovic, 2010)

Although people with sensory disabilities are more commonly thought of as totally blind or deaf, partial hearing or vision loss is much more common. Other types of sensory disabilities can affect touch, balance, or the ability to detect the position of one's own body in space. Colour blindness is considered a sensory defect. (Vukmirovic, 2010)

Cognition is an ability to perceive, recognize, understand, interpret, and respond to information. It relies on complex processes such as talking, memory, learning, and recognition. Cognitive disabilities can hinder the ability to think, learn, respond, and perform coordinated motor skills. Such individuals might have difficulty navigating through complex environments, like streets, and might become lost more easily than other people might.

For those of us fortunate to live to an older age, 85 percent will have a permanent disability that limits our range of mobility. (Vukmirovic, 2010)

