2013| Mobilidade, Cidade e Território| paranoá**9**
ISSN_1677-7395

CYCLISTS' BEHAVIOUR: IDENTIFICATION OF FACTORS ON COMMUTING BY BICYCLE

ANDRADE, Katia
KAGAYA, Seiichi

ABSTRACT

In Japan, cycling is a widely accepted transportation mode and often used for commuting or other purposes. Accordingly, this paper focuses on the reasons that motivate people to cycle, even though the Japanese transportation policies towards cycling are somewhat limited when compared to other countries with high cycling levels. Behavioural and statistical analyses are presented with a focus on unimodal commuting trips. In the behavioural analysis, commuters' views on cycling are presented. In the statistical analysis, Nested Logit models are estimated to assess factors with strong influence on cycling. This paper contributes to further understanding the behaviour of active cyclists.

Keywords: *Cycling; Active Cyclists; Bicycle Commuting*

INTRODUCTION

Around the world, cycling has been used for two main purposes. Some societies view and utilise the bicycle as an integral part of the transportation system. Even if not used as the main transportation mode, it can still be used efficiently as a complementary transportation mode to public transit modes. The Netherlands, Germany and Denmark are examples of European countries where cycling accounts for high daily shares. Among Asian countries, Japan and China present significant cycling rates (Andrade et al, 2011). Several developing countries have a hidden but significant population of cyclists, particularly observed in smaller municipalities. However, in many countries cycling has been merely seen as a means of recreation and is rarely used for daily travel. Examples are the United States, Australia and Great Britain where nationwide statistics suggest insignificant bicycle shares.

An extensive body of literature exists on the propensity to cycle and how this relates to built environment, socio-demographic, temporal and weather factors. Land use, population density and employment activity characteristics have been shown to relate to the decision to cycle (Cevero, 2002; Targa & Clifton, 2005). Furthermore, bicycle facilities and infrastructure have been proved as important factors on cycling decisions (Akar & Clifton, 2009; Dill & Carr, 2003). A few researches have also highlighted the importance of supporting policies towards bicycle use (Pucher et al., 1999). These factors affect travellers' perceptions towards mode choices along with personal attitudes and cultural differences (Pucher & Buehler, 2007). Conversely to most of previous research, this paper adds to the transportation literature by addressing highly active cyclists in an urban environment with limited cycling specific policies and infrastructure, and discusses likely reasons that motivate people to cycle. This approach provides and interesting opportunity to further investigate cycle decisions.

This paper analyses the data collected by the Laboratory of Infrastructure Planning and Design of Hokkaido University (HU, Japan) on the travel patterns of the university's commuters. Non-cyclists are also under attention, and their views are assessed as a way to improve the cycling system. The behavioural and statistical analyses focus on commuters' unimodal bicycle trips, even though a few aspects of other modes and multimodal journeys are also discussed with an informative view. In the statistical analysis, Nested Logit (NL) models are developed to investigate factors with strong influence of cycling. The results of the models highlight factors with strong influence on cycling, both within the contexts of Sapporo city and HU campus. Household structure, life style characteristics, and cycling infrastructure appear to have strong influence on the decision to cycle.

The remainder of the paper includes a summary of cycling levels and infrastructure in Japan; characteristics of the case study and survey sample; the behavioural analysis of HU commuters; the statistical analysis, which includes the modelling framework and the mode choice modelling outputs; and conclusions.

ISSN_1677-7395

CYCLING TRENDS AND INFRASTRUCTURE IN JAPAN

The bicycle is a widely accepted transportation mode throughout Japan (Figure 1). National statistics indicate that 17% of weekday-trips are made by bicycle in the country (MLIT, 2007). Also, cycling accounts for almost 19% of trips within the three major metropolitan areas of Tokyo, Osaka and Nagoya. Trips by private car account for 25% within the same metropolitan areas, as shown in Figure 1.

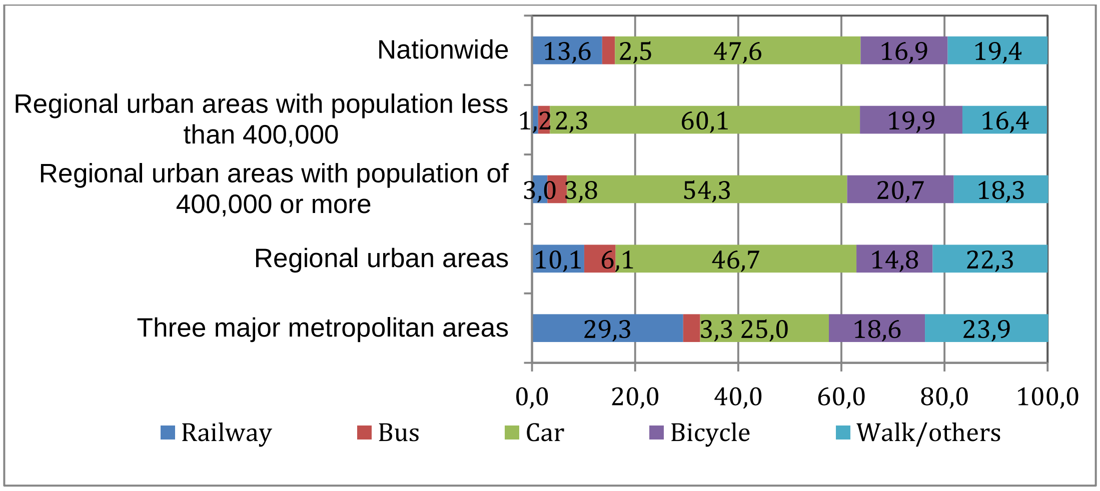


Fig. 1. Mode Share of All Trips in Japan (%) Source: Nationwide Traffic Characteristics Survey, 2005

Sapporo metropolitan area has similar cycling rates compared to national rates. Also, in downtown Sapporo city, non-motorised modes play an important role when counting short to medium distance trips. A survey highlighted that non-motorised trips account for the great majority of all trips in the surroundings of Sapporo station area (Sapporo, 2006), as detailed in Figure 2. Furthermore, bicycle trips doubled between 1994 and 2006 in comparison with a 26% reduction in automobile trips and stable rates of trips by train and subway during the same period.

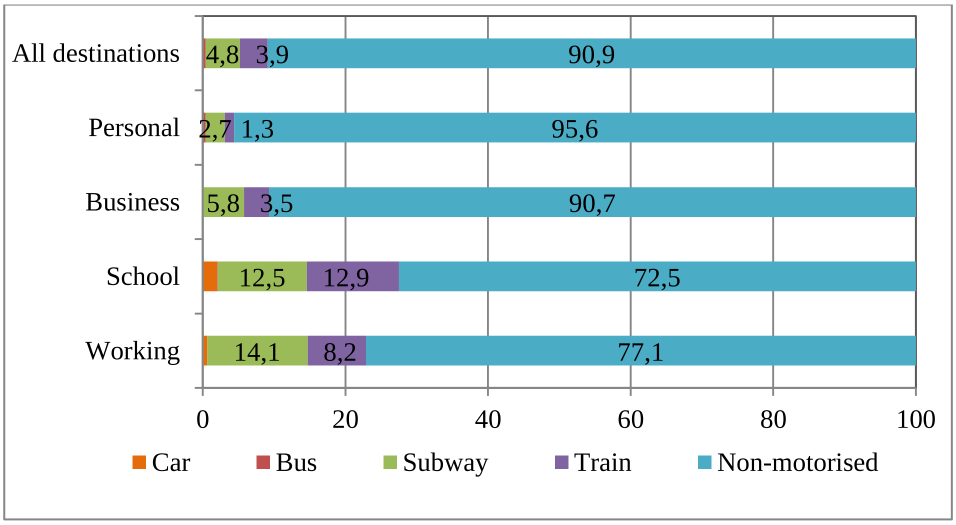


Fig. 2. Mode Share by Trip Purpose in Downtown Sapporo (%). Source: Sapporo Person Trip Survey, 2006

Despite these high figures and the increasing cycling rates in several cities, Japan does not present extensive on-road and off-road bicycle facilities and services. Moreover, Japanese urban transportation plans most frequently treat bicycle and walking as a single mode, despite their different needs and the big number of cyclists (Hyodo, 2000). These plans often focus on either implementing bicycle parking facilities, or establishing bicycle zones in road intersections. In practice, the cycle network is not well established around the country with a few of the urban cycling routes built to accommodate recreational uses. Sapporo is not an exception in terms of limited bicycle facilities. Cycle lanes are often located within less accessible areas, such as university campuses and alongside river banks for recreational purposes. This scenario motivates cyclists to share sidewalks with pedestrians. Under the Japanese Road Traffic Law, cyclists are required to ride on roadways, but may also ride on sidewalks for safety reasons (JFS, 2010). Sapporo, along with several other Japanese cities, has recently intensified efforts towards improving bicycle infrastructure. Accordingly, city plans taking bicycle into consideration have gained popularity in recent years (City of Sapporo, 2011).

HOKKAIDO UNIVERSITY: CASE STUDY

Hokkaido University (HU) is one of the major national universities in Japan and has two campuses. The Faculty of Fisheries campus is located in the south of Hokkaido Island (Hakodate city), 250km far from the capital city of Sapporo. HU main campus is located within downtown Sapporo city and has 1.8km^2 of area. The main gate is 0.5km far from Sapporo station and 1.4km far from Odori station areas, which compose the main commercial areas in Sapporo downtown (Figure 3). The campus is convenient for cycling because of its greenery and cycle-friendly environment. 22 thousand students and staff commute to the university (18% staff, 30% graduate students, and 52% undergraduate students) (HU, 2011).

ISSN_1677-7395

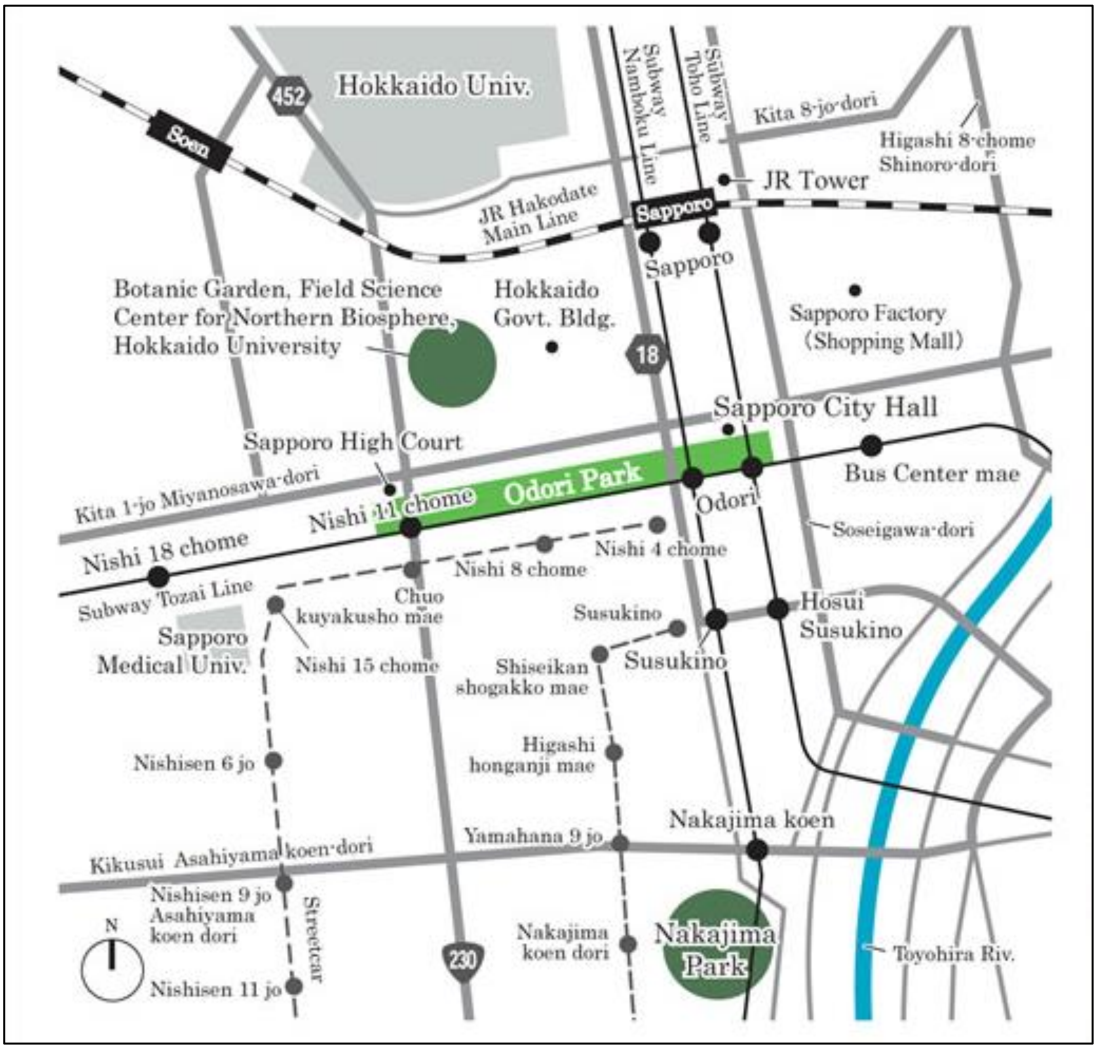


Fig. 3. Map of downtown Sapporo. (http://www.sapporo-park.or.jp/odori/)

The university population represents 1.2% of the total population of Sapporo and 2.6% of the working population, as summarised in Table 1. A considerable part of households in Sapporo is composed by 1person, followed by 3 plus and 2 people households. Moreover, a big number of households own a car (66.3%) and more than half of individuals own a bicycle (59.1%). While 42% of the city's total population is 50 years old or over, overall it is an active cycling population (as discussed in the previous section). Similarly, students and staff of HU are highly active cyclists; and therefore are an interesting population segment when investigating cycling behaviours in Sapporo.

Tab. 1. General Characteristics of the Data Sample

Characteristic			%	(notes)
Gender				
	Male		68.6	
	Female		26.9	(4.5% no reply)
Age range				
	20-25		52.4	(mostly undergraduate students)
	26-30		15.5	(mostly graduate students)
	31-40		12.5	(graduate students and employees)
	41-50		4.5	(mostly employees)
	50 plus		5.7	(employees) (9.4% no reply)
Household structure				
	1 person		52.9	
	2 people		14.0	
	3 plus people		28.2	
		with children	68.1	
		without children	31.9	(4.9% no reply)
Status				
	Undergraduate		42.7	
	Graduate		36.6	
	Staff		20.2	(0.5% no reply)
Status and Nationality				
	Japanese student		55.4	
	International student		23.9	
	Japanese staff		17.5	
	International staff		2.7	(0.5% no reply)
Have bicycle				
	Yes		74.4	
	No		25.6	
Have car available (in household)				
	Yes		43.1	
	No		52.4	(4.5% no reply)

Population and main demographics of Sapporo (Sapporo, 2006)
Total population: 1.9 million people (46.9% males, 53.1% females)
Employment status: 44.7% (71.6% employed males, 48.8% employed females)
Age range: 0-19 (15.6%), 20-25 (7.2%), 26-30 (6.4%), 31-40 (15.2%), 41-50 (13.6%), 50+ (42.0%)
Household structure: 1 person (40.3%), 2 people (27.5%), 3 plus people (32.2%)
Have bicycle: 59.1%; Car ownership (household): 66.3%

ISSN_1677-7395

Survey Sample

The Hokkaido University Transport Survey (HUTS) was carried out in April 2011. Home mail box delivery, direct handled questionnaires and on-line delivery approaches were used in the survey. Mail box delivery focused on residents living at a cycling distance from the campus and included the biggest number of distributed questionnaires. Questionnaires were directly handled to cyclists approaching the campus or while cycling within the campus. The on-line delivery focused on international students and staff, and also on those living at further distances from the campus. In mail-back surveys, the response rates usually average between 12 – 20% (Stopher, 2000), thus the other methods were also employed to increase the response rate and to achieve variety among respondents.

The survey focused primarily on cycling issues and cyclists' views and attitudes towards cycling. However, it also included several other transportation aspects both in order to gather responses from non-cyclists and to look at cyclists' behaviour when performing non-commuting trips. The survey was based on Revealed Preference (RP) information. Initially, respondents were asked about their mode choices to campus (both most frequent mode and a second option), commuting time, and their mode choices during different seasons. This question was included because mode choices are likely to change due to the severe winter conditions in Sapporo. The core of the survey included several bicycle-related questions, such as bicycle ownership, cycling behaviours in weekdays and weekends, factors influencing bicycle choice (primarily to campus, but also to other destinations), available infrastructure and safety issues. Questions about public transport and car usage also looked at multimodal trip behaviour. These questions meant to investigate whether or not multimodal trips include cycling, and whether they are somewhat correlated to cycling to campus. Socio-demographic information complemented the survey.

The final sample includes the responses from 410 individuals, which represents 1.9% of the university's commuters. The diversity within the university body is well represented by the sample, as shown in Table 1.

Travel Behaviour of Hokkaido University Commuters

HUTS data is analysed in order to further understand commuters' travel behaviours and attitudes towards cycling. This descriptive analysis indicates individual aspects, personal attitudes and life style characteristics that influence the decision to cycle among HU commuters. It is used as the basis for the modelling exercise in the statistical analysis.

As shown in Table 2, non-motorised trips account for the great majority of Hokkaido University commuting trips. Cycling is referred by 60% of the respondents as their most usual commuting mode. Walking is the second most used mode, whilst many respondents also commute by public transport. Private automobile appears as a less popular mode. Table 2 also reveals higher cycling rates among students than staff, even though both groups are more likely to cycle or to walk than to use motorised modes.

Tab. 2. Modal Split among HU Commuters (%)

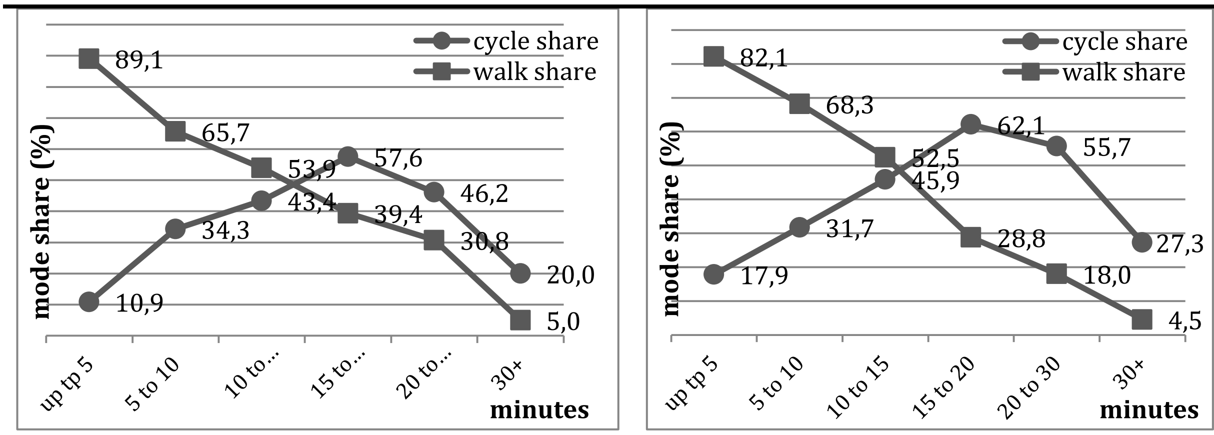
Transport Mode	Undergraduate	Graduate	Staff
Bicycle	69.9	64.3	29.6
Walk	7.8	19.6	32.1
Bus	3.0	1.4	4.9
Subway	10.2	9.8	11.1
Train	8.4	2.8	4.9
Car	0.6	2.1	17.3

The preference for cycling explains the high number of bicycles per household. Among cyclists, the average number of bicycles per household is 1.5. This number is high as the majority of the respondents compose single households (see Table 1). Furthermore, the greater preference for non-motorised modes is coherent with commuting distances and Hokkaido University transport policies. Most commuters live within the neighbourhood of the university. 44% of them live within 10 minutes commuting distance from the campus, while 75% within 20 minutes. The average commuting time is 18 minutes. HU transport policies include restrictions to the use of private cars. Also, it has been motivating people to cycle by creating a more cycle-friendly environment. Broadening cycle lanes and improving bicycle parking facilities have been recently prioritised by the university. The behaviour of HU commuters appears to match the travel behaviour of Sapporo commuters. Cycling and walking trips account for approximately 75% of commuting trips (working and school trips) within Sapporo downtown (Sapporo, 2006).

Only 18% of cyclists commute by bicycle all year long, whereas 42% walk to the campus during the winter, followed by 24% who would use public transport. Weather is highlighted by 79% of the sample as an important factor in whether to cycle or not to a destination. This output reflects the severe winter conditions faced by the northern Japanese island of Hokkaido. Sapporo presents frequent and intense snowfalls often recorded in more than 100 days per year, while the cumulative snowfall is approximately 5m per year (City of Sapporo, 2011). Non-bicycle commuters are more likely to use the same transport mode throughout the year.

Commuters were also inquired about multimodal travel behaviour. The public transport system in Sapporo city includes buses, three subway lines and several train lines. Trains are often used for inter-municipal journeys, but also for trips within Sapporo. The respondents tend to live closer to subway stations than to train stations, as these are scarcer within the city. Over all commuters, the average walking time to the closest subway station is 18 minutes, while it is 25 minutes to the closest train station. Nearly 72% of respondents live up to 15 minutes of walking distance to a subway station. This figure is 39% when considering the closest train station. Figure 4 shows the cycling and walking shares for home-station trips and for several time intervals. It is observed that bicycle shares increase along with increasing walking distance, 15 minutes being a threshold to higher bicycle than walking trips.

ISSN_1677-7395



(a) Closest subway station *(b)* Closest train station

Fig. 4. Trends of non-motorised modes used to reach public transport stations.

Statistical Analysis: Nested Logit Model

Nested Logit (NL) models are estimated in this study. Random utility theory is assumed to derive such models (Bierlaire, 2011). This theory suggests that choice preferences towards a certain alternative can be shown through its utility. Also, it is assumed that the alternative with the highest utility is chosen by the decision maker (Meyer & Miller, 2001). The utility of a certain alternative is composed by observed and unobserved (random) terms. The observed term of the utility includes a set of observed variables related to the alternative and the decision maker; and a vector of alternative coefficients. The random term includes the uncertainties related to the analyst's limited information on individual preferences (Ben-Akiva & Lerman, 1985). In the NL structure, the alternatives are grouped in different nests according to their similarities (Ortuzar & Willumsen, 2001). Details of the derivations of utility functions in NL models are not described here, but can be found in the broad literature on this topic.

The NL mode choice model includes a set of four alternatives: bicycle, walk, public transport (aggregation of bus, subway and train), and private car. Two nests include the alternatives of bicycle and walk (non-motorised nest); and public and car (motorised nest). The attribute variables are classified in four groups:

Group1: Personal and household characteristics

Group2: Travel behaviour and life style variables

Group3: Bicycle infrastructure and services variables

Group4: Accessibility variables

The focus of this paper is to investigate the particular effect of attribute variables in the alternatives. In this, all input attributes are mode specific. All variables in groups 2 and 3 are bicycle-specific.

DISCUSSION ON THE MODELS' OUTPUTS

Table 3 summarises the results of the NL models. The alternative specific constants and variables related to groups 1 to 4 (as described above) were added sequentially to the models. Private car is set as the comparison case. The log-likelihood ratio tests show that each set of new input variables increase the explanatory power of the models. Also, it is shown that the final model structure (NL 4) achieved a significant explanatory level compared to the initial model (i.e. the model composed by ASC only). Accordingly, the discussion is based upon NL 4 (highlighted in Table 3). Whilst several variables were tested in the models, the final model structure mainly includes variables related to non-motorised modes because of the authors' interest in further understanding factors affecting bicycle choices.

All coefficients are sign-coherent, and most of variables are significant at the 0.95 confidence level (critical value is 1.96). In Group 1 (personal and household characteristics), household car availability affects negatively the choice of non-motorised and public modes, which is an expected result. However, it is interesting to note that the coefficient related to car availability for walk mode is higher in magnitude than those for bicycle and public modes. The higher coefficient for walk suggests that people's decision towards walking to campus is more sensitive to having a car available at home than the decisions to cycle or to use public modes. Household type also appears to affect mode choices. Single household type (here defined as 1-person household) is positively and significantly correlated to non-motorised mode choices. University staff are likely to travel by car, while being a student did not appear to affect mode choices. Thus, this variable was dropped from the analysis.

Variables in Groups 2 and 3 are bicycle-specific and they reveal insightful information on the cycling choice to campus. Variables related to travel behaviour and life style (Group 2) are added to the model so as to investigate personal attitudes towards cycling. It is noted that people who practice any kind of physical activities (other than cycling and at least twice a week) are also more likely to cycle to campus. This result confirms the information previously stated in this paper, in which commuters perceive the need of exercising as an important factor in their mode choice. Also, cycling to perform other activities (such as shopping, leisure and business) appears to be strongly correlated to cycling to work. It is then suggested that cycling is a life style choice, which is attached to a chain effect. Moreover, the model reveals that people who cycle more frequently in sidewalks are more likely to commute by bicycle. Sidewalk cycling may be correlated to the cyclists' feeling of safety while cycling in Sapporo, which also shows strong influence in the decision to cycle (Group 3). In terms of infrastructure, the existence of bicycle paths in the way to campus affects bicycle choice. The possibility of carrying bicycles in public transit modes also affects positively the decision to cycle. This service is not available in Japan, unless bicycles are folded and packed.

Group 4 includes accessibility variables. Commuting time coefficients for bicycle and walk are negative, which is a sensible output. Commuters are likely to choose the mode that presents the least travel time if all else is equal. However, the coefficients related to walking distance to the closest subway and train stations affect positively the bicycle choice. These

ISSN_1677-7395

outputs suggest that people are more likely to cycle to public transit stations if the walking distance increases. These variables reflect the high numbers of cycle-transit multimodal trips in Japan. Also, they reflect the RP information described earlier in this paper. Even though these variables are not exclusively related to commuting trips, it is interesting to note that they are correlated to the bicycle choice to campus.

Tab. 3. Outputs of the Nested Logit Models

Variable	NL 1	NL 2	NL 3	NL 4
ASC: Alternative Specific Constants (base case fixed on Car)				
Bicycle	3.770 (2.37)	1.720 (2.28)	0.976 (1.24)	4.050 (3.90)
Walk	3.160 (0.45)	2.590 (4.61)	2.460 (3.30)	5.090 (4.79)
Public	2.950 (4.83)	2.860 (3.71)	2.850 (4.17)	2.900 (5.79)
Group 1: Personal and household characteristics				
Staff – Car	2.150 (3.72)	1.770 (3.04)	1.690 (2.99)	1.950 (3.23)
Single household – Bicycle	1.830 (3.90)	1.990 (5.36)	2.020 (4.82)	1.090 (2.40)
Single household – Walk	1.690 (1.48)	1.610 (3.94)	1.580 (3.58)	1.070 (2.27)
Car availability – Bicycle	-1.030 (-4.28)	-0.733 (-2.66)	-0.777 (-1.76)	-0.588 (-1.78)
Car availability – Walk	-1.040 (-4.06)	-1.090 (-3.75)	-1.110 (-2.33)	-0.959 (-2.72)
Car availability – Public	-0.502 (-2.39)	-0.519 (-2.39)	-0.542 (-1.36)	-0.521 (-2.23)
Group 2: Travel behaviour and life style*				
Cycle to perform other activities		1.850 (4.35)	1.590 (5.32)	1.090 (2.33)
Cycle more frequently in sidewalks		1.140 (3.95)	0.676 (2.15)	0.573 (1.86)
Practice physical exercises twice a week (other than cycling)		0.350 (1.31)	0.359 (1.16)	0.524 (1.84)
Group 3: Bicycle infrastructure and services*				
Bike paths in the way to campus			0.861 (2.72)	0.762 (2.12)
Feel safe while cycling in Sapporo			1.090 (3.56)	1.060 (2.30)
Possible to carry bikes in public modes			0.960 (3.15)	0.597 (1.48)
Group 4: Accessibility variables				
Commuting time – Bicycle				-0.129 (-5.94)
Commuting time – Walk				-0.094 (-5.05)
Walking dist. to train station – Bicycle				1.150 (2.85)
Walking dist. to subway station – Bicycle				0.403 (1.16)
Goodness of fit				
Initial log-likelihood	-555.90	-555.90	-555.90	-555.90
Final log-likelihood**	-370.85	-309.08	-291.02	-240.95
Number of observations: 401				

* Bicycle specific variables
** Constant log-likelihood (i.e. ASC only): -424.293
t-statistics shown in parentheses

CONCLUSIONS

This paper presents the results of behavioural and statistical analyses, which focus on active cyclists' behaviours and attitudes within the Japanese context. The analyses are based on the Hokkaido University Transport Survey (HUTS) conducted in April 2011 at Hokkaido University. They highlight characteristics of the transport system, household and individual perceptions that affect cycling choices. Students and staff are selected as they represent active cyclist commuters in Sapporo city.

Respondents of the HUTS suggest that improvement measures to the cycling system would contribute to more cycle-friendly journeys. In particular, increasing the number of free bicycle parking lots, improving the existing cycle lanes, and implementing exclusive cycle routes are amongst these measures. They also indicate that the greatest majority of their trips are performed on sidewalks rather than sharing roadway space with motorised vehicles. This is a particular feature of the Japanese transportation system, which allows cyclists to use sidewalks for safety reasons. Also among non-cyclists, a positive attitude is observed towards cycling. The majority of non-bicycle commuters live at far distances from the campus, whilst they do cycle within their residence's neighbourhood.

In the statistical analysis, Nested Logit mode choice models are estimated. The final model outputs suggest that having a car available at home does not affect bicycle and public transit choices as much as it affects the choice to walk to campus. This output reflects the high level of service offered by public transit modes in Japan with many commuters leaving their cars at home and rather commuting by public transport. It also reveals that people who live within a cycling distance would rather choose to cycle as it may be faster than using a car to campus.

Life style characteristics are directly related to the propensity to cycle. The model showed that practicing any physical activities, other than cycling and at least twice a week, also motivate bicycle commuting. This suggests that people are aware of the physical benefits resulting from frequent cycling. Cycling to perform other non-working related activities also appears to have a positive influence on cycling to work, which suggests a chain effect attached to the decision to cycle. The analysis of accessibility variables indicate that longer commuting time has a negative influence on cycling, but longer walking distance to public transit stations rather motivates the use of bicycle. This output matches the high numbers of multimodal trips in Japan, particularly within urban areas.

The findings of this study provide insightful information on commuters' behaviour towards the decision to cycle. This information may be used by government bodies and transport practitioners in Japan and elsewhere when planning for more cycle-friendly urban environments.

REFERENCES

ANDRADE, Katia, **WOODS**, Lee & **KAGAYA**, Seiichi. CYCLING WITHIN URBAN AREAS: THE CASES OF ENGLAND AND JAPAN. CD-ROM. European Transport Conference, 2011.

ISSN_1677-7395

AKAR, Gulsar & **CLIFTON**, Kelly. THE INFLUENCE OF INDIVIDUAL PERCEPTIONS AND BICYCLE INFRASTRUCTURE ON THE DECISION TO BIKE. CD-ROM. Transportation Research Board of the National Academies, 2009.

BEN-AKIVA, Moshe & **LERMAN**, Steven. DISCRETE CHOICE ANALYSIS: THEORY AND APPLICATION TO TRAVEL DEMAND. MIT Press, Cambridge, 1985.

BIERLAIRE, Michel. AN INTRODUCTION TO BIOGEME VERSION 1.6, biogeme.epfl.ch. Accessed June 10, 2011.

CERVERO, Robert. BUILT ENVIRONMENTS AND MODE CHOICE: TOWARD A NORMATIVE FRAMEWORK. Transportation Research Part D: Transport Environment, Vol. 7, pp. 265-284, 2002.

CITY OF SAPPORO. GENERAL OVERVIEW OF SAPPORO. 2011. http://www.city.sapporo.jp/city. Accessed April 10, 2011.

DILL, Jennifer & **CARR**, Theresa. BICYCLE COMMUTING AND FACILITIES IN MAJOR U.S. CITIES: IF YOU BUILD THEM, COMMUTERS WILL USE THEM. In Transportation Research Record: Journal of the Transportation Research Board, No. 1828, Transportation Research Board of the National Academies, Washington, D.C., pp. 116-12, 2003.

Hokkaido University Website. CAMPUS LIFE. http://www.hokudai.ac.jp/en/. Accessed Jan. 12, 2011.

HYODO, Tetsuro., **SUZUKI**, Suzuki & **TAKAHASHI**, Katsumi. MODELLING OF BICYCLE ROUTE AND DESTINATION CHOICE BEHAVIOUR FOR BICYCLE ROAD NETWORK PLAN. In Transportation Research Record: Journal of the Transportation Research Board, No. 1705, Transportation Research Board of the National Academies, Washington, D.C., pp. 70-76, 2000.

JFS Japan for Sustainability. 98 MODEL DISTRICTS DESIGNATED TO ESTABLISH BICYCLE LANE NETWORK. 2008. http://www.japanfs.org. Accessed Jan. 10, 2011.

MEYER, Michael & **MILLER**, Eric. URBAN TRANSPORTATION PLANNING. Mc Grow Hill, United States, 2001.

MLIT Ministry of Land, Infrastructure, Transport and Tourism. 10th METROPOLITAN AREAS TRANSPORTATION CENSUS. 2007.

ORTUZAR, Juan de Dios & **WILLUMSEN**, Luis. MODELLING TRANSPORT. 3rd Edition. John Wiley & Sons, England, 2001.

PUCHER, John & **BUEHLER**, Ralth. MAKING CYCLING IRRESISTIBLE: LESSONS FROM THE NETHERLANDS, DENMARK AND GERMANY. Transport Reviews, Vol. 28, No.4, pp. 495–528, 2007.

PUCHER, John, **KOMANOFF**, Charles & **SCHIMEK**, Paul. BICYCLING RENAISSANCE IN NORTH AMERICA? RECENT TRENDS AND ALTERNATIVE POLICIES TO PROMOTE BICYCLING. Transportation Research Part A: Policy and Practice, Vol. 33, pp. 625–654, 1999.

Sapporo DfT Department for Transport. PERSON TRIPS SURVEY OUTPUTS. 2006. http://www.douou-pt.jp/master/img/pdf/MP02.pdf. Accessed Feb. 15, 2011.

STOPHER, P. R. SURVEY AND SAMPLING TECHNIQUES. In: Hensher, D. A., and K. J. Button (eds.) Handbook of Transport Modelling. Pergamon, Oxford, UK, 2000.

TARGA, Felipe & **CLIFTON**, Kelly J. BUILT ENVIRONMENT AND NONMOTORISED TRAVEL: EVIDENCE FROM BALTIMORE CITY USING THE NHTS. Journal of Transportation and Statistics, Vol.8, pp. 55-70, 2005.