

Title	Understanding the nature of walking and cycling for transport in Japan
Author	Berent, Pola / Yoshida, Nagahiro
Citation	Memoirs of the Faculty of Engineering Osaka City University. Vol.58, pp.25-43.
Issue Date	2017-12
ISSN	0078-6659
Type	Departmental Bulletin Paper
Textversion	Publisher
Publisher	Graduate school of Engineering, Osaka City University
Description	

Placed on: Osaka City University Repository

Placed on: Osaka City University Repository

Understanding the nature of walking and cycling for transport in Japan

Pola BERENT* and Nagahiro YOSHIDA**

(Received September 30, 2017)

Synopsis

The following document is a summary of the existing academic articles available in English. The literature review was conducted for the purpose of gaining an understanding of cycling and walking behaviors in Japan. This was background research in order to acquire theoretical knowledge for the further study, which aimed to establish whether people in Japan (where cyclists regularly mix with pedestrians on sidewalks) show different attitudes and perceptions of comfort while travelling on segregated or unsegregated shared-use paths and to identify whether it is dependable purely on technical aspects of path design (i.e. physical characteristics) or/and whether the travel behavior generated by traffic law has impacts on it.

KEYWORDS: Cycling, Walking, Active Travel, Japan, Traffic Law, Shared-use, Comfort, Level of Service

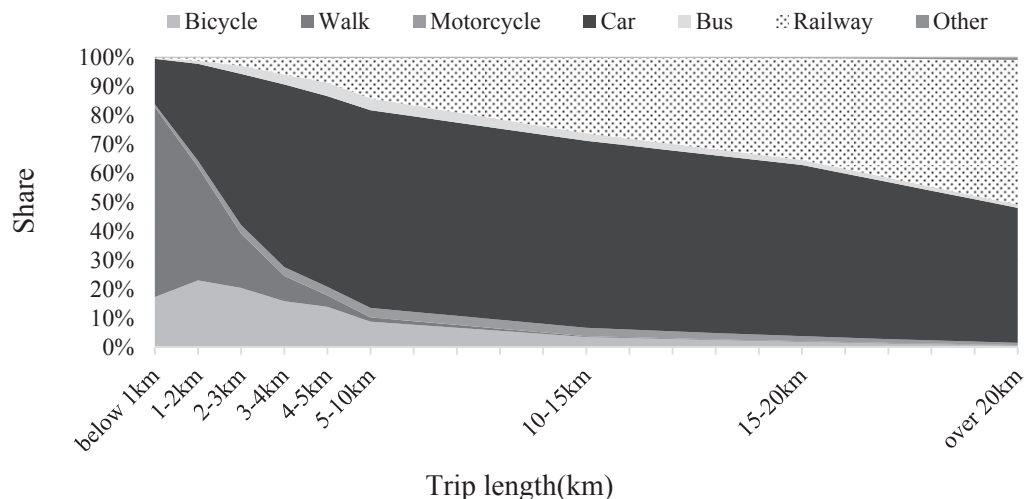
1. Introduction

This literature review provides a deeper understanding of cycling and walking behavior in Japan, with the focus on the following themes: statistical data on cycling and walking for transport, transport policy, traffic law, traffic education, factors that may be affecting levels of walking, promoting cycling, challenges of cycling and shared-space, safety, design guidelines, shared-use paths, level of service and perceptions of comfort.

2. Literature Review

2.1 Cycling and Walking in Japan

Cycling and walking are popular modes of transport in Japan. Figure 1 shows the share of representative transport mode by trip distance according to 2015 Nationwide Person Trip Survey. Walking and cycling constitute as the majority modes for trips up to 3km, and cycling makes up a significant proportion of trips up to 10km.



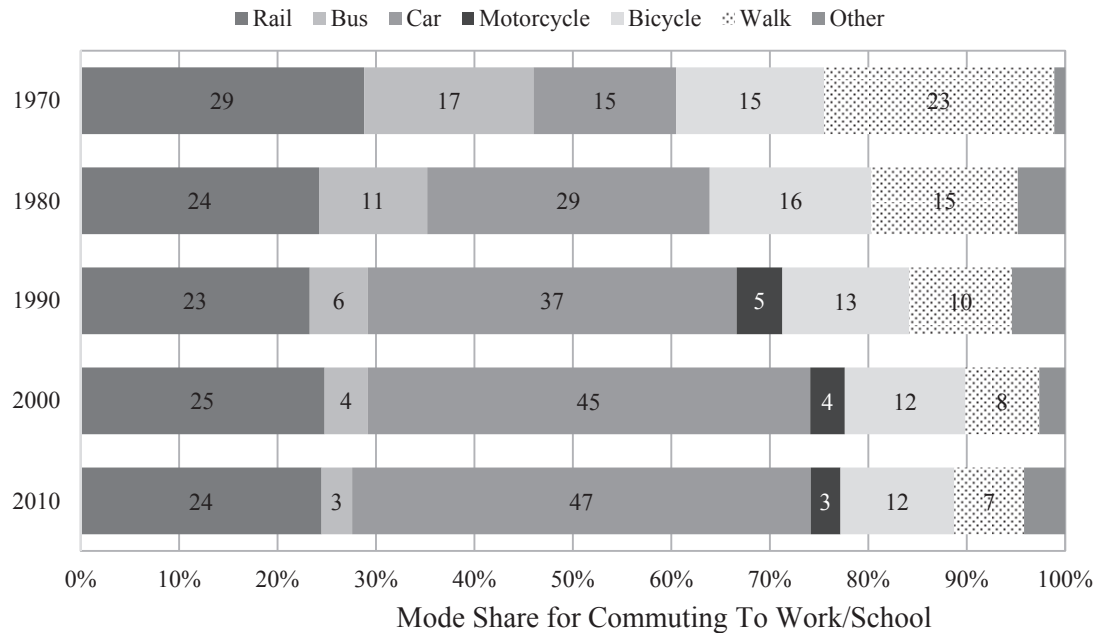
Source: 2015 Nationwide Person Trip Survey

Figure 1. Mode Share by Trip Distance (MLIT)

* Visiting PhD Student (JSPS Fellow), Centre for Urban Sustainability and Resilience, Department of Civil, Environmental and Geomatic Engineering, University College London

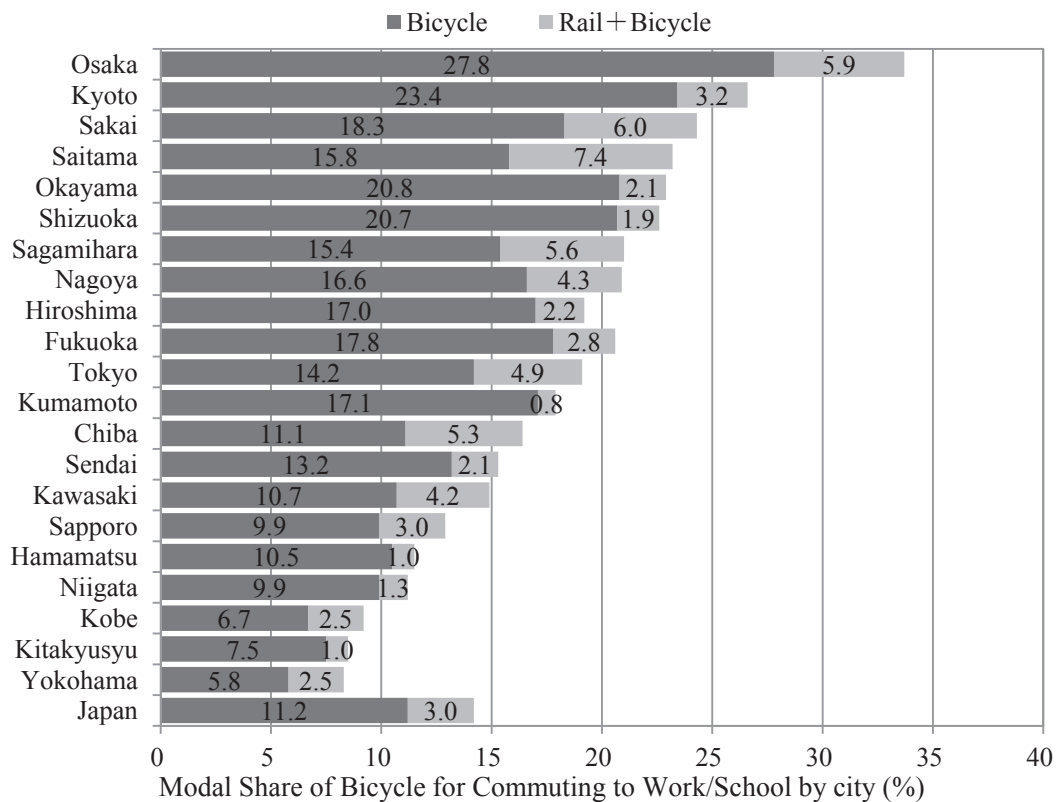
** Associate Professor, Department of Urban Design and Engineering

Figure 2 and 3 show in more detail the breakdown of representative transport modes for commute trips to work and school. Figure 2 shows that in the most recent years (since 1990s) levels of cycling remain stable, while walking is gradually declining. Figure 3 shows more detailed data for Japan's main cities. Osaka city stands out for particularly high levels of cycling.



Source: Census (Ministry of Internal Affairs and Communications Statistics Bureau) *Including motorcycle

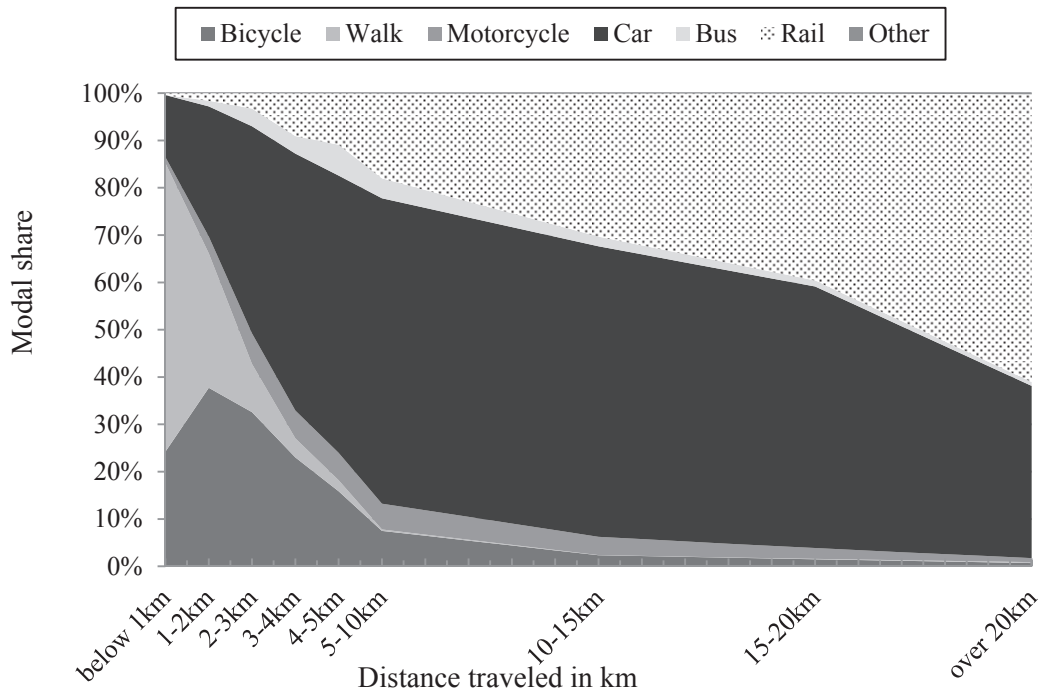
Figure 2. Mode Share for Commuting To Work/School: Trends since 1970s.



Source: Census 2010 (Ministry of Internal Affairs and Communications Statistics Bureau)

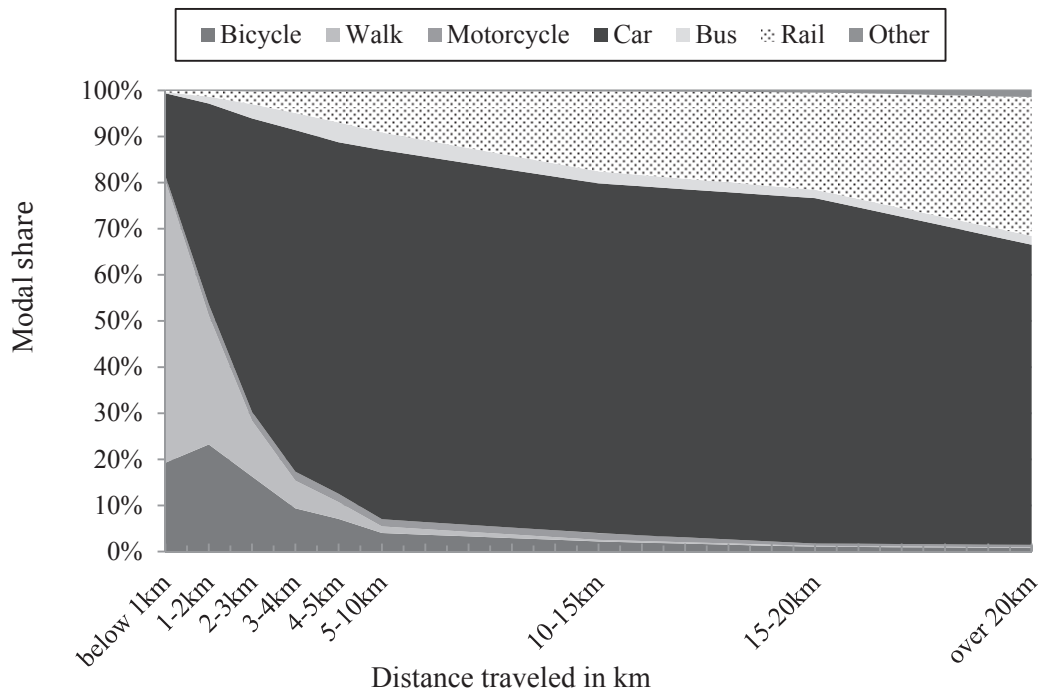
Figure 3. Mode Share of cycling for Commuting to Work/School by City.

Figures 4, 5, 6, 7 and 8 show the mode share by distance for trips for different purpose, including: 'commuting', 'personal errands', 'going to school', 'business' and 'going home'. Interestingly, for each of these purposes cycling and walking make up a large proportion of the trips for short distances. Going to school (Figure 6) shows particular reliance on walking and cycling for the widest variety of distances.



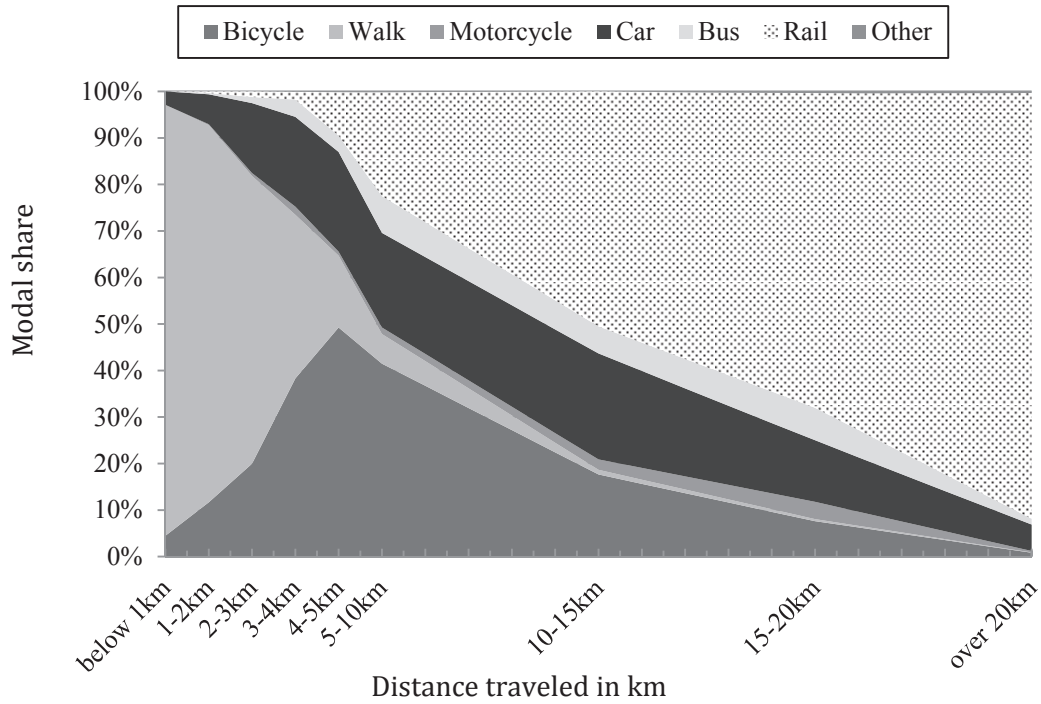
Source: 2015 Nationwide Person Trip Survey

Figure 4. Mode Share by Distance for Commute (MLIT)



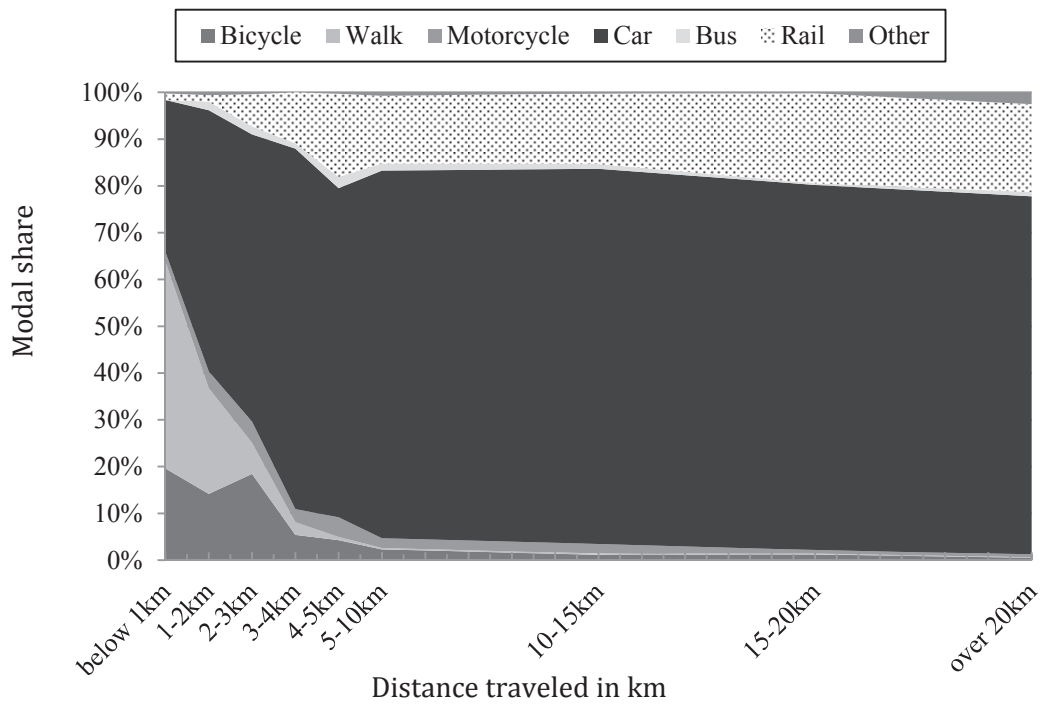
Source: 2015 Nationwide Person Trip Survey

Figure 5. Mode Share by Distance for Personal Errands.



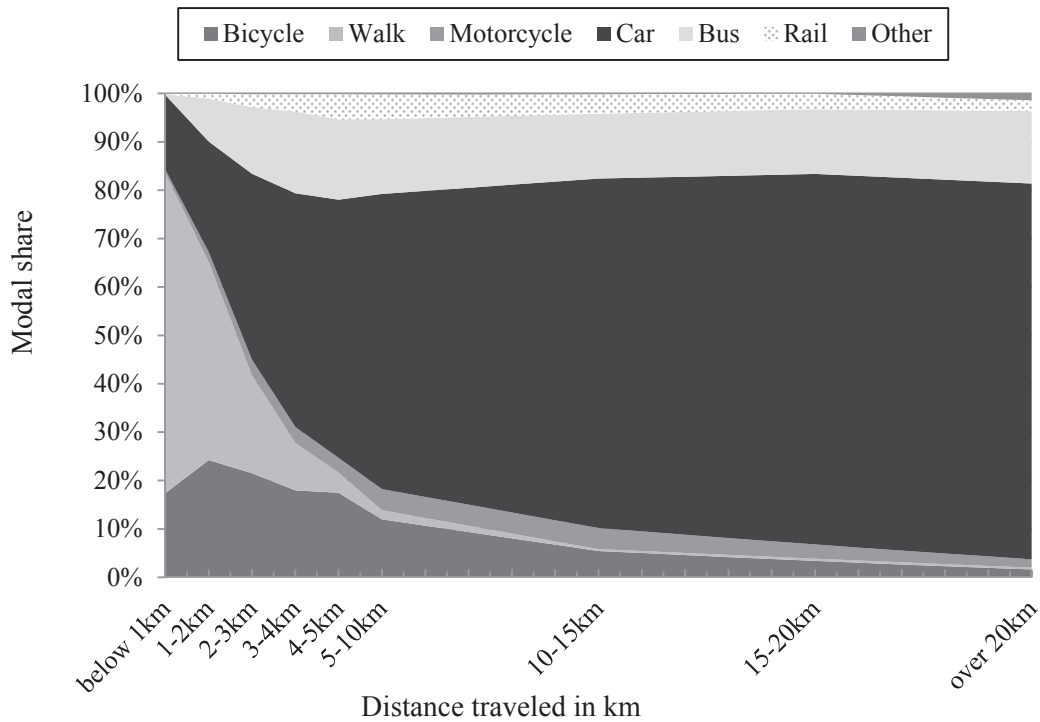
Source: 2015 Nationwide Person Trip Survey

Figure 6. Mode Share by Distance for Going to School.



Source: 2015 Nationwide Person Trip Survey

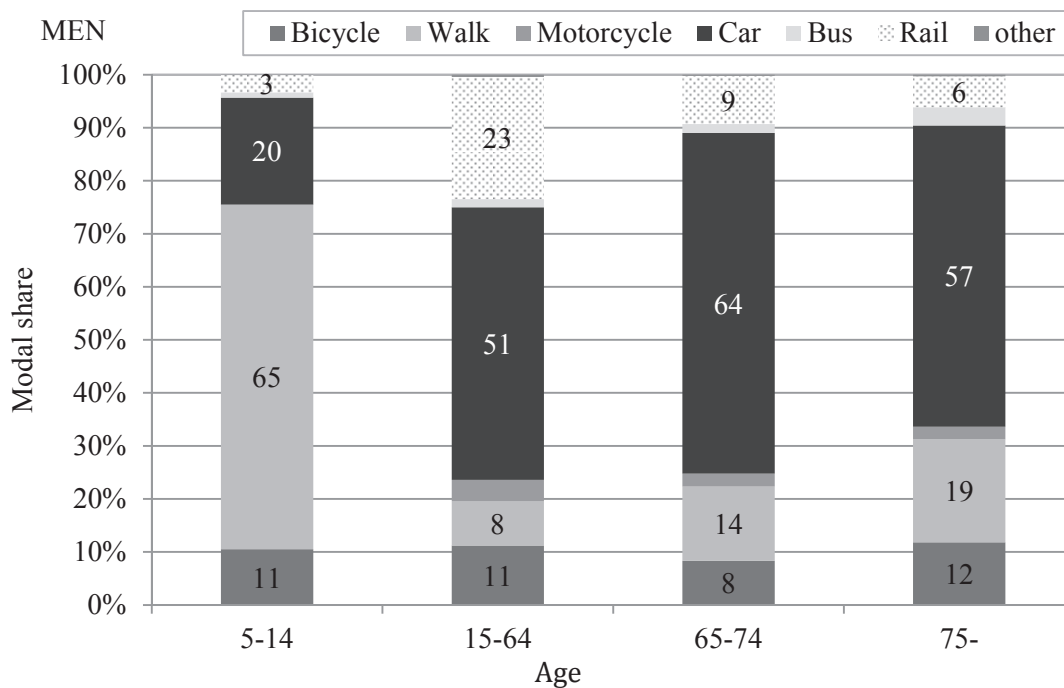
Figure 7. Mode Share by Distance for Business.



Source: 2015 Nationwide Person Trip Survey

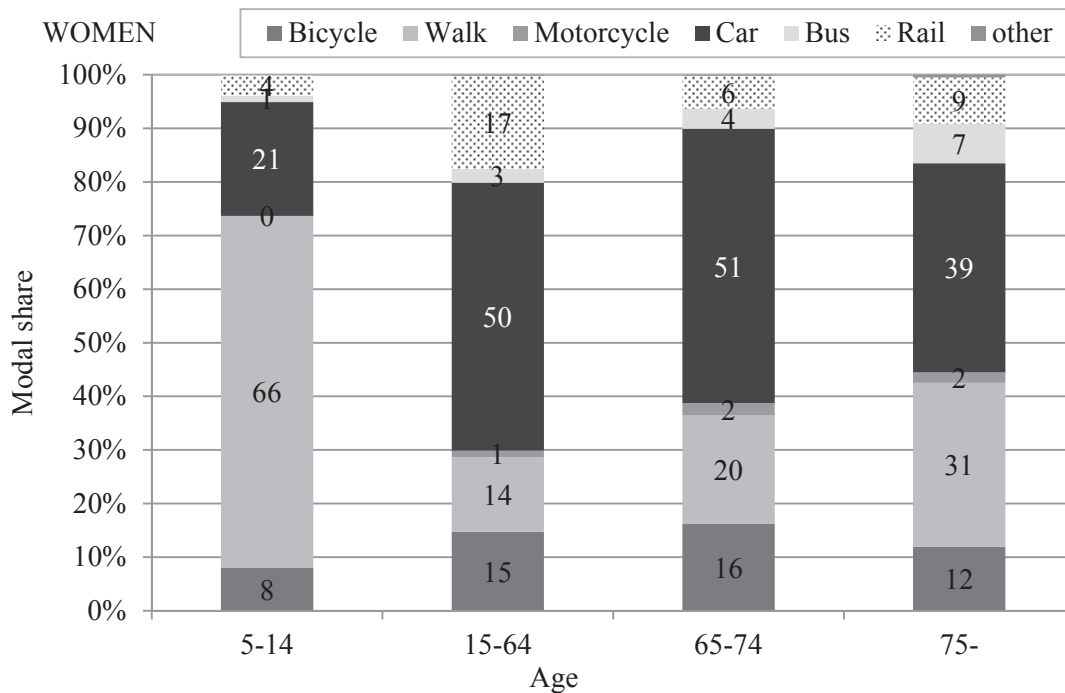
Figure 8. Mode Share by Distance for Going Home.

Furthermore, cycling in Japan is more popular among women than men. The only group where opposite is observed is men aged 5-14 (11% male cyclists to 8% female cyclists). Similar applies to walking, with particularly high proportion for women in all age groups.



Source: 2015 Nationwide Person Trip Survey

Figure 9. Modal share among men by age group.



Source: 2015 Nationwide Person Trip Survey

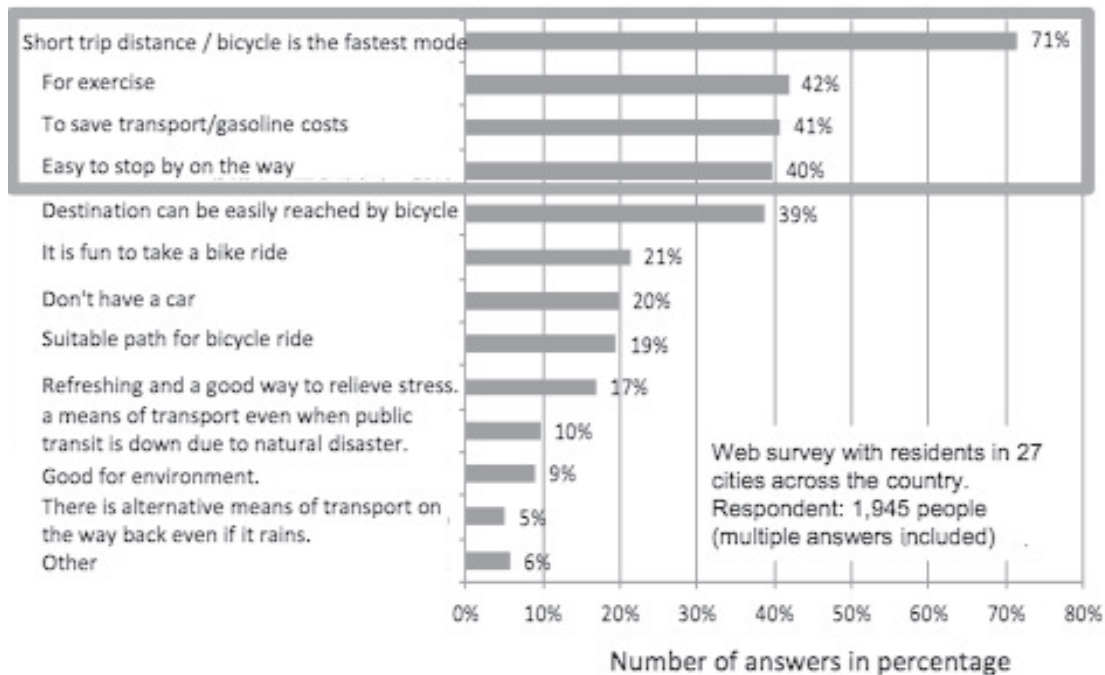
Figure 10. Modal share among women by age group.

Interestingly, ‘the Japanese transportation system is the high number of multimodal bicycle-public transit trips, particularly in large urban centers’ (Andrade et al., 2011). A similar pattern is observed for walking: Mitsui et al. (2009) state the relationship between higher levels of pedestrian activities in urban areas and the existence of well-organized public transportation systems. Other factors include the inconvenience of owning a private car in large cities due to parking shortages and high cost of car maintenance (Mitsui et al., 2009).

It is important to emphasize, that the high levels of cycling and walking are achieved simultaneously with provision of ‘highly efficient’ and accessible public transport network (rail and subway in particular) (Andrade et al., 2011). In fact, it can be speculated that active travel modes and public transport in Japan complement each other. However, there is also a direct association with longer distances to public transport stations (Andrade and Kagaya, 2012).

Andrade and Kagaya (2012) identified the socio-demographic characteristics associated with the choice to cycle. It was found out that in Japan people living in single-person households are more likely to choose non-motorized modes of travel. Moreover, people who cycle for other purposes and those who exercise on a regular basis are more likely to commute by bicycle. Simultaneously, there is no link with car ownership and the decision to cycle (Andrade and Kagaya, 2012). However, it is important to emphasize that this applies to Sapporo and differences are prominent between major cities, smaller urban areas and rural areas.

People choose to rely on bicycles for multiple reasons (Figure 11), including the most often quoted: efficiency (shorter travel time), exercise, financial savings and practicality (ability to stop by on the way).



Source: Web survey carried out by National Institute for Land and Infrastructure Management in Jan 2012.

Figure 11. Reasons for using a bicycle (MLIT).

2.2 Transport Policy in Japan

In the past, transport policy in Japan focused primarily on road development (MLIT, 2015). In more recent years, the main challenges policy-makers have been facing include ‘the prevention of global warming, preservation of natural resources and energy, social and economic impacts of a dwindling birth rate, changes in population demographics (aging and shrinking population), development of a safe and comfortable transportation system, streamlining and globalization of physical distribution, expanding inter-regional gap between outlying regions and urban centers and funding issues concerning road maintenance and improvements’ (Japan Research Center for Transport Policy, 2015). Hence, there has been a significant shift towards more environmentally-friendly approach (Kanemoto, 2002).

The Ministry of Land, Infrastructure and Transport (MLIT) is the key government department at the national level in Japan responsible for transport (Enoch and Nakamura, 2008). Some of the key policies include (International Transport Forum Summit, 2012) :

- Compact city development using public transport
- Construction of high-speed railways
- Ensuring transportation to/from remote island
- Expanding ITS (Intelligent Transport System)
- Improvement of cycling environment
- Improving railway stations as transport hubs
- Developing railway-station-based community rental cycle system in urban area
- Expanding smart interchange
- Developing highway bus and rail ride in Tokyo
- Improving bus punctuality
- Publication of low carbon city development guidance
- Road development and improvement of access roads to airports and harbours

In general, transport problems tend to be approached holistically, making transport policies the key driver for change. The primary focus is 'on law enforcement and education options, rather than on auto-based engineered solutions like air bags' (Hayakawa et al., 1999).

Even though cycling is very popular in Japan, there are only a 'few Japanese transportation policies and strategies address cycling' (Andrade and Kagaya, 2012). There is no transport walking policy. The policy which significantly affects the pedestrians is the 'barrier-free policy', which is one of the general principles of universal design policy (MLIT, 2005). It focuses on achieving barrier free conditions in order to make public transportation systems more accessible.

2.3 Traffic Law in Japan

Traffic law in Japan is defined by the Road Traffic Act which was enacted in 1960. It is a document which aims at 'preventing dangers on the road, promoting the safety of other traffic and its smooth flow, and contributing to the prevention of obstacles due to road traffic' (Saito et al.). In the context, where shared use space (between all road users) is such a common occurrence, traffic law becomes the key to creating a safe street environment.

The pedestrians (which also includes wheelchair users) are expected to use sidewalks or pedestrian lanes when available. If they are not, they should use the right hand side of the road. Other rules include: never running out into the road, not skipping/running when walking on the road, crossing at junctions with traffic lights or pedestrian crossings, using pedestrian bridges or underpasses where available, following traffic lights and always check for safety, not cross where it is forbidden and never crossing the road diagonally or without checking. In bad weather and at night, pedestrians are advised to wear bright clothing to increase visibility. However, this is not regulated by law.

There are also additional rules for using railway crossings (which are common). Pedestrians are obliged: to always stop in front of the crossing and ensure it is safe to cross, be aware and careful at all times, not cross when the warning bell sounds or the barrier begins to descend and not play on or nearby the tracks. Moreover, children are required to cross under supervision (Gifu Prefectural Police Headquarters, 2007).

In terms of cycling, Japanese law is more complex. It regards bicycles as light vehicles (Road Traffic Act; Article 17 Clause 1)' (Suzuki and Nakamura, 2017) 'and cyclists have to use roads along with normal motor vehicles according to the Road Traffic Law' (Yamanaka and Namerikawa, 2007). However, while 'cyclists are required to ride on vehicle roads, but may also ride on sidewalks for safety reasons [JFS, 2008]' (Andrade et al., 2011).

A bicycle is allowed to run on a sidewalk as an exceptional rule for safety reasons, in order to protect cyclists from fatal traffic accidents (Andrade et al., 2011), (Suzuki et al., 2012): 'the Road Traffic Act allowed people to bicycle on sidewalks legally in December, 1978'. This law was introduced as a response to an increasing number of bicycle fatalities observed in the 1960s and an increasing trend of people cycling on sidewalks illegally for their own safety. 'At the peak around 1960, there were approximately 1,800 deaths every year for a period of more than 10 years. This was equivalent to a little less than 20% of all fatalities by traffic accidents at that time'. Initially, it was tested as an experimental solution in Yokohama and Kawasaki cities in June, 1970 and proved successful in reducing fatalities (Suzuki and Nakamura, 2017). However, it is essential to emphasize that when this law was first established, the intention was to introduce a network of bikeways, which is yet to happen, due to challenges such as space restrictions. (Suzuki and Nakamura, 2017).

Currently, the Road Traffic Act identifies three cycling facilities: roadways, bikeways, and sidewalks. First, "people must operate a vehicle on a roadway when it is separated from a sidewalk or a side strip (Road Traffic Act; Article 17)". Because a bicycle is a type of vehicle, people must bicycle on the roadway. Second, "when a bikeway is developed, people must ride a bicycle or a tricycle on it (Road Traffic Act; Article 63 Clause 3, there is an exception)". And third, "A person can bicycle on a sidewalk when it is permitted legally (Road Traffic Act; Article 63 Clause)" (Suzuki and Nakamura, 2017). The rules regarding that have been reviewed and updated in 2008: 'permitted legally' now stands for 'within and area with road signs or other signposts indicating permission to do so', 'if the rider is under 13 years old' and

‘in unavoidable circumstances due to roadway of traffic conditions’ (Japan International Training Cooperation)

Yet, in practice, most cyclists take on different ways depending on the traffic quantity (Tokuyasu et al., 2015) making cycling on sidewalks is a common practice. According to research conducted in Tokyo in 2003 ‘there are more people that believe they must bicycle on sidewalks as the general rule (45%) than people that know the rule (27%). Moreover, while pedestrians should be given priority, ‘in reality people often honk to get pedestrians out of the way.’ (Suzuki and Nakamura, 2017). Tokuyasu et al. confirmed the issue with following the law stating that in practice ‘most of cyclists take on different ways depending on the traffic quantity’ (Tokuyasu et al., 2015).

Furthermore, there is also a traffic law, which refers to how a bicycle can cross an intersection. Once again, this was introduced after identifying that ‘the majority of bicycle traffic accidents occur at intersections between turning automobiles and bicycles from sidewalks’ (Hirotaka and Koike, 2014). The cyclists are not obliged to follow pedestrian signs, but are free to cycle along the car traffic. Another innovative policy was designed to reduce bicycle theft: the ‘bicycles must be registered with local authorities, with the licence fee included in the sale price’ (Enoch and Nakamura, 2008).

Considering the challenges (see Section 2.7) Japanese government continues to review the existing law. In the last few years the road traffic law has been tightened up, including strengthening criminal punishments. These include:

Table 1. Traffic Rules and Penalties.

Traffic Rules	Penalty
Riding a bicycle on a right side of the road	Imprisonment for up to three months or a fine of up to 50,000 yen
Riding on a sidewalk when circumstances are not ‘exceptional’	Imprisonment for up to three months or a fine of up to 50,000 yen
Not yielding to pedestrians and/or cycling slowly on a sidewalk	A fine of up to 20,000 yen or pecuniary penalty
Cycling under influence of alcohol	Imprisonment of up to five years or a fine of up to one million yen
Riding double on a bicycle (except with a child under 6 years old)	A fine of up to 20,000 yen or pecuniary penalty
Cycling side by side	A fine of up to 20,000 yen or pecuniary penalty
Cycling without lights (headlights and rear lights or reflectors) during evening hours	A fine of up to 50,000 yen
Not obeying traffic lights	Imprisonment for up to three months or a fine of up to 50,000 yen
Not stopping and checking for safety at an intersection	Imprisonment for up to three months or a fine of up to 50,000 yen

Other safety measures include children under 13 to be instructed by their guardians to wear helmets, cyclists should not use their mobile phones or umbrellas while cycling. (https://www.jitco.or.jp/download/data/leaflet_English.pdf)

Figure 12 identifies all signs for cyclists and pedestrians:

 Signs for Pedestrians and Cyclists 歩行と自転車利用に関する標識の種類と意味	
 <p>Road closed to pedestrians, vehicles and bicycles</p> <p>歩行者、車、自転車の通行禁止。</p>	 <p>Reserved for pedestrians only</p> <p>歩行者だけが通行できます。</p>
 <p>Road closed to vehicles and bicycles</p> <p>車や自転車の通行禁止。</p>	 <p>Reserved for pedestrians and cyclists only</p> <p>自転車と歩行者だけが通行できます。</p>
 <p>No entry for vehicles and bicycles</p> <p>車や自転車はここから入ってはいけません。</p>	 <p>Reserved for cyclists only</p> <p>自転車だけが通行できます。</p>
 <p>Bicycles are prohibited</p> <p>自転車の通行禁止。</p>	 <p>Pedestrian crossing</p> <p>横断歩道です。</p>
 <p> Vehicles and bicycles must slow down to enable a sudden stop</p> <p>車や自転車はすぐに止まれる速さで通行すること。</p>	 <p>Bicycles may cross within the designated lines</p> <p>自転車横断帯です。</p>
 <p> Vehicles and bicycles must come to a full stop. Look both ways before proceeding</p> <p>車や自転車は、一時停止して、右・左の安全を確認すること。</p>	 <p>Caution required for children from local schools, kindergartens, child-care centers, etc.</p> <p>学校、幼稚園、保育所等があります。</p>
 <p>Crossing by pedestrians is prohibited</p> <p>歩行者の横断禁止。</p>	 <p>Traffic lights ahead</p> <p>信号機があります。</p>

Figure 12. Signs for Pedestrians and Cyclists (National Police Agency).

2.4 Traffic Education

In Japan, the primary safety concern is fatalities and injuries suffered by children and young people (aged 24 or less). Therefore, traffic safety education and awareness activities play a crucial role in delivering a safer transport network.

The implementation system is based on the concept of 3Es of traffic safety: ‘Engineering (in the form of traffic management and traffic engineering techniques), Enforcement (of the law) and Education, focusing on people, who constitute one of the causal factors in traffic accidents’ (Nishiuchi, 2014).

Table 2. E of Safety and Measures (Nishiuchi, 2014).

E of Traffic Safety	Measures
Engineering	The installation of traffic safety facilities (these consist of facilities put in place by public safety commissions (the police), including traffic lights, regulatory signs, road markings, and traffic control centers; and facilities put in place by road managers, such as footbridges, sidewalks, warning signs, carriageway markings, guard rails, street lights, delineators, and traffic safety mirrors)
Enforcement	Enforcement of the law (traffic control and enforcement), education (through promoting and maintaining appropriate behaviour and attitudes to traffic)
Education	Traffic safety classes at elementary, junior high, and high schools and traffic safety events (organized by prefectural governments, municipalities, and prefectural police forces). Educating professionals involved in promoting traffic safety education activities; producing teaching materials (manuals compiled by the national government, prefectural government, or municipality)

2.5 Factors Affecting Levels of Walking

Referring to Muraleetharan and Hagiwara (2002) factors that affect the walking behaviours of pedestrians include the distance to their destination, the personal attributes of the pedestrian, the trip purpose, familiarity with the route, the presence of recreational points of interest, and environmental conditions (Muraleetharan and Hagiwara, 2002). Interestingly, in Japan, there is no significant association between perception of crime safety and walking. The reason for that could be potentially small variations in perceptions of safety among the Japanese: Japan is generally regarded as safe (Inoue et al., 2010).

Further study investigating the associations between perceived neighbourhood environment and walking among adults was conducted. ‘Among Japanese adults, living in walkable communities, as defined by high residential density, good land use mix, and good street connectivity, is an important factor in walking for transport’. On the other hand, walking facilities (eg, sidewalks), aesthetics, and traffic safety are important factors in walking for leisure. For women, there is a significant association between walking to work and the environment. The reasons suggested are that potentially ‘women are more likely to work within walking distance’. Similar was observed for walking for other purposes (daily errands), which can be explained by women’s role in managing households (Inoue et al., 2010).

Moreover, in Japan, the levels of walking are significantly affected by the relatively high proportion of elderly adults. This age group tends to have different lifestyle (for example they no longer commute to work, have reduced childcare obligations) and a lower level of fitness compared to younger age groups. The research was conducted which looked into the factors correlated to transportation walking among the elderly. Two environmental attributes were identified: social environment and aesthetics. ‘In addition, bicycle lanes, access to exercise facilities, and household motor vehicles were significantly associated with transportation

walking... Among men, significant correlates of this type of walking were bicycle lanes, crime safety, traffic safety, aesthetics, and household motor vehicles. Among women, access to shops, access to exercise facilities, and social environment were related to this type of walking.’ Interestingly, the neighbourhood environmental characteristics that were proven to be associated with levels of transportation walking previously (residential density, access to public transport) did not show any association for elderly adults. ‘These results indicate that transportation walking among elderly adults might have similar characteristics to recreational walking.’ (Inoue et al., 2011).

2.6 Promoting Cycling in Japan

In the recent years Japan has been experiencing a rapid increase of bicycle users. This primarily due to changing lifestyles: people are becoming more environmentally and/or health conscious. Bicycle is no longer seen just a supporting transportation tool (Suzuki et al., 2012). It has also been affected by the Great East Japan Earthquake in 2011: in terms of urban mobility, that was a turning point. The natural disaster and urgent need to rebuilt ‘has provided the opportunity for a paradigm shift away from the conventional automobile-dependent society toward a new mobility society, a movement to switch from automobiles to public transportation and bicycles’ (Hirotaka and Koike, 2014).

Even though, levels of cycling in Japan are high, there are still ongoing efforts to promote it even further. These include:

- Establishing 98 ‘Bicycle Road Model Districts’ by MLIT and NPA in 2007 to ‘promote the development of bicycle roads, bicycle lanes, and sidewalks shared by cyclists and pedestrians’ (MLIT)
- Introducing cycle hire schemes. They have been increasing in popularity since 1990s, after the successful implementation in the cities of Toyama (Toyama Prefecture), Kitakyushu (Aichi Prefecture), Saitama (Saitama Prefecture) and Fujisawa (Kanagawa Prefecture). (Andrade et al., 2011). By October 2016, there have been 100 cities with public bicycle systems (Suzuki and Nakamura, 2017). The purpose of installing the public bicycles is the improvement of the transport network, connected with public transport stations (questionnaire survey by MLIT in 2016, shown in Figure 8.). However, the number of ports available still remains low compared to other countries (Suzuki and Nakamura, 2017).
- Public and private companies (such as Nagoya city office) ‘have been encouraging its employees to commute by bicycle, by for example increasing bicycle commuting allowances [JSF, 2010]’. This practice is not common yet. (Andrade et al., 2011)
- Cities are adopting local plans to promote cycling further. For example, Utsunomiya City introduced the Basic Plan to Utilize Bicycles in 2003. The measures pursued include: the formation of a citywide bicycle route network, provision of bicycle parking facilities near railway stations and bus stops and short-term parking spots and introduction of community rental cycle system. In 2010 it introduced Utsunomiya Bicycle City Promotion Plan, which vowed to continue these measures and also support the promotion of environment, health, sports, and tourism through cycling (Hirotaka and Koike, 2014). However, in many cases Japanese ‘urban transportation plans often treat bicycle and walking as a single mode, despite the numerous bicycle users [Hyodo et al., 2000]’. (Andrade et al., 2011)
- Introducing measures to promote safer cycling: for example an active campaign has been taking place to promote the use of helmets among senior cyclists. Tochigi Truck Association has donated 1000 bike helmets to be donated to the elderly free of charge (Hirotaka and Koike, 2014).
- Collaborations between cities and the Regional Offices of the Ministry of Land, Infrastructure, Transport and Tourism. This allows to introduce new, experimental solutions, for example blue arrow-shaped pavement markings to guide bicycles, introduced on the National Highway No.4 in Utsunomiya (Hirotaka and Koike, 2014).

- Monitoring: the majority of new measures introduced are monitored in order to measure their effectiveness. These include some of the measures listed above. The desired outcomes include increase in cycling and reduction in accidents.

Moreover, surveys have been conducted which suggest that cycling in Japan could be promoted further through ‘implementing exclusive cycle routes, along with improving existing cycle lanes and increasing the number of free bicycle parking lots, would contribute to more cycle-friendly journeys’ (Andrade and Kagaya, 2012).

2.7 Challenges of Cycling and Shared-Space

The presence of high levels cycling and omni-present shared space result in a variety of issues. In the recent years the situation has been gradually getting worse to the point that ‘violations of traffic rules and etiquette by users of bicycles and other familiar modes of transport’ have been identified as a social problem. (Nishiuchi, IATSS). Some of the most prominent challenges include:

- Safety issues (Section 1.8)
- ‘Illegal parking around stations and shopping malls: this contributes to increasing traffic congestion and the number of accidents in surrounding areas.
- High numbers of abandoned bicycles within urban areas. This is caused by the fact that in Japan, the costs of fixing a bicycle are high compared to purchasing a new one. (Andrade et al., 2011)

However, Japanese national and local governments appear to efficiently identify these issues and effectively respond to them through introduction of policies and regulations. (Andrade et al., 2011) (Hirotaka and Koike, 2014).

2.8 Safety (Statistics and Perceptions)

The accident statistics with cyclists and pedestrians involved remain very high. ‘At present, the number of cyclists has been increasing all over the world, and the collision accidents which rested in cyclists has been recognized as one of social issues in Japan’ (Tokuyasu et al., 2015). The causes of collisions include ‘by the faults and/or the bad manner of a cyclist, such as ignoring a traffic light, operating a smartphone, and over speed etc.’ (Tokuyasu et al., 2015).

While ‘one possible reason for the differences in risk environments is the poor separation between cars and other traffic users in Japan. Approximately 75% of Japan is mountainous, making its population density extremely high. Because most roads in Japan go through heavily populated urban areas, isolating pedestrians and bicyclists from motor vehicles is very difficult’ (Koshi, 1988).

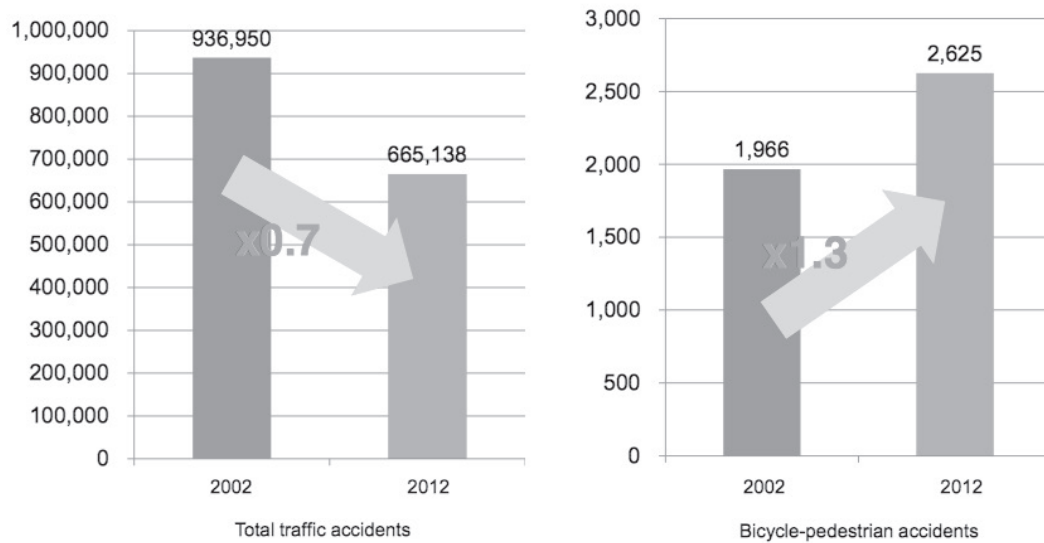
Referring to Hayakawa et al., ‘despite this increased exposure, Japanese accidents tend to be less lethal’. The potential reason is that, traffic congestion leads to lower speeds of vehicles (Hayakawa et al., 1999). In fact, despite high figures, Japan has been observing a steady decrease in road fatalities since 1990 (International Transport Forum, 2016). Table 3 shows the trend.

Table 3. Road Fatalities By Road User Group.

	1990	2000	2010	2013	2014	2014 % change from			
						2013	2010	2000	1990
Cyclists	1 509	1 278	938	813	738	-9.2	-21.3	-42.3	-51.1
Moped users	1 320	944	459	357	321	-10.1	-30.1	-66.0	-75.7
Motorcyclists	1 920	903	570	503	489	-2.8	-14.2	-45.8	-74.5
Passenger car occupants	3 887	2 903	1 201	1 086	1 053	-3.0	-12.3	-63.7	-72.9
Pedestrians	3 955	2 955	2 016	1 871	1 753	-6.3	-13.0	-40.7	-55.7
Others	2 005	1 427	644	535	484	-9.5	-24.8	-66.1	-75.9
Total	14 595	10 410	5 828	5 165	4 838	-6.3	-17.0	-53.5	-66.9

Despite, relatively high number of accidents, cycling is regarded as safe in Japan, primarily because cyclists ‘ride on sidewalks rather than share roadways with motorized vehicles’ (Andrade and Kagaya, 2012). This perception of safety ‘plays an important role in the decision to cycle (by travelers in Sapporo)’ (Andrade and Kagaya, 2012).

Yet, Suzuki and Nakamura (2017) argue that cycling on a sidewalk is unsafe, despite the common perception otherwise. In fact, the statistics report an increase in accidents between cyclists and pedestrians. Based on that they draw a conclusion that ‘it seems that the Japanese situation, cycling on sidewalks is safer than the other countries where people bicycle on roadway, but as you can see the reverse is true. Because of them, we can say that bicycling on sidewalks is not always safe’ (Suzuki and Nakamura, 2017). Figure 13 shows that while the total number of traffic accidents decreased by 30% between 2002 and 2012, the bicycle-pedestrian accidents have increased by 30%.



Source: NPA statistics

Figure 13. Total traffic accidents versus bicycle-pedestrians accidents (MLIT).

2.9 Design Guidelines

Japan has published a number of design guidelines for pedestrian and cycling facilities.

For walking, the technical guideline to design a pedestrian space has been enacted in the law of Road Construction Ordinance, with the focus on pedestrian safety. It specifies the width of lane for pedestrians and/or cyclists with a requirement of over three meters. It is believed that this dimension will reduce the rate of collisions in pedestrian space (Tokuyasu et al., 2015).

In November 2012, the Road Bureau of the Ministry of Land, Infrastructure, Transport and Tourism and Traffic Bureau of the National Police Agency issued the ‘Bicycle Usage Environment Creation Guidelines for Comfort and Safety’. The document adapted the core of Road Traffic Law that ‘a bicycle is a vehicle, which in principle, travels on vehicle road’: it therefore, focused on comfortable and safe provision of road space for cyclists, hence promoting segregation between cyclists and pedestrians. Figure 14 shows the proposed types of facilities, depending on the road conditions (Kobayashi et al.).

Another official document is “Guideline for developing bicycle parking facilities” published by MLIT, which puts a lot of emphasis on promotion and development of public bicycle systems. Cycle hire schemes are seen as a potential solution to illegal bicycle parking and a way to save parking lots and a measure of improving the transport network through promoting multi-modal trips (bicycle parking at the stations) (Suzuki and Nakamura, 2017).

	A: Roads where automobiles travel fast	B: Road other than A and C	C: Roads where automobiles travel slowly and the automobile traffic volume is low
Necessity for separation of bicycles and automobiles	Structural separation	Visual separation	Mixed
Type of Bicycle travelling space	Bicycle track	Bicycle lane	Mixed use on vehicle lane (As necessary, the road shoulder is colored, or belt-shaped road markings or pictograms are placed inside the vehicle lane on the left side.)
Criteria	Automobile speed higher than 50 km/h (For example, road with a speed limit of 60 km/h where speed restrictions are not enforced)	Road that is not covered by conditions A and C (For example, road where a speed limit of 50km/h is enforced, etc.)	Automobile speed of 40 km/h or less, and traffic volume of 4,000 or less

Figure 14. Types of Facilities: Different Levels of Segregation and How to Choose a form of improvement according to traffic conditions.

2.10 Shared-use Paths

Referring to the Japanese traffic law (Section 2.3) sharing space is allowed in certain circumstances. In reality, mixed-use is very common. Figure 15 shows the types of unsegregated and segregated facilities and a total length of provision in Japan.

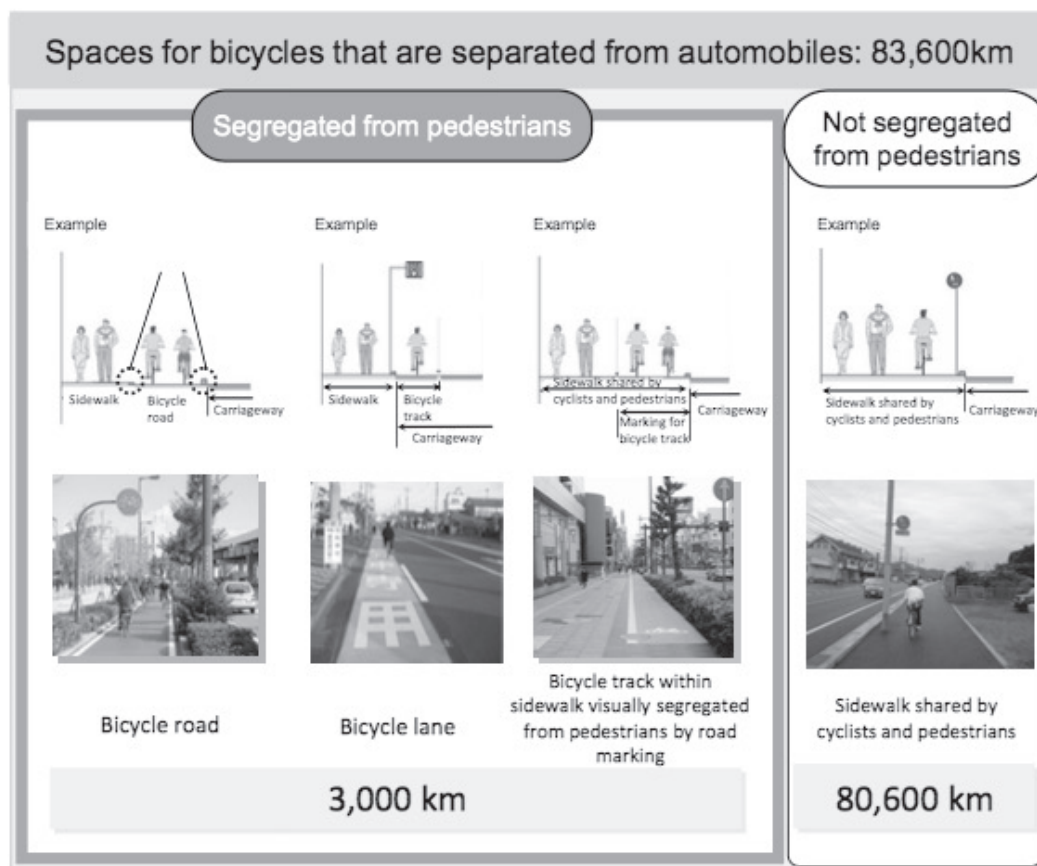


Figure 15. Segregated and Unsegregated Paths: Types and Total Lengths (MLIT)

Zhe et al. has pointed out the disadvantages and advantages of shared-use paths in Japanese context. He points out how cycle/pedestrian shared use negatively affects safety of pedestrians and enforces the reduction of cyclists speed. However, on the other hand, he mentions the association between shared-use and high levels of cycling in Japan for variety of purposes and among women and elderly, emphasizing the advantage of safety and freedom for utility cyclists (Zhe et al., 2008). This fits into what some other researchers claim, stating that ‘the possibility of sharing side- walk space with pedestrians appears to have a strong positive impact on cycling’ (Andrade and Kagaya, 2012).

Yet, in the recent years, there has been a tendency to encourage segregation as a more viable option. Currently, most cities still lack extensive cycling networks (infrastructure). Cycling facilities are primarily parking and designated zones within road intersections (Andrade et al., 2011). Due to high levels of cycling, and consequently, safety concerns, ‘in 2008, the Ministry of Land, Infrastructure, Transport and Tourism of Japan [MLIT] has launched a plan to establish an extensive bicycle lane network nationwide’ (Andrade et al., 2011)

Interestingly, Misui (2012) pointed out that the plan to introduce a cycling network might become more achievable with time. He suggested that the social demand for improved cycling traffic space will continue. Meanwhile, the demand for automobile traffic is expected to decline due to population decline. ‘Future maintenance of excess road capacity may produce excessive burden on the future generations and reallocation of the road space from automobile traffic space to bicycle traffic space is the pressing issue’ (Misui, 2012).

2.11 Level of Service

Highway Capacity Manual defines Level of Service as ‘a quality measure describing operational conditions within a traffic stream, generally in terms of such service measures as speed and travel time, freedom to maneuver, traffic interruptions, and comfort and convenience’ (Highway Capacity Manual, 2010). It identifies six levels, from A to F: A represents the best operating conditions and F the worst. HCM considers a diversity of transport modes, including walking and cycling, however it is applicable primarily to American roads which represent significantly different conditions than Japan or Europe.

Hence, considering the high levels of walking and cycling in Japan, multiple studies were conducted in attempt to define the level of service. Research has been conducted, which confirmed that ‘in order to promote cycle use in urban areas, improvement level of service for cycling on streets is considered to be an integral part of (...) policy’ (Yamanaka and Namerikawa, 2007). Tsukaguchi et al. have also emphasized the importance of level of service for promoting walking stating that ‘regional environment, amount and level of service of urban amenities and attributes of the residents form main elements that contribute toward the attitudes toward walking and pedestrian behaviour in general’ (Tsukaguchi et al., 2007).

Zhe et al. have completed a study which evaluated the level of service of shared use paths, focusing on users’ safety and comfort with consideration for traffic volume on the path. By using a video survey of shared use streets, the authors analysed the relationship between cycling speed, frequency of hindrance and traffic density or traffic volume of street users. In conclusion, the author proposed the conditions necessary to apply shared use of bicycles and pedestrians on the sidewalks, considering the traffic flow of pedestrians and bicycles per width of sidewalks’ (Zhe et al., 2008).

In Japan, level of service can play particularly important role in promoting active travel. While people would usually choose the shortest route to get to their destination, some cities in Japan (for example Sapporo) are designed on a grid. Considering that the distance no longer plays a significant role, it was proved that the probability that a route will be selected increases as the average overall LOS of that route increases. The research was conducted for walking. It was proven that the likelihood that a route will be selected decreases with increases in the length of the route. The results suggest that when pedestrians choose routes, they consider the overall LOS in combination with the lengths of sidewalks and crosswalks (Muraleetharan and Hagiwara, 2002).

2.12 Perception of Comfort

The concept of comfort appears in multiple guidelines and studies conducted in Japan.

The study on improvement of comfort of road space looked closer at the perceptions of pedestrians, cyclists, other road users and roadside residents. It identified the importance of barrier-free pedestrian space, autonomous mobile support and improvement of comfort for living roads. It also suggested the diversification of needs among the road users leading to road space reconstruction. Interestingly, it emphasized that to create road environment that is people-centred the comfort is the key. This was followed by looking at specific situation in Japan: with aging population the perception of comfort and needs are changing.(NILIM, 2006).

For cycling, in 2012, the Ministry of Land, Infrastructure, Transport and Tourism (MLITT) and the National Police Agency published an official guideline for development of safe and comfortable cycle facilities. It was revised in 2016. This document covers ‘the planning of bicycle traffic space, design of bicycle traffic space, enforcement of bicycle traffic rules, and comprehensive action to promote bicycle usage’ (Hirota and Koike, 2014).

The document identifies three types of bicycle facilities: “bicycle path” (two-way bicycle tracks on the both sides of a road), “bicycle lane” (a one-way bicycle lane on the left side of a roadway), and “local discretionary lanes or pictographs” (a sign for clarifying cycling space on a roadway). This guideline also further emphasizes the need for segregation, by mentioning the planning process of a bicycle network (Suzuki and Nakamura, 2017).

The research into pedestrian comfort also evolves around segregation. Referring to Yamanaka and Namerikawa (2017) the key to increasing the comfort of pedestrians lies in improving the pedestrian and cycling facilities (for example sidewalks). The measures include ‘separation of pedestrians and cyclists, removal of on- street bicycle parking and barriers on sidewalks’ and ‘making priority system appropriate in traffic rules for bicycles on urban streets and of junctions.’ (Yamanaka and Namerikawa, 2007).

3. Discussion

Cycling and walking are very popular modes of travel in Japan: they constitute as the majority modes for trips up to 3km, and cycling makes up a significant proportion of trips up to 6km. ‘The Japanese transportation system is the high number of multimodal bicycle-public transit trips, particularly in large urban centers’ (Andrade et al., 2011). A similar pattern is observed for walking.

Traffic law is defined by the Road Traffic Act. The pedestrians (which also includes wheelchair users) are expected to use sidewalks or pedestrian lanes when available. If they are not, they should use the right hand side of the road. A bicycle is allowed to run on a sidewalk as an exceptional rule for safety reasons, in order to protect cyclists from fatal traffic accidents (Andrade et al., 2011), (Suzuki et al., 2012): ‘the Road Traffic Act allowed people to bicycle on sidewalks legally in December, 1978’. Yet, in practice, most cyclists take on different ways depending on the traffic quantity (Tokuyasu et al., 2015) making cycling on sidewalks is a common practice and unsegregated shared-use omni-present.

The negatives of shared-use include the affect on safety of pedestrians and enforcing the reduction of cyclists speed. In fact, in the recent years the ‘violations of traffic rules and etiquette by users of bicycles’ have been identified as a social problem. (Nishiuchi, IATSS). The accident statistics with cyclists and pedestrians involved remain very high.

However, there is also an association between shared-use and high levels of cycling in Japan for variety of purposes and among women and elderly, emphasizing the advantage of safety and freedom for utility cyclists (Zhe et al., 2008).

Interestingly, Japan has managed to achieve the targets set by the UK for the future: high cycling modal share especially for short distance trips, domination of multi-modal trips with cycling and walking stages, high numbers of women and the elderly walking and cycling on regular basis. This has been done without many design guidelines, but with the focus on education and by ensuring people feel safe (through allowing cycling on sidewalks).

Hence, while in Japan, in the recent years, there has been a tendency to encourage segregation as a more viable option, further research is needed to understand if promoting shared-use could be the key first-step to promoting cycling and walking in the UK.

4. Acknowledgement

This literature review was a part of the 3-month academic fellowship awarded by Japan Society of Promotion of Science to Pola Berent.

5. References

- 1) Andrade et al., 2011, Cycling in Japan and Great Britain: A Preliminary Discussion [online]. Available from: https://www.econstor.eu/bitstream/10419/120175/1/ERSA2011_1052.pdf
- 2) Andrade and Kagaya, 2012, Investigating Behavior of Active Cyclists influences on Bicycle Commuting [online]. Available from: <http://trjournalonline.trb.org/doi/pdf/10.3141/2314-12>
- 3) Enoch and Nakamura, 2008, Transport policy and organization in Japan [online]. Available from: <http://www.tandfonline.com/doi/pdf/10.1080/01441640701526699?needAccess=true>
- 4) Gifu Prefectural Police Headquarters, 2007, Japanese Traffic (Pedestrian and Cyclist's Edition) Avoiding Accidents [online]. Available from: https://www.pref.gifu.lg.jp/foreign-languages/English/life/traffic/text/index.data/eigo_hokousyanado.pdf
- 5) Hayakawa et al., 1999, Traffic accident statistics and risk perceptions in Japan and the United States [online]. Available from: <http://www.sciencedirect.com/science/article/pii/S0001457500000075>
- 6) International Transport Forum, 2016, Road Safety Annual Report 2016 [online]. Available from: <http://www.oecd-ilibrary.org/docserver/download/7516011e.pdf?expires=1495595398&id=id&accname=guest&checksum=015F6942242C0BF3A763F6AA3479B63C>
- 7) Inoue et al., 2010, Association between Perceived Neighbourhood Environment and Walking among Adults in 4 Cities in Japan [online]. Available from: https://www.jstage.jst.go.jp/article/jea/20/4/20_JE20090120/_pdf
- 8) Inoue et al., 2011, Perceived Neighbourhood Environment and Walking for Specific Purposes Among Elderly Japanese [online]. Available from: https://www.jstage.jst.go.jp/article/jea/21/6/21_JE20110044/_pdf
- 9) International Transport Forum Summit, 2012, Case Studies on the Japanese Transport Policy [online]. Available from: http://www.mlit.go.jp/kokusai/itf/policy_index.html
- 10) Japan International Training Cooperation Organization, 2018, *The Rules concerning Riding Bicycles on Public Roads have been Revised* [online]. Available from: https://www.jitco.or.jp/download/data/leaflet_English.pdf
- 11) Kanemoto et al., 2002, Road Transport and Environmental Policies in Japan [online]. Available from: <http://www.rieti.go.jp/jp/publications/dp/01e003.pdf>
- 12) Kobayashi et al., 2013, A New Guideline for the Creation of Safe Comfortable Bicycle Use Environments [online]. Available from: <http://www.nilim.go.jp/english/annual/annual2013/46.pdf>
- 13) Koike, 2014, Mobility perspective for a local city in Japan [online]. Available from: <http://www.sciencedirect.com/science/article/pii/S0386111214000168>
- 14) Koshi, M., 1988, Road safety: success and failure in Japan [Kout- suanzen: nihon ni okeru seikou to shippai]. Traffic Engineering 23, 45–54 (in Japanese).
- 15) Ministry of Land, Infrastructure, Transport, and Tourism, 2015, Creating Safe and Secure Road Spaces for Cyclists [online]. Available from: https://www.mlit.go.jp/road/road_e/pdf/Bicycle.pdf
- 16) Ministry of Land, Infrastructure, Transport, and Tourism, 2012, Improvement of Cycling Environment [online]. Available from: <http://www.mlit.go.jp/common/000208016.pdf> Or Available from: http://www.mlit.go.jp/kokusai/itf/kokusai_policy_000011.html
- 17) Mitsui et al., 2009, Daily Walking Activity among Male Office Workers in a Rural Town in Northern Japan [online]. Available from: https://www.jstage.jst.go.jp/article/jpa2/29/1/29_1_43/_pdf
- 18) Ministry of Land, Infrastructure, Transport and Tourism, 2015, White Paper on Land, Infrastructure, Transport and Tourism in Japan [online]. Available from: www.mlit.go.jp/en/statistics/white-paper-mlit-index.html
- 19) Ministry of Land, Infrastructure and Transport, 2005, General Principles of Universal Design Policy [online]. Available from: <http://www.mlit.go.jp/kisha/kisha05/01/010711/04.pdf>

- 20) Misui, 2012, Economic Analysis on Improvement of Bicycle Traffic Space [online]. Available from: <http://www1.tcue.ac.jp/home1/c-gakkai/kikanshi/ronbun14-4/02misui.pdf> (In Japanese).
- 21) Muraleetharan and Hagiwara, 2002, Level of Service of Urban Walking Environment and Its Influence on Pedestrian Route Choice Behavior: Analysis of Pedestrian Travel in Sapporo, Japan [online]. Available from: <http://trjournalonline.trb.org/doi/pdf/10.3141/2002-02>
- 22) National Police Agency, 2011, Traffic Safety Guidelines for Pedestrians and Cyclists https://www.npa.go.jp/koutsuu/kikaku/trafficsafety/traffic_safety_english.pdf
- 23) Nishiuchi, 2014, Traffic Safety Education and Awareness Activities in Japan [online]. Available from: http://www.iatss.or.jp/common/pdf/en/iatss/composition/FY2014_Report_JP_En.pdf
- 24) Saito et al., 2015, Laws and policies pertaining to traffic safety [online]. Available from: http://www.iatss.or.jp/common/pdf/en/publication/commemorative-publication/iatss40_theory_10.pdf
- 25) Suzuki and Nakamura, 2017, Bike share deployment and strategies in Japan [online]. Available from: http://www.itf-oecd.org/sites/default/files/docs/bike-share-deployment-strategies-japan_0.pdf
- 26) Suzuki et al., 2012, Proposal and Application of a New Method for Bicycle Network Planning [online]. Available from: <http://www.sciencedirect.com/science/article/pii/S1877042812010105>
- 27) The Japan Research Center for Transport Policy, 2015, Transport Policy in Perspective [online]. Available from: <http://nikkoken.or.jp/english/index.html>
- 28) Tokuyasu et al., 2015, Proposal of Design Support System of Pedestrian Space based on Psychological Assessment [online]. Available from: <http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=7424888>
- 29) Transportation Research Board of the National Academies of Science in the United States, 2010, Highway Capacity Manual.
- 30) Tsukaguchi et al., 2007, Comparison of attitudes toward walking in Japanese cities [online]. Available from: https://www.jstage.jst.go.jp/article/eastpro/2007/0/2007_0_230/_pdf
- 31) Yamanaka and Namerikawa, 2007, Measuring level-of-service for cycling of urban streets using ‘probe bicycle system’ [online]. Available from: https://www.jstage.jst.go.jp/article/eastpro/2007/0/2007_0_208/_pdf
- 32) Zhe et al., 2008, Evaluation of shared use of bicycles and pedestrians in Japan [online]. Available from: https://books.google.co.jp/books?hl=pl&lr=&id=FQG-UcN3ajcC&oi=fnd&pg=PA47&dq=cycling+traffic+law+in+japan&ots=FBVQffbNdt&sig=IvujrsZnWAAWQoFf6jQGLp8Y8FE&redir_esc=y#v=onepage&q=cycling%20traffic%20law%20in%20japan&f=false
- 33) National Institute for Land and Infrastructure Management, 2006, Research for Improving Safety and Amenity in Road Space, Project Research Report of NILIM, No. 7, February 2006. [online]. Available from: <http://www.nilim.go.jp/lab/bcg/siryoku/kpr/prn0007.htm>