

Attitudes towards active mobility in Singapore: A qualitative study

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Abstract

Active modes of transport (i.e. walking and cycling) are being encouraged in many countries. Singapore is advocating strong efforts to attract more users to travel by walking and cycling and thereby achieve 'car-lite' travel. To attract users towards a certain transport alternative, it is important to understand their current perceptions and attitudes towards it and accordingly develop a suitable transport network and related schemes. This paper employs two qualitative techniques, focus group sessions and one-to-one interviews, to gain a deeper understanding of adults and elders perceived advantages, disadvantages, concerns and opportunities to promote walking and cycling in Singapore. It was found that users are comfortable with the walking infrastructure, but they expressed that more can be done to improve the cycling infrastructure including provision of wider paths and parking facilities. Overall, more positive attitudes were registered towards cycling than walking. Work incentives such as flexible working hours are preferred by users to promote walking and cycling. Education to all road users (pedestrians, cyclists, and motorists) was mentioned as a key initiative to increase safety and effective sharing of facilities.

Highlights

- Qualitative study to understand attitudes towards active mobility is employed.
- Users discussed walking and cycling strength, weakness, opportunity, and threats.
- Walking was perceived as a convenient transport mode and cycling as a fun activity.
- Concerns of users can be addressed with infrastructure and policy provisions.
- Modifications of local schemes to promote walking and cycling trips are proposed.

Keywords: Active mobility, travel behaviour, qualitative study, transport schemes, attitudes, perceptions

1. Introduction

Countries are rapidly evolving and adapting to today's globalised and competitive world. This is most prevalent in the field of transport. An area where authorities and researchers are advocating substantial efforts is to develop sustainable and efficient transport networks. Around 1960s, private car usage was in vogue. Yet, the negative aspects of motorisation rapidly became hard to tolerate. The number of traffic accidents increased, air and noise pollution intensified, and people had more sedentary lifestyles (Tolley, 1990). In response, mass transport and active modes of transport, mostly walking and cycling, began to be promoted. Active mobility helped to reduce the negative aspects on motorisation and encouraged people to undertake some physical activity (Pucher & Buehler, 2010; Song et al, 2013).

Singapore is a small and densely-populated country – 716 km² land area and 5.47 million habitants (SINGSTATS, 2014; Tham, 2014) – which is focused on developing an eco-friendly and inclusive transport system using the limited land space available efficiently. A world class public transport (mass rapid transit (MRT) system and feeder buses) has been available since 1991 for inhabitants to travel around the island (LTA, 2015b). The mode share of public transport is relatively high, with a 44% daily usage on average, and 63% during peak periods (CLC & ULI, 2014; Meng et al., 2014). In addition, different types of infrastructures and facilities are provided for pedestrians and cyclists. Walking is currently used for 22% of daily trips (LTA, 2011) and cycling only between 1% to 2% as a principal mode of transport (Cheong, 2016b). Further

improvements on the active-mobility network are planned as part of the national agenda to foster “car-lite” travel among inhabitants.

Travelling by active modes of transport (i.e. walking and cycling) is affected by a series of factors, including the built environment and users’ perceptions of these modes (Easton & Ferrari, 2015; Koh & Wong, 2013). Provisions for walking and cycling, locally and elsewhere, are most of the times focused on increasing safety and convenience for the users. In addition, several policies exist to encourage users to make use of these modes for short trips or for constituent stage(s) of longer trips. However, in contrast with provisions for motorised transport, especially public transport, provisions and policies for active modes are rarely set to be “market-oriented” and able to compete with motorised modes of transport. It is understood that public transport usage entails the usage of active modes for the first/last mile (FLM) stages of trips from stations to home, thus providing users with the benefits derived from walking and cycling. It is worth mentioning that with efforts to enhance public transport service, FLM travel distances are getting shorter and shorter. To determine strengths and weaknesses of the active-mobility transport network, it is essential to understand travel behaviour, attitudes, and needs of pedestrians and cyclists for prevailing conditions. Such knowledge can help policymakers and authorities to evaluate the level-of-service of current active-mobility network. In addition, it can be used to: (1) estimate the importance of service improvement from users’ perception; and (2) develop transport schemes, infrastructures, and policies, aimed to increase the “market share”, i.e. number of pedestrians and cyclists.

Most research studies agree that environmental characteristics of the neighbourhoods play a big role in “shaping” the travel behaviour of pedestrians and cyclists (Cervero et al., 2009; Kemperman & Timmermans, 2014; Lewicka, 2005). In addition, some affirm that specific programmes and policies can help to motivate changes in transport usage, especially if these are targeted at specific groups and if users perceive that the provided infrastructure meets the required level-of-service (Dell’Olio et al., 2014; Tolley, 1990; Zuniga, 2012). Research has also highlighted that engineering approaches, such as infrastructure provision, needs to be coupled with advertising and promotion to maximise their benefit. With these “soft” approaches, the goal of an active commuting culture and a lively society can be reached much faster (Ibeas et al., 2011; Methorst et al., 2010; Pucher & Buehler, 2008). Thus, a deeper understanding of current and potential users’ attitudes and perceptions towards active mobility can help researchers and authorities to develop suitable transport schemes and attractive infrastructures for active mobility (Bordagaray et al., 2015; Hume et al., 2009; Ibeas et al., 2011; Nair, 2016). However, measurements of attitudes and perceptions have been shown to be a challenging task (Alton et al., 2007; Beirão & Cabral, 2007). For example, features such as perception of safety and satisfaction are difficult to quantify and these vary a lot from user to user (Cervero et al., 2009; Mfinanga, 2014).

This paper presents an alternative to measure pedestrians’ and cyclists’ (adults and elders) perception of built environment and policies that are focussed on active mobility. It addresses factors that encourage/limit active mobility; perception of the walking and cycling infrastructure; and schemes to improve the overall active mobility experience. Information is collected corresponding to a qualitative study involving focus group sessions and one-to-one in-depth interviews, conducted among adults and elders in Singapore. Findings are of immediate application to several projects being developed to foster car-lite travel in Singapore. Following this introduction on the ground situation, some key issues and gaps found in the literature are highlighted. Then, the methodology for developing the qualitative study is described. Afterwards, results are presented followed by discussion of the findings. Finally, conclusions, including transport policy recommendations, are presented in the last section.

2. The Local (Singapore) Context

With Singapore's small and densely-populated land area, efforts to reduce private vehicle usage while at the same time meeting the transport requirements of the population is a challenging task (URA, 2011). Singapore adopted Certificate of Entitlement (COE – around 50,000 SGD (approx. 35,900 USD) per vehicle per 10 years (LTA, 2017a)) and the Electronic Road Pricing (ERP) systems to reduce private vehicle ownership and usage. The COE is related to vehicle registration for a period of 10 years, with the COE price being based on a bidding system that is controlled by the authorities to limit the overall number of vehicles able to be registered in any one period. ERP on the other hand is charged when vehicles enter a designated area. ERP cost varies by location and time of the day to help to distribute traffic and relieve road congestion (Meng et al., 2014). A principal effect of these two schemes is that many Singapore inhabitants are not able to access a private car. Whereas, pedestrians and cyclists are also drivers in many countries, this is not the case of Singapore where there are around 8 people per car (LTA, 2015b).

Singapore operates a world class public transport to meet its transport requirements. The MRT currently has 178 km rail and 142 stations island wide (LTA, 2016), in addition to a (mostly feeder) bus network serving the shorter-range travel between transport nodes and the residences. The public transport system is run on a distance-based fare from 0.79 SGD (0.57 USD approx.) to 2.67 SGD (1.93 USD approx.), i.e. transport fare is determined on the total distance travelled regardless the number of transferred stations or modes (MOT, 2012). For this reason, sometimes a short bus ride after a long MRT ride can even be free. The efficiency and accessibility of the public transport system explain its high mode share (Meng et al. 2014; CLC and ULI 2014).

Moreover, pedestrian infrastructure development has received strong attention since the early days of Singapore nation-building (LTA, 2011). Pathways are provided along most roadways. Pedestrian crossings and overhead bridges are also common infrastructures. In addition, shelters are provided within a radius of 400metres from MRT stations and at areas with high levels of pedestrian traffic, such as schools and health facilities. As for cycling, the construction of the Park Connector Network (PCN) in 1992, as means of providing recreational off-road cycling facilities, helped to “revive” cycling (when cycling mode share was close to zero) (CLC & ULI, 2015; Koh & Wong, 2012). Today, cycling takes up between 1% to 2% as a principal mode of transport (Cheong 2016). However, authorities' efforts to further increase cycling mode share are tireless. To date, bicycle parking facilities, 300 km PNC and similar length off-road intra-town cycling paths, and cycling transport infrastructure modifications for 11 towns (called cycling towns) to ensure harmonious co-existence of pedestrians and cyclists are being introduced. In addition, cyclists are allowed to carry foldable bicycles onto the MRT during off-peak periods (Ibrahim, 2003; Wee, 2009).

In Singapore, most traffic signals are oriented to pedestrians and/or motorised users. Cycling traffic signals are most commonly found at demarcated cycling paths and cycling towns. Cycling signals and signs encourage cyclists to keep to the correct paths and to care for other users, with messages such as: “watch out for pedestrians”, “dismount and push”, etc. To provide for vulnerable road users, special zones i.e. School Zones (SchZ) and Silver Zones (SilZ), have been introduced in areas of high number of children and elders (LTA, 2013, 2014b). These special zones entail the application of several signs and road features and markings to: (1) induce motorists to adopt more prudent driving behaviour; and (2) encourage active mode users, especially children and elders, to handle themselves with care around these zones and on the roads in general.

Regardless the transport provisions, congestions and crowding at MRT trains and buses frequently occur, particularly during peak periods (7:00 – 9:00 and 17:30 – 19:30 hours). To ameliorate this situation, the Land Transport Authority (LTA) has introduced the “Travel Smart” Scheme in 2014. This scheme encourages companies to create flexi-travel environments (LTA, 2014a). Employees of companies that have pledged to this scheme and companies themselves can obtain rewards based on a point-based system, with more points assigned to trips made during off-peak periods and fewer points to trips during peak period. Preliminary results have shown that around 12% of the employees modified their travel behaviour to travel

during off-peak periods (LTA, 2014a). To date, not many companies participate in the Travel Smart scheme, and in general the programme is more focused on trips by public transport. Points are assigned per km travelled (by public transport, walking or cycling), which makes the scheme much more attractive to public transport users than to pedestrians or cyclists who only travel a few km each trip.

The main campaign to promote walking and cycling in Singapore is the “walk cycle ride”. This programme encourages walking and cycling as FLM travel modes and it primarily promotes the usage of public transport (LTA, 2017b). Interestingly, while several recommendations for safety and respectful behaviour on roads have been applied for pedestrians, and especially cyclists, not many schemes or campaigns are implemented to promote walking or cycling in Singapore. Herein, authorities and stakeholders could measure feasibility of implementing pro-active mobility campaigns based on users’ perceptions of the current environment and attitudes towards active mobility in general.

3. Methodology

Qualitative data collection techniques are commonly used in research dealing with personal opinions and social experiences (Beirão & Sarsfield Cabral, 2007; Bordagaray et al., 2015; Ortúzar, Iacobelli, & Valeze, 2000; Yeung, Wong, & Xu, 2013). Qualitative data are efficient in evaluating personal attitudes, perceptions, and needs (Bordagaray et al., 2015; Ibeas et al., 2011). These methods are also good at providing sufficient data given a relatively small number of participants, so that data that can be aggregated and compared (Beirão & Sarsfield Cabral, 2007).

In the transport area, qualitative techniques gained popularity not long ago. Previously, pre-selected variables were used to study transport issues, most commonly in the study of mode choice. While pre-selected variables have helped to determine tendencies towards one option over another, they only consider limited attributes. In comparison, qualitative techniques allow users to discuss in detail factors that affect their travel decision (Bordagaray et al., 2015; Corbin & Strauss, 2008; Ghekiere et al., 2014; Winters, Sims-Gould, Franke, & McKay, 2015). Thus, qualitative studies can help to determine strengths and weaknesses of the active mobility network.

Findings presented in this paper are part of a wider study focussed in current perception of walking and cycling. These findings are to be utilised in future quantitative study of several projects being developed in Singapore to increase active mobility (walking and cycling). Knowledge of pedestrians’ and cyclists’ behaviour, strengths and weaknesses of the network, and other associated factors are to be used to, for example, design suitable questionnaires related to active mobility in the Singapore’s context.

3.1. Participants

Three focus group sessions, 20 participants in total, and 26 in-depth interviews, were conducted on adult and elderly subjects. The focus group technique was used to gather information regarding adults’ active mobility perceptions and the interviews were to gather information from the elders. The use of these two techniques provided a clear picture of walking and cycling preferences among adults and elderly. Sampling and simultaneous analysis of responses took place until data started to be repetitive and no new information is added from new samples, at which point theoretical saturation was reached (Morse, 2004), as achieved in this study for the stated sample size.

Adults between 18 to 50 years-old were targeted to participate in focus group sessions. Groups of 6 or 7 participants were formed. This group size was selected to ensure that all participants had a good chance to speak/discuss, and to gather relevant points in not so long time periods (Rabiee, 2004). It should be noted that 8 participants (4 males and 4 females) were invited per session. This was done to mitigate the often-met

situation of a participant not turning up without prior notice, and this strategy ensured that the minimum number of 6 participants was always reached.

Focus group is an excellent technique to gather in-depth information from participants (Ibeas et al., 2011). However, given the diverse multi-racial population of elders in Singapore, it is very common that many of them only speak their mother tongue and not English. Such language barrier restricts their possibility of engaging in in-depth discussion. These constraints, in addition to the much lesser mobility of this road user group, make elders' participation in focus group sessions impractical. Thus, for road users above 50 years-old, one-to-one interviews were employed in surveying older participants.

For the focus group sessions, participants were recruited at the university, near MRT stations, and at recreation facilities in Singapore. Commuters were provided with information sheets about the session and asked to provide their contact information if they were willing to participate. For the one-to-one interviews, elders "hanging-out" near housing areas were randomly approached for their participation. Different users were asked to refer friends/family members who would be interested in participating of the study.

3.2. Qualitative data collection and analysis techniques

Focus group sessions consist of gathering a group of people to discuss their opinions and perceptions towards a specific topic, in this case "walking and cycling in Singapore". The sessions, which were conducted at Nanyang Technological University, Singapore, lasted around 50 minutes and consisted of two stages. First, participants were asked to complete a questionnaire regarding walking and cycling in general as well as their socio-demographic information. Then, participants were asked 9 open-ended questions (the lot of questions was shown using a projector so participants could refer to them during the discussion); around 3 to 4 minutes were given to discuss each question. Participants were prompted to express their opinions and clearly explain their answers.

One-to-one interviews consist of interviews using a semi-standardised questionnaire (structured questionnaire that allows for unanticipated issues to emerge (Ryan, Coughlan, & Cronin, 2009)) and encouraging participants to provide in-depth responses and to discuss their opinions. Same questions used in the focus group sessions were used for one-to-one interviews. General perceptions and demographic information of participants were also collected. Each interview lasted around 35 minutes and was conducted at Housing Development Board (HDB) void decks. Void decks refer to ground level of public housing that is aimed at encouraging social interaction, which is quite unique to Singapore (Koh & Wong, 2015). These locations are frequented by elders. Questions were read and shown to participants and they were encouraged to provide detailed answers.

Focus group sessions were video-recorded while one-to-one interviews were voice-recorded for later analysis and to ensure that no data were lost. Afterwards, these were transcribed and anonymised by assigning each participant a specific ID linked to corresponding participant responses. Recordings were deleted for privacy protection of participants. The transcriptions were audited using the Grounded Theory (GT) approach. The GT approach is commonly used in social science to "discover" new theories related to human behaviour (Corbin & Strauss, 2008; Ng & Hase, 2008), and is suitable to analyse active mobility behaviour of elders and adults (Beirão & Sarsfield Cabral, 2007; Ghekiere et al., 2014). Participants' responses were classified by frequency and specific categories were developed. Categories were created individually for adults and elders. Finally, categories from both users were combined. The categories were compared against findings reported in the literature to ensure that key issues were duly covered and to enhance understanding of active mobility behaviour in the local context.

Furthermore, a SWOT analysis, a common strategic planning tool that is used in human centric studies (Bordagaray et al., 2015; Ibeas et al., 2011), was performed to clearly determine factors that affect

pedestrians' and cyclists' travel behaviour. Perceived advantages of walking and cycling (Strengths), perceived disadvantages (Weaknesses), schemes for promotion of the mode or to encourage users to choose walking or cycling from users' perspectives (Opportunities), and perceived risks or unsafe issues (Threats) were carefully considered.

4. Results

4.1. Respondents' characteristics and active-mode trips

As mentioned, 20 adults and 26 elders participated in focus group sessions and one-to-one interviews (total of 46 participants). The gender split for focus group sessions was evenly-matched and slightly more males (65%) participated in one-to-one interviews. The youngest participant was 20 years old and the oldest at 70 (mean=49 years old; Std. Dev.=14.7). The average household size of participants was 3.5 members (average population household size=3.4 (Lee, 2016)). In 39% of participants' households, there was at least one car available (22% of the participants were regular drivers or car passengers) and in 80% of the households there was at least one bicycle (adult bicycle, children bicycle, or electric bicycle). Two in five (41%) were full time employed or students, 22% part-time employed, and 37% housewives or retired workers. Respondents' characteristics are shown in Table 1.

Table 1. Respondents' characteristics

	Total		Adults		Elders	
Age distribution						
<i>20-30 years</i>			7	35%	-	-
<i>31-40 years</i>	20	43%	6	30%	-	-
<i>41-50 years</i>			7	35%	-	
<i>51-60 years</i>	26	57%	-	-	12	46%
<i>61-70 years</i>			-	-	14	54%
<i>Male</i>	27	59%	10	50%	17	65%
<i>With children</i>	31	67%	11	55%	20	77%
Car ownership <i>(1 or more cars in the household)</i>	18	39%	11	55%	7	27%
Bicycle ownership <i>(1 or more bicycles in the household)</i>	37	80%	17	85%	20	77%
<i>Adult bicycle</i>	33	72%	15	75%	18	69%
<i>Child bicycle</i>	14	30%	7	35%	7	27%
<i>Electric bicycle</i>	10	22%	3	15%	7	27%
Occupation						
<i>Full-time employed</i>	13	28%	8	40%	5	19%
<i>Full-time student</i>	6	13%	6	30%	0	-
<i>Part-time employed</i>	10	22%	2	10%	8	31%
<i>Housewife/retired</i>	17	37%	4	20%	13	50%

Most common reasons for walking and cycling were reported by respondents. Among adults, walking was reported to be most commonly used to connect with motorised modes of transport, as in FLM travel in multi-modal trips, and for work/school-related purposes. Cycling was mostly used for recreation or exercise. Among elders, walking was also used mostly for FLM travel, and the second most common reason was for shopping or to run errands. Elders cycled mostly for FLM travel, social purposes, and for shopping (see Figure

1). All the participants reported to be pedestrians in Singapore and almost all (74%) reported to have cycled in Singapore. Cyclists and non-cyclists were asked to report their perceptions about this mode of transport. Responses from non-cyclists are of special interest to determine possible factors to motivate them to undertake cycling in the future.

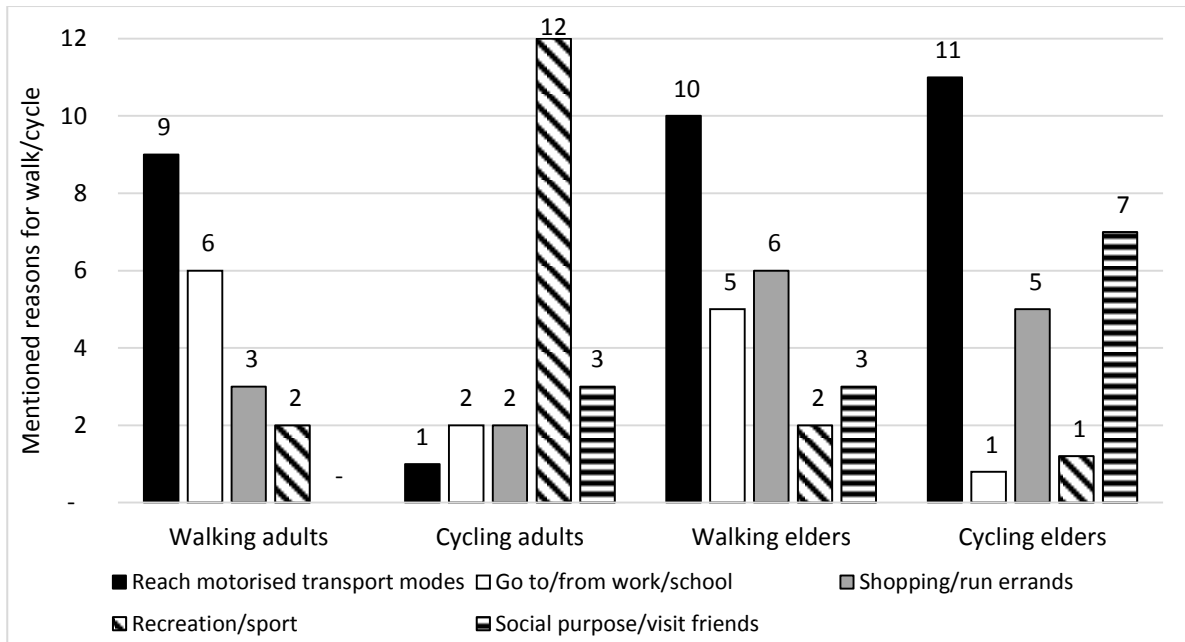


Figure 1.

Reasons for walking and cycling among adults and elders

4.2. Perception of active mobility and travel behaviour

Adults and elders were asked to report their agreement with safety and convenience of walking and cycling. A scale from 0 (strongly agree) to 4 (strongly disagree) was used. Safety and convenience were selected as previous studies in Singapore highlighted that these factors help to increase usage of active travel modes (Nguyen, Koh, & Wong, 2015). Most participants agreed that walking is safe and convenient for all users. In addition, cycling is considered safe and convenient for adults, but the same is not 100% true to elders and especially children. Special zones, i.e. SchZ and SilZ, were perceived to encourage active mobility (see Figure 2). It was agreed that in Singapore the transport environment is conducive for walking. Elders, who mostly do short trips around their neighbourhood, reported that the network is quite walkable. For cycling, many participants expressed that cycling infrastructure level-of-service can be improved. Yet, cycling safety levels were perceived as good.

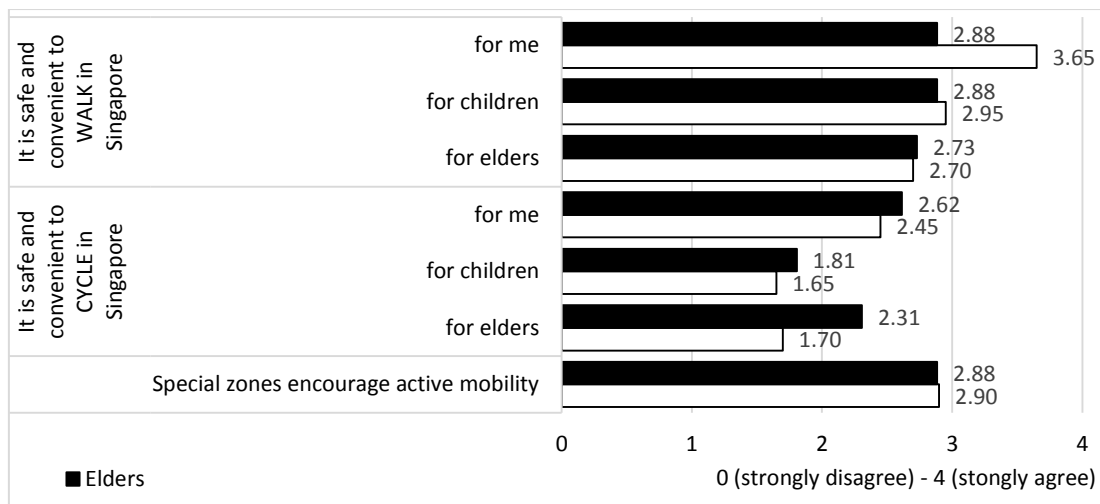


Figure 2. General perception of active mobility in Singapore

Most participants reported to choose to travel by walking or cycling based on travel time (or trip distance) and availability of other modes of transport. Active modes were most commonly used for short travel of maximum 30-minute duration. Around 40% of the participants reported willingness-to-shift from motorised modes of transport to active modes for FLM travel if improvements to the transport network were made (particularly provision of sheltered pathways and bicycle-paths) and several participants discussed the likelihood of undertaking “new” walking or cycling trips. Several of the participants with children reported that they might be willing to allow active trips to school (for their children) if better infrastructure was available.

4.3. Attitudes towards walking

Adults and elders reported several strengths, weaknesses, threats, and opportunities about walking in Singapore. These are summarised in a SWOT matrix as presented Table 2.

Table 2. Walking SWOT matrix

Strengths	Weaknesses
Convenience	Limited to short distance
Independence (<i>can be done alone</i>)	Hot and rainy weather
Reliability	Slow travelling speed
Health and environmental benefits	Sweat and tiredness
Good and safe infrastructure	Crowds and congestions
Cost (<i>free</i>)	
Opportunities	Threats
Way-finding features and signals	High speed of personal mobility devices (PMDs – e.g. kick scooter, hoverboard, etc.)
More shelters and shades	Motorised vehicles high speed
Places to rest	High amount of motorised vehicles
Highlight benefits and convenience	Sharing pathways with other users
Education to all road users	
Incentives to those who walk	

4.3.1. Walking convenience

In Singapore, pathways (mostly with shelters in high-activity locations) provide access to most locations within a neighbourhood on-foot. Thus, walking was viewed as a convenient mode of transport by most participants. It was also considered a mode that can be used independently, without requiring too much

effort or much help from others. Independence of the mode was particularly praised by elders. By not having to depend on transport schedules or on other people, walking was also seen as a reliable mode of transport.

“I would rather walk 15 minutes, knowing for sure that I will arrive in 15 minutes, than wait for the bus 2 minutes and riding from 10 to 20 minutes based on congestion” (male, 22 years-old).

However, it was mentioned that, currently, the convenience of walking is almost matched by the convenience of the bus system, even for very short trips. With bus stops available every 100-200 metres and under the distance-based fare, it was reported that riding the bus for a few minutes rather than walking for a few blocks to reach the destination is a very common travelling characteristic in Singapore.

4.3.2. Benefits of walking

Most participants were aware of the health benefits of travelling on-foot. Some reported walking to work or walking their children to school as a form of exercise. Several elders mentioned that walking was recommended by their doctors. Interestingly, some of the participants, who mostly commute by motorised modes (public or private), took walks as a form of exercise (and not to go to an activity destination). This group mentioned that they would like to combine commuting and exercise. However, active travel may not be feasible when time constraints are present and/or end-of-trip-facilities, such as showers and bike parking, are not available at the destination. Wishes to increase physical activity by walking was most commonly mentioned by female participants.

“I would like to walk, but I need to drop the kids at school and need to arrive to work 20 minutes later, walking will take me longer than that. I cannot be late!” (female, 50 years-old)

“Why not cycle to work? It might even take less time. But then, where do I shower and what do I do with my sweaty clothes?” (male, 34 years-old)

Several mentions were made about the environment-friendliness of walking, and many said that travelling on-foot is a good way to socialise with the neighbours. Parents reported that they allow their children to walk so that they get to know the people who live around the area. It was also reported, mostly by female and elder participants, that having awareness of the neighbourhood and people who live in it helps to increase personal safety sensation.

Being a “free mode of transport” was acknowledged as a big positive feature about walking. However, this was not reported to be a key factor for choosing this mode over others. Participants highlighted the very low cost of the public transport that somehow encourage people to take feeder buses for their first/last mile trips.

“Walking is free, but taking the bus only cost a few cents! Is not that much what one can save by walking” (male, 70 years-old)

4.3.3. Limitations for walking

Distance limitation, slow travelling speed, and hot-rainy weather in Singapore were the most discussed limitations for walking. Also, the need to carry items (especially students) was also discussed. Users, mainly younger users, reported that they need to travel long distance to commute to work or school. Thus, walking trips were in many cases not even considered. Some reported that they need to carry several things to commute to work (e.g. notebooks, lunch, documents, etc.), a task that becomes challenging after walking more than a few blocks. Parents also reported that their children need to carry many things to school, thus walking is not appealing to them.

Weather in Singapore was reported to be an important influential factor of active mobility. Adults stated that in case of rain they are not likely to commute by walking. Elders stated that very high temperature or

rain most of the times cause them to avoid the active-trip or to shift trip timing. Comparing hot and rainy weather, more negative comments about hot weather were made. Only one participant mentioned that:

“That [hot weather] is actually just an excuse, people in other countries walk and cycle in the snow! Now, to shower afterwards will be necessary” (male, 40 years-old)

4.3.4. Safety concerns

Safety concerns were reported to increase with the number of users on pathways and/or vehicles, i.e. under crowding and/or congestion. As pathways are not used only by pedestrians, but rather shared among pedestrians, cyclists, and personal mobility device (PMD – e.g. kick scooters, hoverboards, and other assistive devices that facilitate individual transport) users, the pathway wide was perceived as being too narrow. Most of the participants affirmed that if wider pathways were available, sharing shall not post any danger, thus safety concerns will be reduced. The principal concern was the speed differential when pedestrians cross path with cyclists/PMD users.

“They [PMD users] just go ‘ffuupp’ and don’t even look around for other users” (female, 28 years-old)

Public transport stations (e.g. bus stops), waiting areas of road crossings, and other locations where many users congregate were of special concern. Respondents stated that high number of users, moving in a relatively free-pattern, cause confusion, and there is increased concern of pedestrians about being involved in conflicts or even accidents with other users, including other pedestrians. It is noted that most crowdedness occurs during peak periods, when users are “just in a hurry” to reach their destinations, and tend not to be respectful of other road users.

About the on-road vehicles, adult and elder pedestrians explained that they do not feel very safe walking when there is heavy traffic on the roads adjacent to the pathways, which is very common during peak periods. They expressed their perception of vulnerable users like pedestrians to be more likely involved in a traffic accident when there are many vehicles, especially bigger vehicles such as goods vehicles and buses.

4.3.5. Alternatives to promote walking

To further increase the number of walking trips, participants mentioned several infrastructural provisions and soft approaches. Shelter provision was expressed to be very important to promote walking trips. The rain-cover and shade provided by these infrastructures were considered as an incentive to undertake more and longer walking trips. This is in line with local authorities’ efforts to provide a comprehensive shelter network. In addition to the shelters, several mentioned that these can be complemented with greenery not only to reduce the weather temperature but also to have better scenic views.

Signage was associated with convenience of walking. Most of the adult participants were comfortable with currently available signs. Yet, many suggested that these could be relocated as some of the signs are blocked by tree branches or are located at “estranged locations”. On the other hand, elders suggested road control signals to be made bigger so that they can be easily spotted. Adults and elders agreed that legend with limited or no wording was best for signals given the multi-racial population. Majority agreed that signals would not be necessary if users respect each other. Thus, participants affirmed that educational campaigns and publicity should be available for all users.

“Just like they [people in the street] give flyers about shops or even public transport service, they should also give flyers for good behaviour on footpaths and towards pedestrians” (male, 54 years-old)

Most elders and some adults said that having places to rest and water dispensers on the streets should be an approach to increase walking trips. These ancillaries maybe not be necessary for commuting to work or to school (due to time schedule), but certainly useful for social or shopping trips. This led to the discussion about incentives for those who walk to work. Some of the incentives included “If you walk to work you can

arrive half/an hour later”; “if you walk to work you can enter and exit later”; and “If you do it [walk or cycle to work] you can get an extra day-off”. Interestingly, none of the parents ever considered the idea of “flexible school time”.

Another well-discussed soft approach was to promote benefits and convenience of walking, as well as to highlight that walking can compete with bus services for short distance trips, which was seen as especially true during peak periods. Participants said that promotion of the benefits derived from walking should be made as part of a holistic approach of transport, health, and social development authorities.

4.4. Attitudes towards cycling

As in walking, positive and negative aspects about cycling were examined. These were classified accordingly and a cycling SWOT matrix was constructed considering specific features of cycling trips (see Table 3). Most participants discussed about off-road cycling activities and highlighted issues when sharing paths with pedestrians.

Table 3. Cycling SWOT matrix

Strengths	Weaknesses
Health and environment benefits	Lack of infrastructure and parking
Enjoyable activity	No access to bicycles
Avoid congestion	Hot and rainy weather
Fast travelling speed	Unclear cycling rules
Long travelling distances	Sharing spaces (with cars/pedestrians)
Cost (<i>accessible as compared to cars</i>)	Bicycle weight
Opportunities	Threats
Bicycle-paths (on or off roads)	Not designated cycling space
Bicycle-sharing systems	High speed of PMDs
End-of-the-trip facilities	Motorised vehicles high speed
Signals for cyclists	Absence of safety gears among cyclists
Education and training	Crossings
Cycling activities/events	
Allow bicycles on MRT	
Incentives for cyclists	

4.4.1. Cycling activity or trip?

First, it is worth mentioning that participants in general discussed about cycling with much more enthusiasm than when they discussed about walking. Especially male participants. During the interviews, cycling was regarded by adults as a “very enjoyable and fun activity”. This was related to the fact that cycling is not a widely-used mode of transport, but more commonly-used as an activity in itself among this user group.

Although adult participants mentioned that cycling is much faster and can be used for a longer distance than walking, they agreed that the travel distance is nevertheless limited as well. Many adults reported making several long trips, for which motorised modes were selected over cycling. Elders, however, did use cycling for social and utilitarian trips. They reported that some of their trips are “far” to walk, but just nice for cycling.

4.4.2. Benefits of cycling

As for walking, health and environmental benefits of cycling were mentioned. Yet, interestingly more environmental aspects than health benefits were discussed. Cycling was seen as a green mode of transport that could help to reduce CO₂ emission. In addition, it was seen as a way “to connect with nature”. For the

health benefits, both user groups, i.e. adults and elders, mentioned that this is a good way to exercise as well as to relax.

Cycling for medium-length trips was also seen as a way to avoid traffic congestion and save money. Many mentioned that during peak periods, one can either cycle for 10 minutes or take *“the very crowded bus that stops every 2 minutes”* for a 20-minute ride. Many said that after a few rides, instead of taking bus or MRT, the cost for buying a bicycle is ‘recovered’ and cycling thereafter can help to reduce transport expenses. Some adults and most elders also mentioned that bicycles are much more accessible as compared to cars. Thus, this is a very good alternative for personal mobility in case one cannot or does not want to use public transport.

“I might never be able to afford a car here [In Singapore], but a bicycle yes. With it [a bicycle] I can go to buy diapers at any time, even 2 or 3am” (female, 31 years-old)

4.4.3. Limitations for cycling

The main limitation and concern mentioned by current and potential cyclists is the perceived lack of infrastructure and parking. Majority mentioned that absence of cycling paths (on- or off-roads) deter them from cycling. Bicycle parking was also mentioned as a “big deal”. Many mentioned that while there are parking spaces at many MRT stations and HDB void decks, these parking facilities are not in good conditions and most of the time occupied by abandoned bicycles (e.g. rusty bicycles with missing parts).

Another very important limitation discussed was not having access to bicycles. Although it was mentioned that users do not perceive bicycles as an expensive thing, many consider “illogical” to buy a bicycle to ride it only twice a day. Parents also mentioned that they would allow their children to cycle to school or other locations if they could rent a bicycle near the home and return it near the destination, which eliminates parking concerns.

The hot and rainy weather in Singapore (or more commonly the perspiration produced when cycling) was mentioned as a limitation. Not for the temperature per-se, but for not having trip-end facility to refresh/change after reaching the destination. Lastly, the weight of the bicycle was also mentioned. For the majority of elders, bicycles are quite heavy if they need to push them upslope (at crossings or side-slope), and the *“weight can feel even heavier under hot weather”*. Thus, other modes were selected by elders if they were aware of having to negotiate hilly topography on the way.

4.4.4. Safety concerns

The same concerns of the pedestrians are shared by cyclists. While on pathways, cyclists reported to be very worried about hitting some pedestrians or hitting some road furniture when trying to get out of pedestrians’ and/or PMD users’ way. Serious concern was reported when there are children around.

“You [cyclist] never know in what direction they’ll jump, and parents don’t teach them to be aware or respectful either. Very few times parents tell their kids to move out of the way, they prefer to give a bad look to the cyclist” (female 69, years-old)

In addition to concerns on pathways, cyclists also reported concerns when cycling on the roads. Several mentioned that riding on roads alongside big vehicles driving at high speed was very worrying. In many cases, adults and elders reported that users, either pedestrians (on pathways) or drivers (on the roads), do not respect them at any location, which increases the safety concerns. This was reported to occur, especially at crossings *“where everyone thinks they have more rights than cyclists”*.

Absence of safety gears was mentioned as a safety concern as well. Many reported that cyclists can be difficult to spot, thus increasing possible conflicts and accidents. These conflicts and their severity could be reduced if bicycles had lights and riders wore bright-colour clothes and if cyclists wore helmets.

4.3.5. Alternatives to promote cycling

Unsurprisingly, the provision of bicycle paths (on- or off-roads) was considered a major way to promote more cycling trips. Participants affirmed that such facilities are likely to increase safety levels, and making cycling a more attractive mode of transport. Other infrastructural modifications such as improving crossings to a more bicycle-friendly layout and provision of signals specifically designed for cyclists (*“easy to be understood with just a glance”*) and signals/signage being placed at cyclists’ eyesight level in conspicuous locations can further increase safety.

“There are 100+ signals for pedestrians and for motorists, but for cyclists there are very few. Also, many of them are at places where no one really looks” (male, 60 years-old)

Based on responses, provision and/or improvement of bicycle parking are a must so that potential users will go from being merely potential cyclist to become an actual cyclist. Adults and elders also discussed that if there were bicycle for rent, i.e. bicycle-sharing systems (though such specific terminology was rarely used, bicycle sharing was commonly referred as *“bicycles for rent, public bicycles, etc.”*), more people will cycle on a daily basis. Interestingly, some mentioned that bicycles of different sizes should be available so children can also have access to them.

With the many complaints about the weather, provisions of showers or similar facilities at destination or even at work locations were recommended by participants. These facilities, known in the literature as *“end-of-the-trip-facilities”* are seen as encouragement to use cycling as a mode of transport. Moreover, participants, particularly male workers, mentioned that they are likely to shift from bus to bicycle for their FLM travel from home to work if they were allowed to carry of bicycles onto the MRT at all times (instead of presently being restricted to off-peak periods).

Education for all road users to respect cyclists, cycling training to improve cycling skills, law enforcement (mainly for speeding vehicles and cyclists on pathways), incentives to people who commute to work by bicycle, and local activities/events that promote cycling and its related health and environmental benefits were recommended to further increase the cycling rate in Singapore. Many said that local authorities should collaborate so they can all *“get the benefits of cycling”* leading to a better transport, healthier and more educated citizens, and an eco-friendly and social country.

5. Discussion

To offer a satisfactory walking and cycling transport-network-service and attract people to use it, it is important for infrastructure and policies to match current and potential users’ expectations (Susilo & Cats, 2014; Susilo et al., 2015). Potential users (who shift from motorised modes) were identified to be those users that are currently using public transport for short trips.

Results can be discussed following the socio-ecological model. The model argues that social factors, environmental factors and policies have that affects personal perception and behaviour (Winters et al., 2015). It was found that, overall, users are comfortable with the level-of-service of walking facilities but not with the cycling facilities. Also, there were much more positive attitudes and greater willingness-to-shift to cycling as compared to walking. At the current stage of developments, users see cycling as a highly interesting mode of transport, and one that could surpass other modes of transport. This *“novelty factor”* should be taken advantage of and cycling should be promoted as *“an ideal mode of transport”*. Publicity and

campaigns are a key factor to ensure the success of this mode (Assaker, Vinzi, & O'Connor, 2011; Markou & Singh, 2003).

Participants did not discuss much about social factors affecting active trips. It was mentioned that by actively commuting one could get a better knowledge of the society and increase interactions with the neighbours. At areas with elevated walking and cycling trips, not only positive perception of the neighbourhood is increased, but so does the perception of safety and security, which further increases active travelling and fosters an active society. Another social factor mentioned by adults and elders are the conflicts among users. Users, commonly reported conflicts with users of higher travelling speeds, that is pedestrians with cyclists and cyclists with motorists.

Infrastructure level was the most widely discussed at the sessions and interviews. For walking, provision of more covered walkways, with some "green" features (plants), was mentioned as one key attribute to encourage more users to travel on-foot. On the other hand, most participants mentioned infrastructure improvement for cycling being: wider paths; crossing enhancement; more and improved cycling facilities; and signal modifications. Interestingly, wish-list (or required) improvements for cycling are much related to safety concerns of pedestrians. Indeed, local authorities are advocating serious efforts to meet infrastructural requirements of pedestrians and cyclists in Singapore. Leaving social aspects of these modes as future points on the agenda. This could be the main explanation why participants provided more elaborated answers concerning the environmental level as compared to the social level.

Regarding policy level, participants understood that transport network improvements alone are not enough to promote active mobility (Cervero et al., 2009; Pucher & Buehler, 2008). Other "complementary" services should be provided. These include bicycle sharing schemes and end-of-the-trip facilities. These services are currently being implemented overseas and its implementation in Singapore are being analysed by authorities (Cheong, 2016a). The cost of providing these services should be carefully reviewed. The overall cycling cost should be able to compete with public transport services. Many participants highlighted that the public transport service is so convenient and accessible in Singapore that it is considered superior to active trips even for short distances. The efficiency of the MRT and feeder bus service in Singapore is a feature that needs to be carefully factored into local transport research. A balance between enhancing public transport improvement and encouraging active mobility needs to be found (Ogilvie, 2004; Zuniga, 2012).

Moreover, among incentives to attract more people to walk and cycle to their destinations, most reported incentives are associated with flexible working hours or other work-related incentives. Such incentives have been shown to be efficient in several countries (He & Giuliano, 2015; Kitamura et al., 2000). Users' perceived attractiveness of such incentives can provide motivation for local authorities to enhance the current "Travel Smart" scheme so that it is equally focused on public transport and active modes of transport usage. School hours need to be considered in such scheme, even though while flexible working hours were mentioned, flexible school hours were not (yet) considered by parents. The current restriction to only allow foldable bicycles onto the MRT needs to be reviewed since several participants mentioned that being able to carry their bicycles onto public transport will encourage them to cycle for their FLM travel.

In addition to all the mentioned alternatives, education for all road users was constantly mentioned as a way to increase the number of walking and cycling trips. Participants mentioned that it is essential for all to learn to share spaces and be respectful to each other. Cyclists in particular mentioned that users need to "accept" them on roads or on pathways so that sharing can be done in a more comfortable and safe way. Education campaigns have shown its efficiency in improving overall transport safety (Davis, 1998; LTA, 2015a; Pucher & Buehler, 2010). Demographic characteristics, such as age and gender, should be taken into consideration when designing education and advertising campaigns as there are factors/features that have more influence in specific users. At the same time, increased traffic safety was mentioned as a factor that encourages the

usage of active mode of transport. Thus, more educated users will lead to higher safety levels, which will increase the attractiveness of walking and cycling in Singapore.

6. Conclusion

This work presented findings from two qualitative techniques, i.e. focus groups and one-to-one interviews. Strengths, weaknesses, opportunities (to promote) and threats (safety concerns) of walking and cycling as modes of transport are highlighted. Adults and elders current travel behaviour, perceptions, and opinions were considered. Using Grounded Theory, findings were used to gain a deeper understanding of pedestrian and cyclist travelling characteristics and factors that limit or encourage active mobility. These findings form a strong basis to develop quantitative studies to measure the efficiency of several transport policies and schemes currently being developed in Singapore.

Results show that attitudes towards walking and cycling are quite different. Walking was described as a safe and somehow convenient “mode of transport” but the distance and travelling limitations reduce its attractiveness. Cycling, on the other hand, was perceived as an enjoyable “activity” and most of the limitations can be addressed with the provision of infrastructures, facilities, or policies, e.g. no access to bicycles can be addressed with the provision of bicycle-sharing systems and perspiration from cycling activity can be addressed with the provision of end-of-the-trip-facilities. Users expressed their willingness-to-shift from motorised modes to active modes of transport given certain infrastructural and/or policies modification. Potential-shift to cycling was more commonly reported than potential-shift to walking.

Moreover, it was understood that pedestrians and cyclists share similar safety concerns, with the most commonly mentioned ones being conflicts and perceived lack of respect from other users at facilities shared between pedestrians and cyclists. Pedestrians reported a perceived high risk of being involved in an accident with a cyclist, while cyclists perceived a high risk of being involved in an accident when trying to avoid pedestrians. Cyclists also reported safety concerns when cycling on the roads. Participants agreed that most of these conflicts can be reduced with wider walking and cycling spaces, clearer signals, and intensive education and courtesy campaigns.

Finally, findings indicate that in the local context, several schemes that are currently being implemented overseas can facilitate to increase the usage of walking and cycling as strong modes of transport. As mentioned by the participants, these schemes should not only come from transportation authorities, but it should rather be collaboration between all authorities and stakeholders. It is also important to understand that different users have different travel behaviour and needs. Thus, strategies to promote walking and cycling should be customised to suit the needs of all, which will help to attract a higher number of potential users.

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