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Exploring effects of norms attributes on daily
non-work related mode choice on Chinese
students in the Netherlands

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Abstract

The primary purpose of this paper is to investigate the effects of norms on Chinese students living in the Netherlands transportation mode choice in association with non-study or work-related purposes during weekends. The data generated for the analysis was collected based on an online revealed preference (RP) data collected for both Chinese students in the Netherlands and China for comparison purposes (total of 150 students).

This paper adopts a Multinomial Logit Model (MNL) for analyzing. The variables compromise three different dimensions, namely, travel characteristics, socio-demographics, and norms variables. The variables of travel characteristics and socio-demographics are derived from previous researches and customized for Chinese students living in China and the Netherlands. Four different norms are mainly tested and accommodated in the model. Notably, the framework of the norms is the following study of an extended norms taxonomy concluded by Wenzig and Gruchmann in 2018. More than the conventional norms topology, this paper presents personal norms, introjected norms, social norms, and descriptive norms as the structure of norms. The measurements of norms variables employ Likert five-scale technique (Likert, 1932). The dependent variable for both of them is *Mode*, compromising car, bike, Walk, Public Transport, and Taxi.

The results of two Multinomial Logit models uncover the different mechanism behind choice behavior and underline the relationship between norms variables and traffic mode choice on weekends for a non-work related purpose. For students who live in China, the factors of age, introjected norm, social norms, yearly budget, income are statistically significant. Besides, the most influential factors of their traffic mode choice are introjected norms.

For Chinese students in the Netherlands, none of them selected Car or Taxi. The students are mainly live in the megalopolis area, which locates in the central-western Netherlands. For those students, a total of nine variable categories are effective significantly. Except for introjected norms, descriptive norms and personal norms turned out to play a role in mode choice. Also, trip characteristics and socio-demographics are statistically significant, namely the purpose of sport and shopping, the ownership of Chinese transport pass, the travel cost, the number of a roommate in the Netherlands, Household income level and

gender. Similarly, introjected norms remain the most effective factors.

The contributions of this research are three-fold: first, norms variables are effect significantly in the Multinomial Logit model. Which contribute to proving the importance of the intervenes of norms. Also, to Students who live in the Netherlands, their mode choice is influenced by more categories of norms than those in China, which suggest that Chinese policy-makers should pay more attention to the use of norms tools and value the new tipping point given by Chinese students as the new generation of behavioral models. In details, unlike previous papers, underlined the importance of social norms, introjected norms (guilty feelings) impact Chinese students' choice strongest. Lastly, among all the studies of traffic mode choice, there is an absence of taking Chinese immigrant students as their research target group.

Keywords – Mode choice, Norms, Non-work activities, weekends, Chinese students

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1 Introduction

1.1 A challenge for cities

With the thriving of cities and urban economy, a series of side effects throw a considerable challenge to residents and policymakers. An inevitable result of urban development is that the number of motor vehicles has increased, with a side effect of traffic congestion. Since the last century, excessive traffic pressure has been plaguing and restricting the city's better and smarter development.

It is well known that exhaust gases in motor vehicles contain harmful substances, including particulate matter (PM), nitrogen oxides (NO_x), carbon monoxide (CO), and hydrocarbons (Winkler et al., 2018). The academic community has not stopped discussing and trying to reduce the harmful emissions of motor vehicles. However, in addition to the growing private motor vehicle ownership, another culprit in air pollution is traffic congestion due to slower driving speed and longer driving time. The reduction of traffic congestion contributes to decreasing harmful emission (Winkler et al., 2018). Countries have tried to manage congestion in order to reduce negative impacts. Not only limited to the pollution emitted into the air, but the side effects of traffic congestion is also threatening people in different ways. In 2013, by employing a simulation model, scholars found that exposure to traffic congestion can significantly increase health risks for on- and near-road-populations (Zhang and Batterman, 2013). Furthermore, these health risks can be fatal on occasion. It has proved that the density of traffic contributes to trauma deaths (including the traffic accident fatalities) (Lipfert et al., 2006). Besides the risks, the experimental results show that there is no correlation between road traffic noise and overall mental disorders, but there is some evidence that they are related to anxiety (Sygna et al., 2014) .

Due to the adverse effects of extensive traffic pressure, countries are trying to solve this through taxation. In the year of 2000, Texas Transportation Institute imposed a congestion charge of 68 million dollars on 75 urban areas (Taylor, 2002). Stockholm, the famous sustainable city, also took the lead in implementing relevant policies, namely the Stockholm trial. The Stockholm trial consists of two parts in total; 1) to increase the supply of public transport services from 2015, and 2) to start to impose congestion tax on

private cars in 2016 (Eliasson, 2009). In the case of Stockholm, they set 18 control points in the inner city and charged drivers when entering or exiting the city center.

However, as more and more countries begin to manage traffic through similar means, new problems arise. In the pilot area of Stockholm, traffic congestion has been alleviated significantly, and the government has increased its fiscal revenue. However, some scholars have questioned the success of this policy because the evaluation has neglected large areas which were not subject to the trial (Prud'Homme and Bocarejo, 2005). Furthermore, it is possible that some drivers bypassed the charging area in order to avoid payment, thus harming the reliability of the results.

Since 1986, due to the demand for fast- and low-cost policy tools, Santiago, Chile, has introduced a driving restriction policy that prohibits vehicles from being used on specific days of the week. Similarly, in China and Mexico, the government has adopted a policy to limit the number of private car driving days to reduce traffic (Sun et al., 2014). Beijing's traffic demand management for motor vehicles comes from the guarantee of traffic operation arrangements and order during the 2008 Beijing Olympics. From July 1st to September 20th, 2008, Beijing first implemented the One-Day-A-Week Limiting policy. On October 11th of the same year, it was adjusted to the "tail number limit" policy, from trial and short-term execution to transition to a long-term policy to ease traffic pressure in Beijing. One-Day-A-Week Limiting has a positive impact on the improvement of traffic conditions, and it is often used in mitigating traffic congestion, but excessively strict restrictions will encourage the frequent use of private cars, for instance if an individual wishes to socialise, causing the limit to be violated (Liu et al., 2018). A similar policy, the Hoy No Circula (HNC), was conducted in Mexico City, stimulating the need for families to purchase a second car, which in turn led to a further increase in the total number of vehicles (Sun et al., 2014).

In conclusion, every country has made many efforts to solve the traffic problem, but whether it is collecting congestion tax or restricting travel days, it can not solve the traffic problem fundamentally. For example, in order to avoid being charged, the driver may choose to bypass the non-charging area, pushing the issue elsewhere (i.e. traffic pressure transferred to non-charging areas). Another example mentioned above is that a large number of unnecessary second car purchases are made in order to cope with

the limit policy. Similarly, the congestion charging may give individuals extra financial burden on daily budget, for example the expense of childcare service (Saleh and Farrell, 2005). There are policies and measures to counter. If planners and policymakers want to comprehensively and fundamentally improve traffic management, they should consider using decision-making psychology, such as understanding needs and changing ideas, as their foundation.

1.2 New Opportunities

1.2.1 A New Mode Alternative – Bikes

One may ask a question, why not use fuel alternatives? Although there are promising new energy sources such as bio fuels and synthetic fuels, it can be costly (both money and time wise) within a short term, and difficult to implement to a large scale (Winkler et al., 2018). Moreover, in theory, it seems doable to transfer to active traffic mode, but it would be much difficult in reality. A cheap and easily available alternative is re-emphasized. In the 21st world, bicycles have become a new transportation mode choice for urban residents and help to move faster towards the sustainable transportation.

1.2.1.1 Bike-using in the Netherlands

The prevalence of bike-using in the Netherlands can be dated back to 1920, since then, bikes has became the most popular transportation mode (Lusk, 2012). Beyond its functions, bicycles has contributed to construct Dutch identity and social recognition. With this popularity, the Dutch government developed traffic policies for the bicycle (Ebert, 2004). In 1920s, the ownership of bicycles is roughly 64 times as many as cars tenure. Until 1940s, bikes still played a dominant role (Martens, 2007). However, after World War II, there was a shrink of bike-using and more road space for vehicle emerged (Stoffers, 2012). The re-prosperity of bike-using started from 1970s due to the bicycle-friendly planning and related encouraging policies (Van Goeverden and Godefrooij, 2011).

To date, bicycles has revived to be the main transportation modes for people who living in the Netherlands. According to the the Fietsersbond (Dutch Cyclists Union), a research concluded several patterns of Dutch bike use behavior: (1) the major purpose for bike

trips is shopping. The number of that is more than work trips and study trips, (2) women who aged from 30 to 60 conducted more bike trips, (3) Dutch conduct more bike trips than immigrants (Van Goeverden and Godefrooij, 2011).

1.2.1.2 Bike-using in China

China was a bicycle-dominate country in the last century. From 1970 to 1978, there was only a slow growth of the numbers of bicycles (Liu et al., 1993). Due to the economic reform policy in the year of 1978, the rapid growth of bicycles emerged (Zhang et al., 2014). In 1980, the ratio for bike ownership is a bicycle for 3 residents who living in the urban area of China (Jun and Heng, 1992). Later the ratio increased to a bicycle for 2 inhabitants in urban area (Zhang et al., 2014). To Chinese workers, bikes are considered as the only affordable transportation mode with frequent flexibility and stability (Ren and Koike, 1993). By then, the price of a new bike equaled to their average salary for two months (Liu et al., 1993). People took bike trips not only for work related purpose, also evidences showed for leisure and shopping activities (Ren and Koike, 1993).

However the trend faded since 1995 and the ratio of bike ownership dropped rapidly in 1996 (Tanaboriboon and Ying, 1993). Due to the relatively slow speed, policy-makers inferred that it was bike that influence the traffic system negatively (Jun and Heng, 1992). Moreover, with the economy thriving and rapidly urbanizing, the policies and plannings are designed focusing on vehicles. Beijing municipality even banned bike use in the year of 2002 (Tanaboriboon and Ying, 1993). But during that period, E-bikes became prevalent (Zhang et al., 2014). With the advent of the 21st century, the use of bicycles has significantly been reduced (Shi et al., 2010) until the fast spread of sharing bikes (Zhang et al., 2014).

There is no doubt that bicycles are currently a very promising green and environmentally friendly means of transport for Chinese cities. The number of public sharing bikes is still growing (Kaltenbrunner et al., 2010).

1.2.2 A New Policy-Making Strategy – Norms

For policy making, using administrative and economic means to achieve goals is the most common means. As mentioned above, administrative and economic instruments have

limitations in certain respects. In psychology research, some scholars have noticed the importance of psychological factors for policy making, but in the reality, Some empirical studies have found that governors can easily ignore the role of social norms (Cialdini, 2007, 2005). Norms, for a long time, there was an absence of generic definitions of norms (Gibbs, 1965). Bierstedt (1957) concluded it as a rule, a standard and a social expectation which guides our behaviour. Johnson (1967) described it as a behavioural pattern existing in our brain, and when we are following the guide of the pattern, the feeling of that can be seen as the process of accepting the norm. More than feelings, norm includes sanctions and beliefs (Morris, 1956).

Morris (1956) also suggested that the typology doesn't apply to the norms. But, now in the physiological literature remains different types of norms. Personal norms can be described as a moral obligation to conduct certain behaviour following the own-value system and feelings (Schwartz, 1973). And for pressures and rules from the outside, the social norms are personal understandings of group behavior in the whole society (Cialdini, 2003), and it can be seen as a individual perceptions of the behavior of a particular group (Lapinski and Rimal, 2005). Also, there are other norms involve in the norms system, see elaborations in the next chapter.

Via the neglect of norms, decision makers may make erroneous estimates leading to a reduction in policy efficiency. A example also given by Cialdini suggested that developers are tend to mobilize the public by describing the problem as exaggerated. Moreover, people's judgments are tend to be subjective, which also means that people mistakenly underestimate the influence of others' behavior on their behavior. However, as Schultz et al. concluded, in the past decade of practice, normative information have been used as the primary tool for changing social behavior in the practices of many countries. The areas involved are not only pro-environmental, but also related activities such as drinking, drug use, eating disorders, gambling and so on (Schultz et al., 2007).

Incorporating social normative factors into policy development may increase productivity. Fritsche et al. suggested that in an environment where the whole society agrees with pro-environmental behavior, the views from social norms will encourage them to make more environmentally friendly behaviors, for example, decrease the usage of private cars or join the car poolings. Besides, Cialdini advocated that instead of focusing on negative

behavior, policies that promote correct behavior will be more influential.

In the empirical findings of the relationship between traffic mode choice and norms, numerous studies proved that norms intervention is significant in the choice model. A recent study aimed to predict the acceptability of traffic policy relying on the Value belief-norms(VBN) theory found that VBN theory is statistically significant in reducing car use (Jakovcevic and Steg, 2013). Also, a research in Norway, Lind found that the influences of personal norms are significant to predict the changing of traffic modes Lind et al. (2015). Scholars employed an extended norm activation model to explore the behavior of car using in three German campuses (Klößner and Matthies, 2009). The personal norms are significant in the result of modeling, but in reality, it needs more time because it works if norms transform into habits. A research proved that the subjective norms, attitudes factors, and perceptions of behavior are jointly affected college students' use more public bus by the intervention of a prepaid tickets policy (Bamberg et al., 2003). Also, there are some findings of the social norms, for example, a field experiment assigned participants to different norms condition, and those in high social pressure decreased their car use by five times (Kormos et al., 2015).

Normative information play an invisible but crucial role in policy making. For one thing it helps people to avoid subjective errors, and for another thing it improves administrative efficiency. It is intuitive plausible that what should decision makers pay more attention to in the future.

1.2.3 A New Tipping Point - Weekends

Numerous studies on traffic centering on weekdays. However, weekend travel activities are very different from weekdays. Moreover, (Ho and Mulley, 2013) presents a result that the purpose of over 90 percent travels during the weekends are household maintenance and leisure-related. Also, a research found that people tend to travel longer on weekends (Shafizadeh and Niemeier, 1997). For the time allocation, Bhat and Koppelman (1999) found that most weekend travels are undertaken during the midday. Islam and Habib found that due to more free time and flexibility during the weekends, households tend to plan their travels more flexibly.

In research of commuting behavior, Bhat found that commuters gave priority to time

reliability because of a limited time budget (Bhat and Sardesai, 2006). Comparing to weekdays, Ho and Mulley (2013) found that the value of travel time savings (VOTs) are higher on weekends. Also in his tour-based research, the use of public transport shrink about 50% on weekends. It is worthy of exploring the decision-making mechanism on weekends.

Weekend can be seen as a good tipping point for policy implementing. Unlike the high demands on time and efficiency for commuting days, the choice of transportation modes for people on weekends is more flexible. This situation will also be more conducive to the implementation of environmental norms.

1.2.4 A New Group of People - Chinses Students Studying In The Netherlands

In the book of Cycling Culture, a writer explained the popularity of bicycles in the Netherlands as (Cox, 2015)

"Dutch government officials are invited to speak about cycling and it is regularly stated that cycling is in our DNA"

This shows how deeply the bicycle is integrated into the Dutch social culture. Indeed, now standing in a crossroad in the Netherlands, cyclists are the major part of traffic volume. Stoffers (2012) described it as a national phenomenon and it also presented at instances at a national level.

Students are proved to be the relative active part among city residents (Shaw and Thomas, 2006). International Chinese students living in the Netherlands are being exposed everyday to the active bicycle culture in the Netherlands. Many students have already bought bikes in the local area and joined the riders. Also, due to the safety regulations of the Dutch cycling, Chinese students here must also abide by when cornering, such as gesturing and giving pedestrian priority. It has been proved that bicycle culture effects cycling habits positively, and there is a negative correlation between national relevance and future cycling intentions, due to cultural exposure and intensity (Kaplan et al., 2018). Also, the traffic behaviors in the formative years are expected to influenced students' further mode choice(Hergesell and Dickinger, 2013). One can infer that the use patterns of bicycles

will change after these Chinese students in the Netherlands. And as ethnic group in the Netherlands, scholars pointed out a research of female immigrants that cycling in the Netherlands is a mean to meet their emotional and self-fulfilling needs (Kaplan et al., 2018). Thus, the use of bicycles by immigrant Chinese students will be academically valuable.

1.3 Research Aims

The purpose of this paper sought to investigate the effects of norms attributes on transportation mode choice in association with their non-work or non-study-related activity participation during weekends on international Chinese students who live in the Netherlands. Also, variables of trip characteristics and socio-demographics are estimated jointly. By understanding the traveler's behavioral decision-making model in terms of norms, experts can better make policy in the future. There is a silence on transportation mode choice on Chinese students who live abroad, so it is worthy to investigate their mode choice behavior.

1.4 Paper Structure

This chapter illustrates the general introduction and clarifies the aims of this paper. Chapter 2 outlines the background of this study, in the domains of mode choice, norms variables, and choice models. In Chapter 3, it presents the research strategy about survey design and framework of the Multinomial Logit Model (MNL), a variables list will be given as well. Chapter 4 focusing on the results of the descriptive analysis. Model parameter and results analysis can be found in Chapter 5. The last chapter (chapter 6) is the conclusion part, including the limitations of this study and future study suggestions.

2 Background

2.1 Mode Choice

2.1.1 Mode Choice Behavior

Mode choice behavior research has played an important role in policy-making and transportation planning over the past decades (Geurs and Van Wee, 2004). Since the 1960s, scholars has started exploring the reason why people tend to use private motorized modes instead of other public transit modes (Barff et al., 1982). To policymakers and researchers, understanding mode choice is essential, since it not only impact our travel efficiently and satisfaction (Johansson et al., 2006), also influence the transport planning, such as re-designing the function of traffic space in the city and providing new facilities and alternatives for traveler (Ortúzar and Willumsen).

Buying bus tickets, paying for gas, topping up the traffic card, those behaviors make the traffic mode choice a consumer choice behavior (Chen and Li, 2017). As a focal hub of the decision-making process, the choice of traffic modes including various aspects, such as factors in terms of evaluating the service quality of transportation, selecting a specific carrier, or negotiating the cost and performance (Petersen et al., 2005). Economists describe the choice process as a "blackbox", and claim that consumers tend to utilize all the resources maximum (Princen, 1999; Princen et al., 2002; Cherchye et al., 2009). For a decision-maker, he or she has binary, or multiple options(alternatives) to choose. By analyzing the attributes of the alternatives and socio-demographics of the decision-makers, the "black box" yields utility value of different alternatives (Chen and Li, 2017).

Since 1970s, researchers started use Discrete Choice Model(DCM) to analyze travel choice with multiple alternatives travel mode share, frequency, choice of destination, car ownership, residential location, travel purpose, spatial variation in buildings (Bussiere and Snickars, 1970; Crisalli, 1970; Harris, 1972; Wilson, 1971; Koppelman and Pas, 1980; Schwanen and Mokhtarian, 2005). Besides of exploring which choice people would make, researcher also employed DCM to predict the quantity of the alternatives (Dubin, 1988), for example, the number of cars a household would purchase.

2.1.2 Non-work travel on weekends

Although numerous literature contributes to providing systematic and thorough insights on commuting travel, in the past two to three decades, there still remains a research gap of non-work travel behaviors and mode choice.

The pattern of travel behavior on weekends can be different on weekdays. First, weekend and holiday travel usually covers a longer distance. Thus, most travellers prefer choosing motorized mode (Böhler et al., 2006). Second, the result of a national-scale survey in Germany indicated that the number of trips on weekends is lower than that on weekdays, and the trips conducted on Sunday is even less than trips on Saturday (Klößner and Friedrichsmeier, 2011a). Besides, the choices for weekend traveling for a long distance also can be more organized (Maria Kockelman, 1997). A study noted that people incline to use private cars for short-distance travel on weekends, because it would reduce the expense on transporting, especially for four people (Moyano et al., 2016). However, a study in New Zealand showed that older people especially like to use private cars on Sundays (O'Fallon and Sullivan, 2003). The increasing of private car uses is due to more leisure trips are conducted on weekends (Klößner and Friedrichsmeier, 2011a).

Scholar concluded that the specific choice of non-work transportation modes is related to numerous factors (Huang et al., 2008). It is easier to predict the individual's time allocation for work activities than for non-work activities since there are fewer space-time constraints for non-work activities (Kang and Scott, 2011; Bhat, 1997a). Specifically for recreation stops, people allocate more time on it (Misra and Bhat, 2000). In research of tourism, the traveling on weekends underlined the importance of factors in terms of time schedule rather than frequency, because people regularly organize their traffic mode in advance (Moyano et al., 2016). Sener et al. treated family as a "cluster" to investigate their activity and travel behavior on weekends, the propensities are significantly influenced by household attributes, such as household size, household income level and so on (Sener et al., 2010). Huang et al. suggested that, comparing to work travel, non-work travel (including shopping, visiting friends, etc.) will not follow a travel pattern invariably (Huang and Levinson, 2015).

2.2 Chinese Mode Choice

Before the economic reform policy, public transportation has not been fully developed (Liu et al., 1993). At that time, the transportation mode of most urban residents in China was relatively simple. In addition to walking, bicycles became the dominate role of (Liu et al., 1993; Ren and Koike, 1993; Jun and Heng, 1992; Tanaboriboon and Ying, 1993). In the late 1990s, the economic boom has led to a surge of car use (Hook and Replogle, 1996). Afterwards, an expansion also saw in public system. The metro network has been expended in the metropolitan area in China (Yang et al., 2015), however, the issue of whether the public transport system can reduce the use of private cars remains arguable (Pucher and Buehler, 2008).

Non-work trips for Chinese (such health care and go to the bank) are more likely to rely on the use of public transportation and non-motorization (Wang et al., 2014). It has been proved that people prefer paying more for transportation mode with more comforts and better service level (Huang et al., 2008), which can be explained by the economy thriving and salary increase (Pucher and Buehler, 2008; Dargay and Gately, 1999). But, the preference of car using has no significant difference between weekdays and weekends (Wang et al., 2014).

2.3 Dutch Mode Choice

The number of bicycles is immense, perhaps higher than the Dutch population (Rietveld, 2000b). Except for the long cycling tradition, the national and local governments all dedicated to encouraging cycling by providing facilities and offer tax compensate to commuters who use bikes (Heinen et al., 2013). Also, another common travel mode choice is Bike-and-ride, by which people use the bike to access public transportation for each trip (Martens, 2007). Due to it helps traveller save waiting time, the mode share of bicycle at the home end constitute 35% (Rietveld, 2000a).

The Dutch city government is actively promoting the policy of traffic calming. Due to these policies, car travel will lose the convenience of “door to door” compared to public transportation (Pharoah and Russell, 1991). Also see in pedestrian promotion projects, the number of walking trips increased, from 250 to 1600 each year can be observed for

Dutch people (Rietveld, 2000b).

We have reasons to believe that the number of bikes in The Netherlands is probably higher than the number of population. A survey shows that more 85% of the dutch people own a bicycle. (Rietveld, 2000b). The bicycle plays a crucial role in the research about accessibility of public transport in the Dutch society, under a condition of an number of trips of pedestrians (Rietveld, 2000b). However, like situations in other countries, car owners still tend to use private carsBhat (1997a). According to the result of a dutch survey, almost 66% car owners would not consider public transportation as an alternative choice (Van Exel and Rietveld, 2009).

2.4 Research Context

Latent variables denote concepts (Duncan et al., 2013), and they are inferred instead of observed (Gershman and Niv, 2010; Bollen, 2002). Besides of a plenty of researches connecting mode choice with physical factors with respect to built environment (Ewing and Cervero, 2001; Frank et al., 2008; Cervero, 2002), urban form (McMillan, 2007; Dieleman et al., 2002), and residential location (Anas, 1982; Vega and Reynolds-Feighan, 2009; Chatman, 2009), in the recent research latent variables are proved to be more effective.

There is no doubting that the quantitative analysis with respect to multiple latent variables leads to better understanding reasons behind 'individuals' decision-making. Traditional choice models have been improved and refined by introducing the constructions of latent variables (Ben-Akiva and Bierlaire, 1999a; McFadden, 1986; Pendleton and Shonkwiler, 2001).

In the research of mode choice, former studies hardly confronted the relationship between mode choice and cultural context. Actually, the change of social context has been proved to be effective significantly as well. Johansson et al. (2006) pointed out that the transformation to a sustainable and green transportation system plays a role in affecting mode choices. Although cultural context has been proved effective, another scholar noted out that they do not fully explain why people alter their traveling behavior to different situations (Triandis, 1989).

In many specific practices, policies cannot be implemented because it is difficult for people

to change their deep-rooted habits (Chen and Lai, 2011; Schlich and Axhausen, 2003). For example, residents who own private car hardly pay attention to public transportation or change their travel habitual modes. It exacerbates the tendency of inertia to act, including time pressure, distraction, and weakening of self-control (Wood and Neal, 2009). The habit of one behavior will also change. For instance, people who act more environment-friendly in waste recycling, may apply this behavioural habit to choose active travel mode and be less motorized. (Green-Demers et al., 1997). Habitual behavior may cause misunderstanding and out of context: People tend to deceive themselves by ignoring information that is inconsistent with their habits (Steg and Vlek, 2009). Thus the habitual variables are not adequate enough to explain travel behaviors and decision making.

The theory of planned behavior (TPB) states that attitudes, subjective norms, and perceived behavioral control impact people's wishes, and will change their behavior (Ajzen, 1991). Except for context and habitual factor (Armitage and Conner, 2001) The other latent factors of values, attitudinal and belief variables have been found effective in mode choice and travel behaviors. Steg and Vlek (2009) concluded that the more people agree to values that more important than their own interests, the more possible their behavior follows pro-environmental rules. The advantage of studying the latent variable is that using attitude and values can explain many seemingly unreasonable decisions (Steg and Vlek, 2009). Paulssen et al. (2014a) argued that the attitudes that influenced by personal values would impact people's mode choice in turn. In the application of Ben-Akiva et al. (2002), the latent variables of comfort and convenience are modeled through self-stated attitudes and explained the choice model successfully. Also, Johansson et al. (2006) founded that people's attitudes toward flexibility and comfort, as well as their recognition of environmental behaviors, affect individual choice patterns. The function was described by Ajzen that the better the attitude and subjective norms, the stronger the person's intention to perform certain behaviors in general. This is also partly given some policy implications that in addition to economic incentives, there are other ways to guide people to change the habits of transportation. Furthermore, the more subjective norms or behavioral control concepts change, the influence of previous behaviors, such as habitual behavior, on subsequent behaviors should become insignificant (Terry and O'Leary, 1995).

2.4.1 Norms Variables

This paper explores the influence of norm variables on mode choice and activity participation using the TPB framework. Additionally, this research adopts the extended norms taxonomy (Thøgersen, 2006), which distinguishes many social and personal norms. Koppelman and Lyon (1981) first found that a specific traffic mode has a positive relationship with feelings of convenience, feelings of normative beliefs, and general service. Human action is guided by three considerations: (1) beliefs about the possible outcomes (behavioral beliefs), (2) beliefs about the people take normative expectations from others (normative beliefs) (3) and beliefs about the factors may prevent proplr from doing something in the future. Bamberg et al. (2003).

The relationship between intention and normative beliefs is mediated by perceived social norms (See the TPB framework in Figure 2.1).

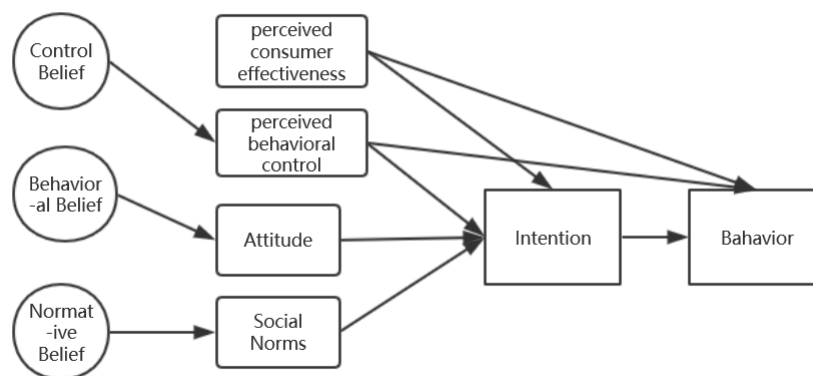


Figure 2.1: Theoretical framework of the theory of planned behavior (Ajzen, 1991)

For a long time, there was an absence of generic definitions of norms (Gibbs, 1965). Bierstedt (1957) concludes a norm functions as a rule, a standard and a social expectation which guides our behaviour. Johnson describes it as a behavioral pattern existing in our brain. When we are following the guidelines of the pattern, the consequent feeling can be seen as the process of accepting the norm. Aside from feelings, norms include sanctions and beliefs (Morris, 1956). In general, norms are considered as the common beliefs about how we should act and behave in society (Wenzig and Gruchmann, 2018). Norms differ based on whether they are internalized or not (Ajzen and Fishbein, 1970; Schwartz, 1970).

Internal norms are well known as personal or moral norms (Deutsch and Gerard, 1955). External norms are often called social, subjective, or perceived norms (Ajzen Fishbein, M. 1980). Norms represent individual behavior based on either self-interest (internal) or cooperation in society (external). Several norm activation models have been developed to explain influences on people pro-environmental behaviour (Nordlund and Garvill, 2002; Stern, 2000).

Stern (2000) proposed a practical operation case about the normative activation model, which is about the application of environmentalist value belief norm theory. Also, Stern (2000) advanced a causal chain to promote environmental protection behavior, which consists of five elements: altruistic values, beliefs about the correlation between human society and the environment, awareness of serious negative consequences, the perceived ability to reduce these risks. All this five variables are proved to be effective in provoking the awareness of responsibility to take pro-environmental action (Steg et al., 2005; Tarrant, 2010). People's acceptance of such values is also very different, even the generation gap (Wey Smola and Sutton, 2002) And there are also studies that demonstrate that macro-level values can activate environmental concerns and personal norms, thereby guiding environmentally beneficial actions. Thøgersen (2006) explores the powerful mechanism between norms and environmentally responsible behavior. Similarly, Herek et al. (2009) demonstrates that moral norms contribute to give a explanation of four environmentally relevant behaviors, including choose to public transportation rather than private cars, slightly breaking through the theoretical framework of TPB. However, for those who lack identity with a behavioral reference, the effects of the perceived norms of the group are relatively weaker (Terry and O'Leary, 1995).

Thøgersen (2006) indicates it is hard to distinguish between descriptive norms and injunctive norms. A positive sign on the relationship between descriptive and subjective social norms are found (Fischer et al., 2009) , which makes it hard to untangle their effects from each other. Social norms, introjected norms are assumed to work in a circulation (Thøgersen, 2006). Social norms are believed to be more significantly correlated with introjected norms (Wenzig and Gruchmann, 2018)

On the other hand, it is suggested that people follow social norms not only because these are signs of normal behaviors (Bamberg et al., 2011), but also it provide a criteria

of identifying the preferred behaviors in the society (Bamberg et al., 2011). Whereas at the same time, personal norms are proved to be the factor which makes people to judge whether a behavior is morally right or wrong (Bamberg et al., 2011). But in the end, social norms can be internalized and effect behaviors as personal norms (Bamberg et al., 2011).

The perception of introjected norms are in line with feeling guilty, which can be considered as a pro-social emotion which helps to compensate for the caused loss or damage (Gailliot and Baumeister, 2007). With the co-effect of descriptive norms, introjected norms are able to explain behaviors in a study of cannabis use Heath and Gifford (2002). Conner and McMillan explored how three different norms effect on cannabis use, they found that introjected norms were statistically significant but no longer being significant after descriptive and social norms entered in the model jointly Heath and Gifford (2002). To study the effects of social norms on consumer's food purchases Wenzig and Gruchmann (2018) formulate statements corresponding with the different norms (see table 2.1). This research adapts these statements to be used in mode choice.

Table 2.1: Questions of Norms

Personal Norm	My own values make me feel obligated to buy local food.
Introjected Norm	I get a guilty conscience when I do not buy local food. When I buy food from other continents instead of local food, I feel bad.
Social Norm	People, who influence my buying behavior, think I ought to buy local food. People who are important to me expect me to buy local food
Descriptive Norm	I believe that many people in the society, who are important to me, buy local food.

2.5 Socio-demographics

Geo-scientists have plenty explored how mode choice is impacted by socio-demographic variables. Age, Socio-economic status, and location of the residence were proved to be effective strongly of spatial behavior (Perchoux et al., 2014). Some of them confirm the significant effect of several socio-demographic characteristics on daily activity and mode choice (Bhat, 1997b; Shafizadeh and Niemeier, 1997; Schwanen and Mokhtarian, 2005;

Koppelman and Lyon, 1981). For example, the results in a recent study highlight income affect opportunities and constraints according to personal, contextual characteristics and thus lead influences to activity (Calastri et al., 2017). Also, scholars hypothesize that differences not only in 'people's attitudes but also in personality traits lead them to attribute varying importance to environmental considerations, safety, comfort, convenience and flexibility (Johansson et al., 2006). Household and presence of children are frequently tested socio-demographic factors which deeply influenced every aspect of daily activity (Verplanken et al., 2008) According to a research, it can be concluded that the slow mode share for travelers who have young children is less in their work trips but more in their non-work trips, compared to that for travelers those who do not have young children(Liu et al., 2015).

In a comprehensive research of Chinese weekend transportation mode choice with socio-demographics, it has been proved that (1)women are more inclined to choose public transportation, (2) the younger the residents, the more they prefer to travel by public transportation, (3)households with preschool children, migrants, women, younger ages, higher education, are more inclined to choose slow traffic (walking and non-motorized) for leisure trips, (4) low-income and middle-income families, middle-aged people, younger or older people, and residents with citizen cards are more inclined to public transportation, (5) public transport (especially the subway) is significantly more competitive in travel demand when it comes to recreational trips, long travel time and distance, (6) residents with private cars, young people, male will travel more by car significantly, (7) low-income travellers are not inclined to car trips, (8) compared with the work and shopping trips, residents more likely to use private cars for leisure activities (Luan Xin, 2018).

2.6 Model

Lave and Train studies the structure of the household's mode choice, such as auto, and accommodated various auto characteristic, household characteristics and driving environment factors into the model by employing a Multinomial Logit Model (MNL)(Lave and Train, 1979) . Sener et al. shed lights in relationship with cycling choice and policy making by using MNL, specifically, route attributes with a high impact on cycling behavior(Sener et al., 2009). Combining the sharing bike ratio and the residents travel

OD matrix, Wu et al. employed a multinomial logit model to forecast the total number of public bicycles and the parking piles (Wu et al., 2013).

An investigation mainly centering on household travel mode choice and behavior differences with respect to car ownership, mode choice, and trip-chaining behaviors by employing a Nested Logit Model (NLM) (Dissanayake and Morikawa, 2002). Moreover, a multi-level approach is used to explore how personality traits and specific situations impact mode choice of autos in a student sample (Klößner and Friedrichsmeier, 2011b). A study used Hybrid Choice Model to investigate effect of students' attitudes toward walking and cycling and the results showed the more they enjoy walking or cycling, the less they want to use private car (Kamargianni and Polydoropoulou, 2013). Mixed Logit model (MLM) is applicable in route choice study due to it has no constraints on the correlations and substitutions of alternatives (Train, 1998). A study estimated how latent variables work and flexible substitution patterns across the modal alternatives by Mixed Logit model (Paulssen et al., 2014b). In addition, the Latent Class Model (LCM) assumes that a discrete number of latent classes are sufficient to account for preference heterogeneity also be employed for mode choice research (Shen, 2009).

The MNL model is mainly used when there are multiple categories of dependent variables. Which is also the most widely used model in the research domain of traffic mode choice. McFadden uses MNL to explain the choices made between alternatives when the attributes of the alternative itself and the attributes of the decision-maker affect the outcome Ewing et al. (2004). This paper will employ the MNL model to analyze the data derived from online surveys.

2.7 Summary

Figure 2.2 illustrates the conceptual model that is derived from the theoretical background. This conceptual model contributes to explore the effects of norms attributes on transportation mode choice in association with their non-work or non-study-related activity participation during weekends on international Chinese students who live in the Netherlands. Those variables will be estimated jointly. The description of variables and corresponding questions designs will be given in the next Chapter.

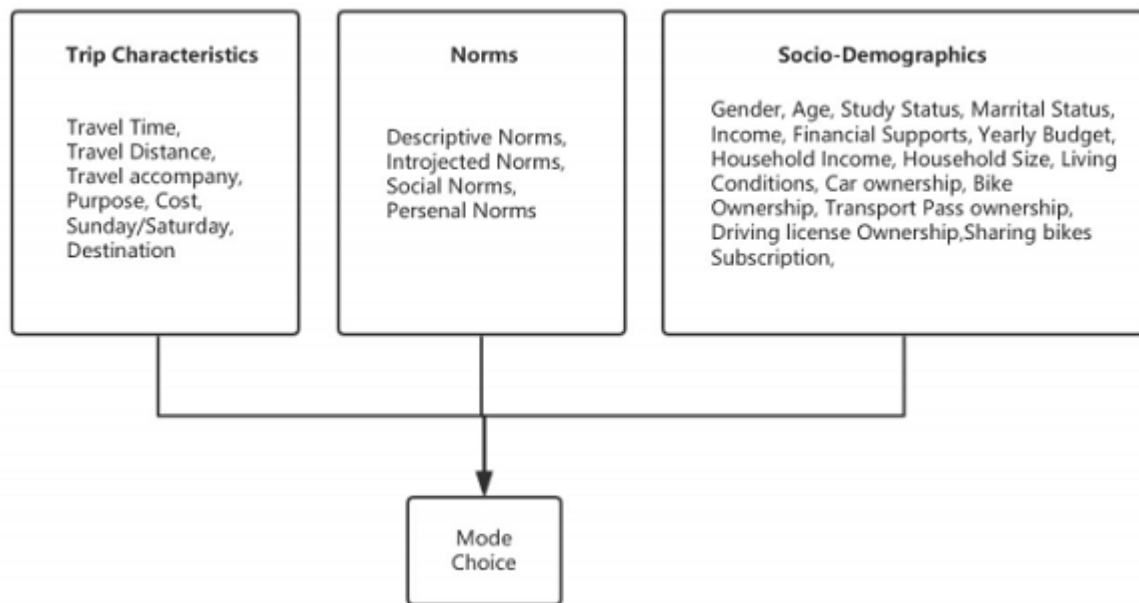


Figure 2.2: Conceptual Model

3 Methodology

3.1 Survey Design

3.1.1 Strategy and Method

The survey is designed by revealed preference (RP) theory which reflects the transportation mode choice they actual made (cha, 2018). In the survey of transportation, a self-reported RP survey helps respondents to provide their actual trip characteristics and socio-demographics information. The essence of the revealed preference(RP) survey is to reveal the real choices or objective conditions of people in the real world (Cherchi and de Dios Ortúzar, 2002), as well as the data results of the existing surveys. The RP survey has limitations due to it is the self-report attributes (Boyle, 2003). Moreover, exploring the impact of some factors usually gives assumptions or scenarios, asks people's attitudes and wishes, and infers the feasibility of making changes in the future (Loewenstein and Schkade, 1999). The primary research purpose in this thesis is to explore the influence of norms and socio-demographics on transportation mode choices during weekends. This study offers five different modes based on reality, such as walking, bicycle, public transportation (PT), bicycle, taxi, and private car. At the same time, the third section of the survey aims to collect socio-demographics information.

3.1.2 Design Tool

The design of this study is cross for two target groups: Chinese students living in the Netherlands (first questionnaire) versus students living in China (second questionnaire). Our designed online was survey implemented in Wenjuan and Limesurvey platforms. In order to inform participants about the purpose of this study, a written briefing is sent with an introduction. For data collection, the sample comprises Chinese international students who live in the Netherlands and Chinese students who live in China. 75 students living in the Netherlands and 130 living in China filled out the survey.

3.2 Pilot Study

Before starting data collection, a pilot study was conducted from 4-10 May 2019 to detect possible shortcomings or avoid overlooking errors within the questionnaire. As a result of this pilot study, several questions were reformulated because of misunderstandings, and other questions were deleted from the questionnaire because of the relatively large amount of time people had spent to complete the survey.

3.3 Survey Structure

The Figure 3.1 presents the flowchart of the this survey. All questions are mandatory , and it is impossible to jump to the question. Besides, participants who do not have a complete answer will not be included in the sample dataset.

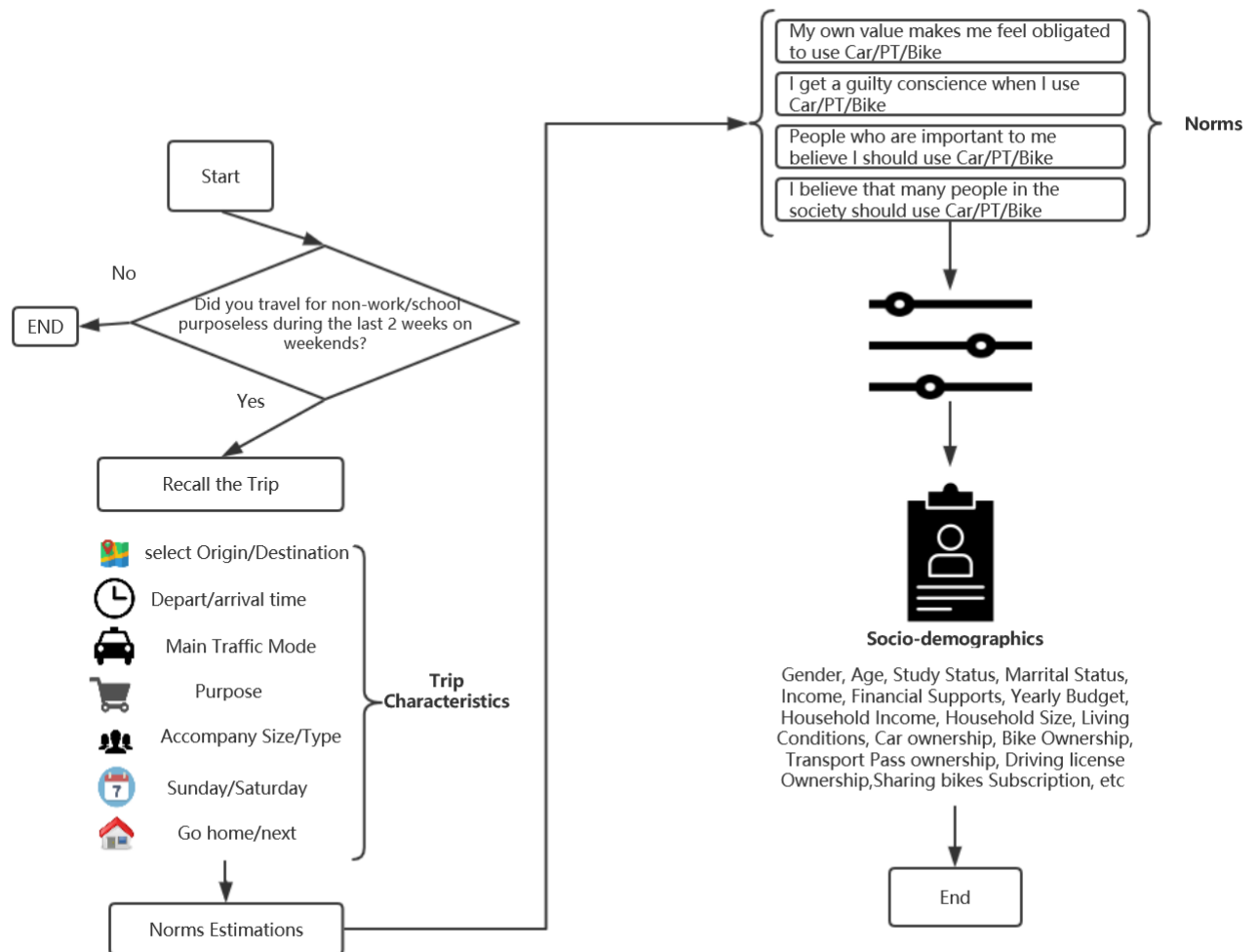


Figure 3.1: Survey Structure

3.4 Data collection and code

The entire data collection process started from May to the end of June, 2019. During the period, the questionnaire was mainly spread in two ways, (1) send a questionnaire link to eligible respondents via email or social network, (2) invite them to fill out the questionnaire on the tablet by approaching them in the public space, such as central stations and campuses. After obtaining all the first-hand information, in order to employ a model to analysis, it is necessary to clean the data, encode, and re-code into dummy variables.

A total of 206 questionnaires were collected, of which 75 were collected in the Netherlands and 131 in China. In order to reduce the error and make the experimental results more accurate, Chinese respondents were screened by the rules of age, gender, study status and other economic factors. And then randomly 75 individuals were selected to be considered as the final data set for China.

The Travel Characteristics variables are described in Table 3.1, and the details of the rest independent variables are presented in Table 3.4. The norms-related statements are described in Table 3.2 and Table 3.3. The descriptive statistics for the main variables is given in the last part of this chapter.

3.4.1 Travel Characteristics

The questionnaire is organized as follows: the first part is aiming to collect travel information. The goal of this part is to know their travel details on one day of the last two weekends. Six variables are examined in this part including travel distance, travel duration, the main travel mode, travel purpose, accompany type and size. The questionnaire is attached in the appendix.

Table 3.1: Variables of Travel Characteristics

Variables	Descriptions
ID	Identifier of the respondent who described the trip they conducted in the past two weeks. There are 75 completed surveys collected from students in the Netherlands and 75 in China
Distance	A Google map application has been introduced into the online survey. The respondents can drag and drop the pin to their desired locations. In this case, they are the location of origin (home address) and destination.
Travel time	Respondents are required to recall the exact time when they left home and arrived at their destination. The questions of leaving and arriving time are presented in a format of HH: MM. For the convenience of analyzing, duration of time use minutes as the unit.
Mode Choice	The choice variable. If multiple traffic modes are used, the survey only records the main mode, which cost the most of the time. 1=public transit, including public bus, tram, metro, train, and so on. 2=bike. 3=walking, 4=car, 5=taxi/Uber.
Purpose	The purpose of trips also affect the traffic mode choice. Purpose question aims to know the main activity at a destination. 1=household maintenance, including doing groceries, postal errands, go to the bank and etc. 2=social, containing all activities with a main social purpose. 3=leisure, for example, visit a museum or exhibition, go to the theatre. 4=sports. 5=shopping, centering on clothes/ cosmetics/ sport gear and etc. 6=health care.
Accompany size	How many people traveled with the respondent to her/his destination.
Accompany type	If the accompany is an adult, the answer is coded as 1. 2= younger than 18 years old. 3= traveled with both adult and non-adult.
Cost	The total expenditure of the main traffic mode. 0 = the mode 'does not generate any fare, e.g., using a bike or walking. 1=no cost 2= 0 3yuan, 3=3.01 9yuan, 4=9.01 up, 5= 0 3 euros, 6=3.01 7 euros, 7= 7 euros up
To home/to next	A binary variable. 1= go back home after the first destination. 0= go to the next destination.
CBD distance	The distance between their residential location to the Central Business District from the coordinates they provide. The unit of this variable is kilometer.
ggmap time	Although this survey allows respondents to click their departure and arrival time, the theoretical travel time calculated by Google map still worth to take into consideration. The unit of Ggmap time is minutes.
ggmap cost	The total cost calculated by Google map based on the origin and destination information.

3.4.2 Norms Variables

The survey conducted here was a follow-up to Wenzig and Gruchmann (2018), and so it used almost the similar questions here adjusted with different paraphrasing aimed at uncovering the effects of four different social norms on respondents.

Likert introduces a measurable potential construct indicator based on the total scale, which is subjective and cannot be directly observed or measured (Likert, 1932). Instead, they can be measured by feelings, behaviors, expressions, and personal opinions, and data can be obtained using a questionnaire. Investigators can measure potential constructs through a series of questions. Each item has five scales: "completely disagree", "a little disagree", "Unclear", "Comparative consent", "very agree", corresponding to scores 1, 2, 3, 4, 5. Attitude is an important variable of potential characteristics. Attitude means that one's emotions and feelings come from the experience of learning the target things. From the study, there will be a feeling of approval or disapproval, consent, or disagreement. This trend ranges from low intensity to high intensity. The advantage of the Likert five-scale scale method is that it is simple in design and can measure comprehensive indicators that other scales cannot measure, in order to measure multi-dimensional complex concepts. The reliability of the scale is also relatively high. Using the scale, the respondent can quickly and accurately locate his own inclinations and attitudes.

For the details of Table 3.2, Respondents were asked to indicate the extent to which they agreed or disagreed ("1-I definitely disagree", "2-I somewhat disagree", "3-I neither agree nor disagree", "4-I somewhat agree", "5-I definitely agree") with the following statements which correspond to our explanatory variables:

Table 3.2: Variables of norms

Personal norms	My own value makes me feel obligated to use Car/PT/Bike
Interjected norms	I get a guilty conscience when I use Car/PT/Bike
Social norms	People who are important to me believe I should use Car/PT/Bike
Descriptive norms	I believe that many people in the society should use Car/PT/Bike

For the purpose of modelling the choice and latent variables, all the variables are re-coded into dummy variables. Based on their response scale where above or equal to 3 or not, see details in Table 3.3;

Table 3.3: Latent Dummy Variables

DApnCar/PT/Bike	I disagree that my value makes me feel obligated to use Car/PT/Bike
DAinCar/PT/Bike	I disagree that I get a guilty conscience when I use Car/PT/Bike
DAsnCar/PT/Bike	I disagree that people who are important to me believe I should use Car/PT/Bike
DAdnCar/PT/Bike	I disagree that many people in the society should use Car/PT/Bike

3.4.3 Socio-demographics

The socio-demographic variables in this study included age, gender, study status, employment situation, marital status, living budget, income level, financial source, household income level, living to accompany, driving license, car ownership, bike ownership, sharing bike membership and transport-pass ownership. In table 3.4, one can find the complete details of these variables.

Table 3.4: Variables of Socio-demographics

Variables	Descriptions
Gender	1=female, 2=male.
Age	1=18-20, 2=21-25, 3=26-30, 4=31-40, 5=41 and above
Study status	1=Bachelor,2=Master, 3=PhD
Marital status	1=unmarried, 2= married, 3=legal partner
Yearly Budget(YyBDG)	The financial budget for living expense in the all year. YyBDG1=less than 10000yuan, YyBDG2=10001-20000yuan, YyBDG3=20001-30000yuan, YyBDG4=30001-40000yuan, YyBDG5=more than 40001yuan, YyBDG6=less than 10000euros, YyBDG7=10001-13000euros, YyBDG=more than 13000euros
Income	A monthly income. 0= no income for now, 1= lower than 1000 euros
Financial Support	The financial source. 1=family support, 2=support by employer or organization (e.g. China Scholarship Council), 3=saving, 4=scholarship and loan
Household income	The total household income in the year of 2018
Household Size	The number of people live in the household except for the respondents. 0= no family member, 1=living with one person, 2=living with two people, 3=living with three people, 4=living with more than three people.
Household Adults size	The number of adult live in the household. Also except for the respondent her/himself.
Live with Household	A binary variable. 1=living with family member now, 0=not living with family member now.
Number of roommate	Number of the roommate they are living with during their study process.
Number of Car Own car in the Netherlands	Number of car they owned in their household. Number of car they owned in the Netherland. Apparently, none of the respondents own a car in the Netherland.
Own bike	A binary variable to ask if they have a bike or not.
Own OV-card	A binary variable of OV-chipcard ownership.
Own Chinese Trans-pass	A binary variable in terms of the ownership of a Chinese transport pass card.
Own Chinese Driving license	A binary variable about driving the Chinese driving license.
Own Netherlands Driving license	A binary variable to ask if they have a driving license or correspondent certificated document in the Netherland.
Own Sharing bike Subscription	A binary variable with respect to the subscription of any sharing-bike.
Sat/Sun	1=Saturday, 0= Sunday

3.5 MNL Model

3.5.0.1 Choice Set Generation Process

Ben-Akiva and Boccara (1995) defined a choice set that is a set which contains all the possible alternatives to the decision-makers. Ben-Akiva and Bierlaire (1999b) described the sophisticated process of identifying all the alternatives to an individual as the a *choice set generation*. In the studies of traffic mode choice, the general approaches for this process are to take alternative availability into the modeling framework by particular rules (also see in (Ben-Akiva and Boccara, 1995)). Furthermore, Ben-Akiva and Bierlaire also gave an example of determining the availability of cars by asking individuals whether they have a valid driving license. Thus, following the choice set generation process, the new factors of availability create by rules are as below.

Table 3.5: Availability

Availability of Cars	Maintain a valid driving license Owns more than one auto in the household
Availability of PT	There is a bus stop within 1km of the place of residence.
Availability of Bikes	Own a bike The city where he/she lives has a sharing bikes system
Availability of Walking	Physically sound and capable of walking independently
Availability of Taxis	Valid taxi service in the place of residence

3.5.0.2 Multinomial Logit Model

The MNL model is based on four assumptions, as Anas (1983) concluded: (1)The alternatives utility for all individuals in the model is the same, (2) No matter whether the number of decision-makers increases or decreases, the utility coefficient will not change, (3) Similar to other logit models, the MNL model is subjected to Gumbel distribution, (4) Every decision-maker will maximize utility.

Also, the MNL model in mode choice model is relying on the assumption of independence of irrelevant alternatives (IIA) (Hausman and McFadden, 1981a), and The IIA property

has been criticized that it lays more constraints on the MNL model. Specifically, it requires the ratio for the probability of any two alternatives is independent and is not affected by any other alternatives (Crown). For example, the possibility of a white-collar choosing PT to work will not change if a new alternative (bikes) is introduced into the choice set.

In the assumption of each ε is distributed independently, at the same time, it is accordant to the extreme value distribution. The maximum-likelihood methods would estimate the parameters of this choice model. The log-likelihood function (see detail in Maddala) is shown as below:

$$\sum_{i=1}^{75} \left(\sum_{j=1}^5 I(y_{ji}) X_{ji} - \log \left[\sum_{j=1}^5 \exp(X_{ij} \beta_{ij}) \right] \right) \quad (3.1)$$

Here, I is the indicator function. Therefore, each observation provides two terms to the log-likelihood function. One is X_{ij} , and the other is minus the logarithm of the denominator, see in 3.1. It is widely used that researchers employ an approach of maximum likelihood estimation (MLE) to estimate the logit parameters. Börsch-Supan and Pitkin (1988) concluded several advantages of the MLE method: (1)convenience (2)eliminated the trouble of the evaluation of multiple integrals (3) the likelihood function is concave.

3.5.1 Mode Structure In This Case

Considered in our study, there are five different categories of the mode choice, namely private car, bike, walking, public transportation and taxi. The utility function for mode j (classes for students in the Netherlands versus students in China) to the student i is defined as follows:

$$U_{ij} = V_{ij}(SD_j, TD_j, NM_j) + \varepsilon_{ij} \quad (3.2)$$

SD is a vector of the socio-demographics of respondents.

TD is the vector of travel details.

NM is the vector of norms.

ε is a vector of unobserved components

j is the choice of traffic modes.

A probability of the mode would take the form as follows:

$$P_{ij} = \frac{\exp(\beta_j X_{ij})}{\sum_{K=1}^5 \exp(\beta_k X_{ik})} \quad (3.3)$$

Where X_i is the vector of explanatory variables which used to describing observation i , β_k stands for the vector of weights (or regression coefficients) corresponding to outcome k , and the score with respect to assigning observation i to category k is displayed as $\text{score}(X_i, k)$. In the discrete selection theory, the final prediction results will choose the one with the highest score. In terms of score, observations represent respondents, and outcome represents choices, and scores are considered to be related to i chooses k .

4 Data

4.1 Descriptive Analysis

In this chapter, the descriptive statistical results of the online surveys are discussed. Table 4.1 displays the means and standard deviation (σ) of the continuous variables. Table 4.2 presents the frequencies of categorical variables. A comparison is made between the results of the online survey in the Netherlands (NL) and the online survey in China (CHN).

See in the Table 4.1, on average, the amount of travel distance of students in the Netherlands on the weekend is bigger than that in China. The travel time of Chinese students in the Netherlands is nearly 10% less than that of students in China. The cost of travel in the group of students in the Netherlands is three times less than that of the group of students in China (0.77euros and 2.35euros respectively). The average distance from the residence to CBD of the students in China is 12 km. For the students in the Netherlands the distance is about 5 km.

The variable with the biggest standard deviation is travel time, up to 48.36. The standard deviation of travel time and travel distance in the Netherlands is bigger than that in China, and the standard deviation of CBD distance is the opposite. In terms of norms variables, the value of standard deviations are close, roughly around 1. The biggest variance shows in the personal norms of cars for students, the smallest is the variable of introjected norms of bike.

The norms are referring to what extent the respondent agrees or disagrees with given statements. The higher the score, the more they agree. The statement with the highest average score is PN_{pt} (personal norms of PT), with a score of 3.6. The students in China commonly disagree with the statements of IN_{pt} (introjected norms of PT) and IN_{bike} (introjected norms of PT), both of them have a score of 1.4, which is the lowest. For students in the Netherlands the statement of PN_{bike} (personal norms of bike) has the highest average score (3.68) and IN_{bike} has the lowest score (1.2). Both the students in China and the students in the Netherlands agree that their value makes them use PT and bicycles, Although students in the Netherlands indicate that they are more inclined to the use of bicycles than the use of public transport. Students in the Netherlands show

approval of the descriptive norms that the society should make more use of bicycles, while students in China display a more neutral attitude towards bicycle use. Concerning social norms, students in China feel less pressure about using a bicycle, while Chinese students in the Netherlands feel that they agree that they adhere to social expectations of using bicycles.

Table 4.1: Summary Of Sample: Average Values Of Variables

Variables	China (mean/ σ)	Netherlands (<i>mean</i> / σ)
<i>Trip Characteristics</i>	-	-
Distance (<i>km</i>)	11.3(21.5)	18.9(34.7)
CBD (<i>km</i>)	11.7(12.6)	5.1(7.95)
Traveltime (<i>mins</i>)	55.4 (43.5)	46.2(48.36)
<i>Norms Variables</i>	-	-
Personal Norms car	2.71(1.33)	2.21(1.1)
Personal Norms PT	3.6(1.16)	3.56(0.92)
Personal Norms bike	3.23(1.2)	3.68(0.98)
Introjected Norms car	2 (0.98)	2.28(1)
Introjected Norms PT	1.4(0.77)	1.53(0.9)
Introjected Norms bike	1.4(0.74)	1.2(0.64)
Social Norms car	2.15 (0.95)	2.05(0.85)
Social Norms PT	3.41(0.97)	3.47(0.98)
Social Norms bike	2.91(1)	3.44(0.99)
Descriptive Norms car	2.91(1.12)	2.81(0.99)
Descriptive Norms PT	3.08(0.91)	2.95(0.96)
Descriptive Norms bike	2.84(0.8)	3.17(1)

Table 4.2 contains a summary of the data about travel characteristics and socio-demographic information. The purpose of travel of students in China is mainly for social activities and recreation, while students in the Netherlands use more time conducting trips for household maintenance. Coincidentally, both in the group of students in China and the group of students in the Netherlands 53.3% traveled alone, and 70.7% went back home after the first destination. Students in China prefer traveling with a bigger group more than Chinese students in the Netherlands. More than half of the respondents in the Netherlands chose to travel by a free mode, such as cycling and walking. Also, students in the Netherlands more commonly travel on Saturdays than students in China.

Both samples contain more females than males. Most respondents are 18 to 25 years old, among the students in the Netherlands more respondents are 26 years old or older than in

the group of students in China. Apart from the considerable share of Master students, the sample from the Netherlands involves more Ph.D. students, while the sample from China contains more Bachelor students. 92% of students are unmarried, and no income group accounts for the central part of both samples. The annual budget level of students in the Netherlands is much higher than that of students in China. The budget level of students in the Netherlands is much higher than that of students in China. Moreover, students in the Netherlands has a budget level of at least close to 10,000 euros. Regardless of where they live, the primary source of income for respondents is family support.

The number of Chinese students in the Netherlands students from low-income families is lower than that in the group of students in China. Overall, the household income levels are higher in the latter group. Most students come from a household with a size of one to three people. Most students do not live with their families in both samples. The group of students in China has a lower number of car-free households (17%) than the group of students in the Netherlands (32%). However, at the same time approximately 30% of the students in the Netherlands come from a household which owns more than one car, comparing to 21% for students in China. In the Netherlands, the majority of students chooses to buy a bicycle and subscribe to a membership of sharing bike systems in China simultaneously. Only around 10% of the students in the Netherlands have their driving license and have the valid documents to ensure they are allowed drive in the Netherlands. None of them owns a car.

Table 4.2: Summary Of Sample: Variables

Variables	CHN	NL	Variables	CHN	NL
Purpose			Financial		
Household	6.7	30.7	family	61.3	64
Household maintenance					
Social	50.7	25.3	employed	22.7	28
Leisure	26.7	21.3	savings	2.7	8
Sports	9.3	8	Household	Income(yuan)	
Shopping	5.3	14.7	<100k	25.3	8
Healthcare	1.3	0	100k-199k	42.7	44
Compartment	Size		200k-299k	9.3	22.7
alone	53.3	53.3	300k up	22.7	25.3
1	10.7	20	Household	Size	
2	14.7	14.7	alone	26.7	13.3
3	8	6.7	1-3	57	73.3
4+	13.3	5.3	4+	13.3	13.4
Accompany	Type		LivingwithHH¹		
adult	42.7	53.3	yes	28	17.3
other	4	46.7	no	72	82.7
Cost	(yuan)	(euros)	Nbcar²		
free	26.7	56	no car	17.3	32
0-3	24	20	1	61.3	38.7
3-9	34.7	10.7	2+	21.3	29.3
9+	14.7	13.3	Own Bike		
To home			1+	38.7	82.7
yes	70.7	70.7	no	61.3	17.3
Gender			OwnCHNTP³		
female	56	53.3	yes	90.7	89.3
Age			OwnCHNDL⁴		
18-25	85.3	70.7	yes	70.7	61.3
26up	14.7	29.3	OwnS-Bikes⁵		
Study Status			yes	69.3	81.3
Bachelor	40	6.7	Date		
Master	56	69.3	Saturday	52	62.7
PhD	4	24	Sunday	48	37.3
Marital	Status		OwncarNL⁶		
unmarried	92	92	no	100	100
Income	(yuan)		OwnNLDL⁷		
no income	38.7	66.7	yes	0	10.6
< 1000	22.7	0			
1001-1499	17.3	0			
1499+	21.3	33.4			

¹ Living with household ² Number of Car ³ Own Chinese Transport Pass⁴ Own Chinese Driving License ⁵ Own Sharing bikes subscription⁶ Own Car in the Netherlands ⁷ Own Netherlands Driving License

Figure 4.1 summarizes the mode choice of respondents in China and the Netherlands for the non-work trip on weekends. The first difference between the two respondent groups can be found in the use of cars and taxis. The respondents living in the Netherlands do not use private cars or taxis, while students in China who travel by private cars and taxis account for roughly one-fifth of the total. The second noticeable difference is reflected in the choice of bicycles. The number of cyclists in the Netherlands is almost three times that of China (36% and 13% respectively). There is not much difference between users of public transport and pedestrians.

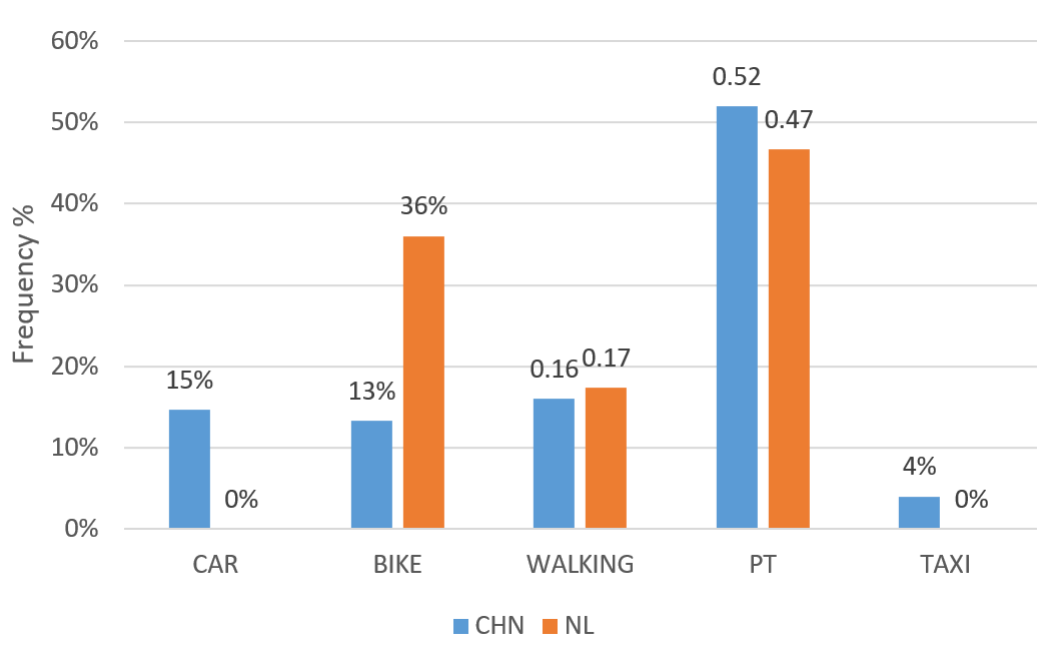


Figure 4.1: Mode Choice

4.1.1 Travel Characteristics

Figure 4.2 presents the means of traveling distance of one trip on weekends. People who use the private car travel roughly 15 times longer than those who use taxis (30.9 km and 2.07 km, respectively). Although the price of taking a taxi in China is relatively lower than in the Netherlands, in this case, people do not take a taxi to a distant destination. For people who use the bicycle, cyclists in the Netherlands travel 5.4 kilometers averagely, while those in China only travel 2 kilometers. The traveling distance of pedestrians does not show many differences. However, there is a big gap between the group of students in China and the group of students in the Netherlands who take public transportation. Students who live in the Netherlands more often travel by train during the weekends.

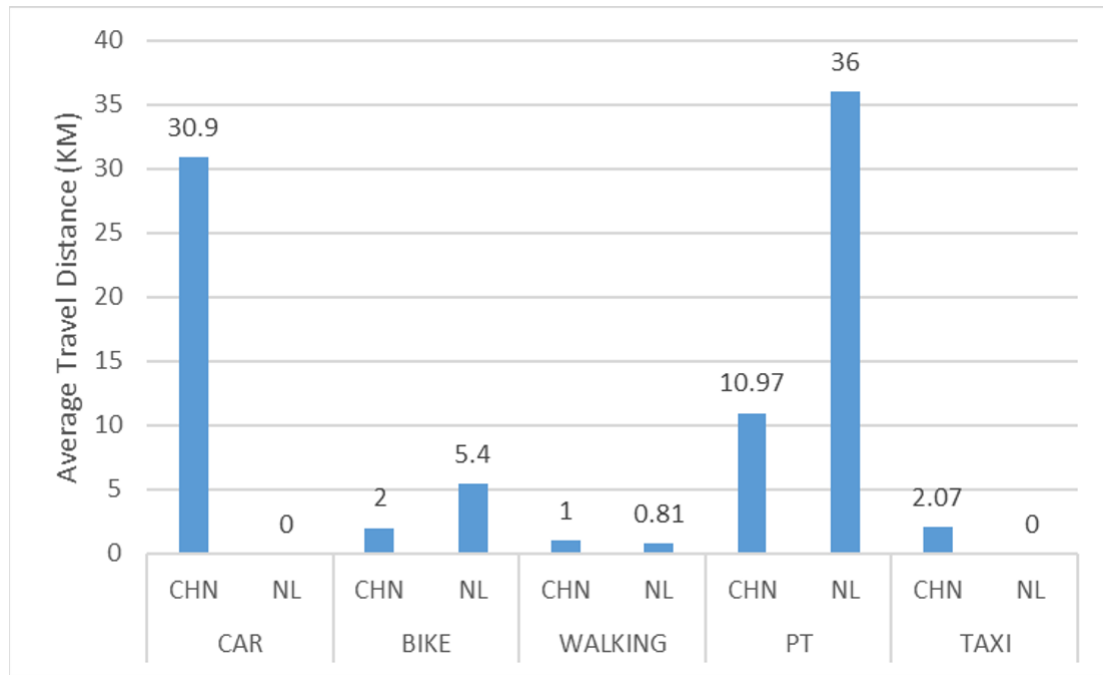


Figure 4.2: Mode Choice with Distance (km)

Figure 4.3 displays the variances of travel time. Combining with figure 4.2, the mean of travel distance for car users is not the biggest, but travel time is the longest (69 minutes). Similarly, the average of PT travel distance in the Netherlands is more than three times that of China, while the average travel times are similar to each other. The respondents in China walk 55 minutes averagely, which is roughly 3.23 times higher than the average walking time for students who living in the Netherlands. Similar, the cycling time in China is longer than than in the Netherlands.

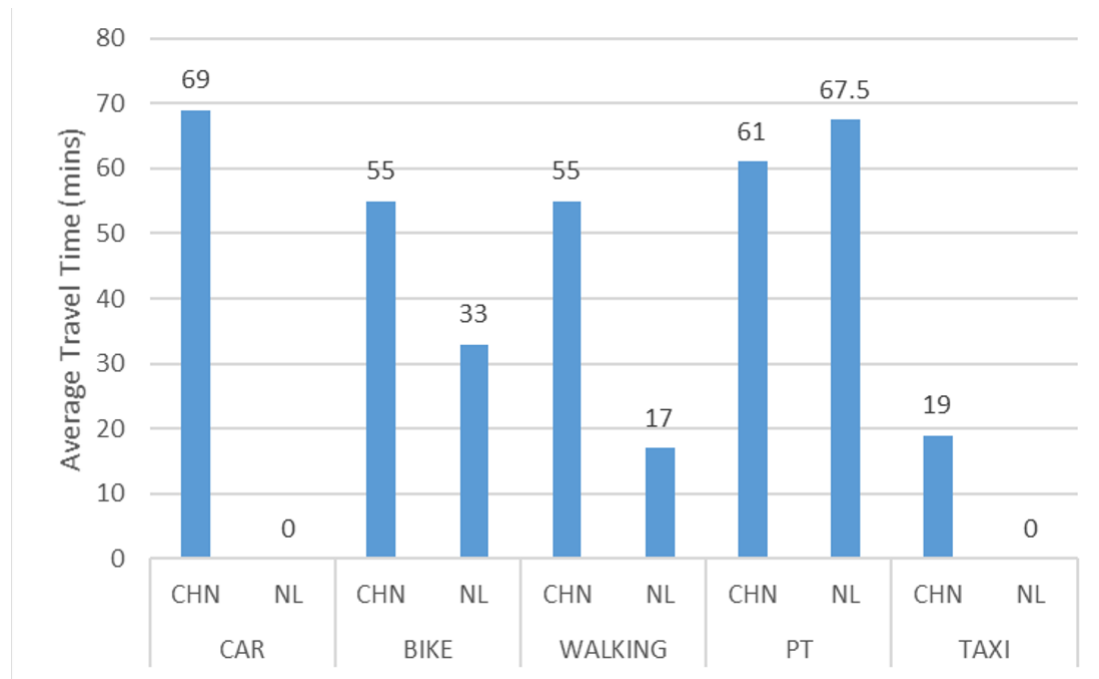


Figure 4.3: Mode Choice with Time (mins)

Figure 4.4 outlines the differences in household income level by five traffic modes. For students who living in China, major of students from relatively low-income families prefer to use PT. Interestingly, this choice tendency also appears among high-income students in China. 9.3% of students who from a high household-income family (300k *yuan* up) choose to take PT. Also, the majority of low household-income (<100k *yuan*) students have the same choice. The vast majority of all students are from middle-income level (101k-199k *yuan*) families, who prefer PT, followed by bike. 16% of the respondents who choose to ride bicycles in the Netherlands come from households with this income level. But Chinese students in the Netherlands from higher income households (higher than 200k) are obviously more inclined to choose comfortable and relatively expensive mode: PT.

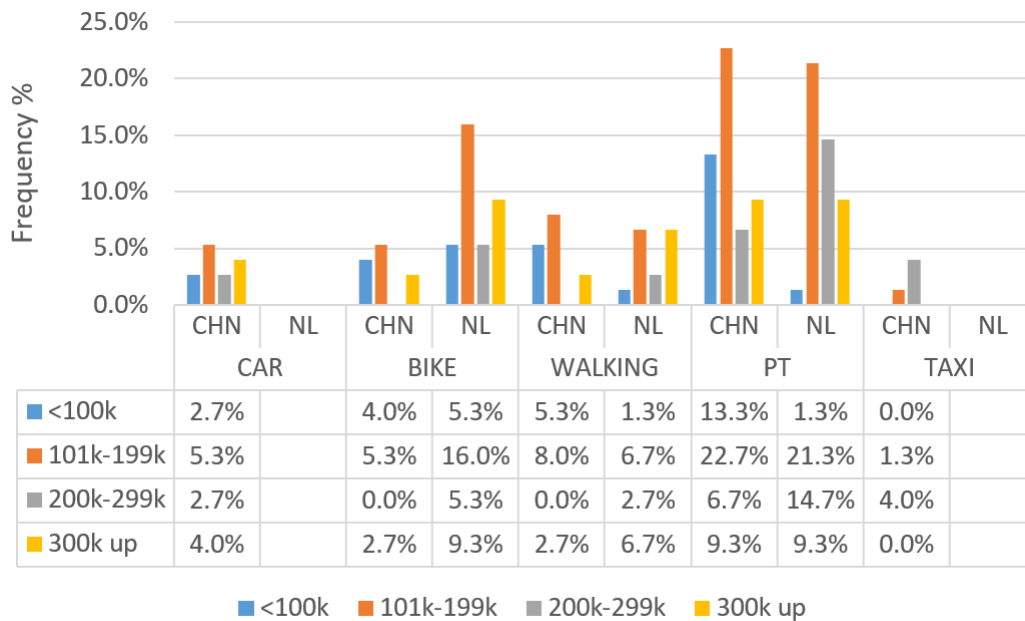


Figure 4.4: Mode Choice with Household Income (yuan)

Figure 4.5 reveals more detailed differences by displaying the activity participation integrated in mode choice. The major purpose of car users is social and leisure during the weekends. Moreover, all the trips by taxi are for social activities. In the aspect of bike users, a relatively large proportion of the respondents living in China indicates that they use bicycles for social activities. Apart from that, the choice of bikes does not show many differences among other activity participation types. However, the activity participation of bicycle users presents a different pattern. 9.3% of the respondents who chosen to travel on foot for household maintenance purposes, and about 8% chosen to walking for shopping activities. Correspondingly, respondents living in China are less interested in going shopping on foot. However, the proportion of students in China who partake in social and leisure activities on foot is significantly bigger than the proportion in the group in the Netherlands. A similar situation can be found in users of public transport; no respondent in China chooses public transport for shopping. Comparing to answers given by the Netherlands questionnaire, China's public transport users conduct more activities related to sports, social, and household maintenance than those who live in the Netherlands. Finally, traveling by taxi is done solely for social purposes.

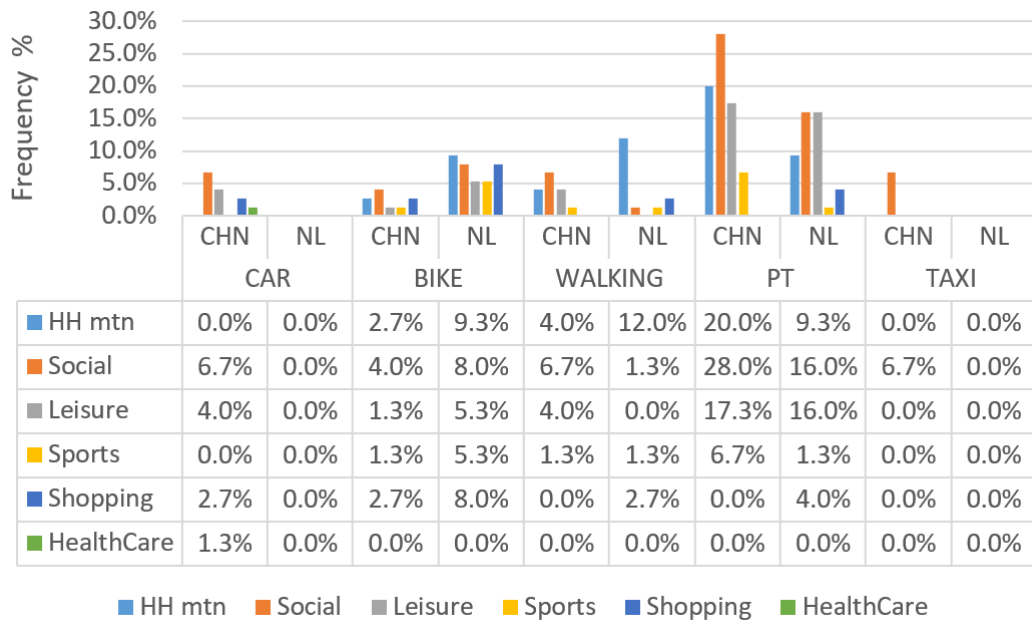


Figure 4.5: Mode Choice with Activity Participation

Compared with other traffic modes (Figure 4.6), respondents who use car are mainly engaged in a jointly trip, with only approximately 2.7% of them choosing to travel alone. Students who use bicycles in China make more group trips with more than three companions. Analogously, the accompany size for pedestrians in the Netherlands (with 2 accompanies maximum) is relatively smaller than that in China, while respondents in China with more than 2 accompanies account for approximately 30% of the total. Conversely, the proportion of public transport users in China who travel alone is more than the proportion in the Netherlands. People who take a taxi prefer travel alone or with one companion.

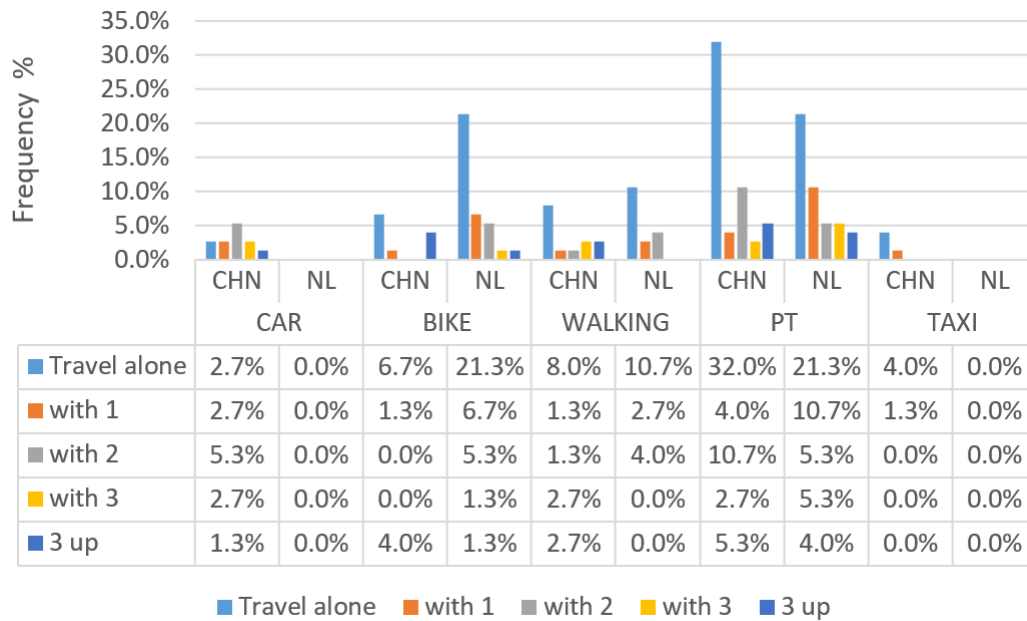


Figure 4.6: Mode Choice with Accompany Size

4.1.2 Attitudes toward Norms

By using Likert five-scale form, respondents are required to give a score towards norms statements from 1-I totally disagree to 5-I totally agree. This paper takes 3 as a boundary line, scores ranged from 3 to 5 indicate consent to the corresponding statement, and less than 3 are more inclined to disagree. The frequency percentage of this two scales are presented in the following graphs.

Figure 4.7 shows the different attitudes with gender. For people who used car in China, they agree that their own value makes them feel like to use bikes (PNbike), also the whole society should use bikes (DNbike). Male car users shows stronger approval of DNbike than female car users. Female cyclists perceive more social pressure regarding using more bikes(SNbike) than male cyclists both in China and in the Netherlands. Only female tend to believe in the whole society should use more non-motorized modes, however male are more likely to believe people should take private car or taxi.

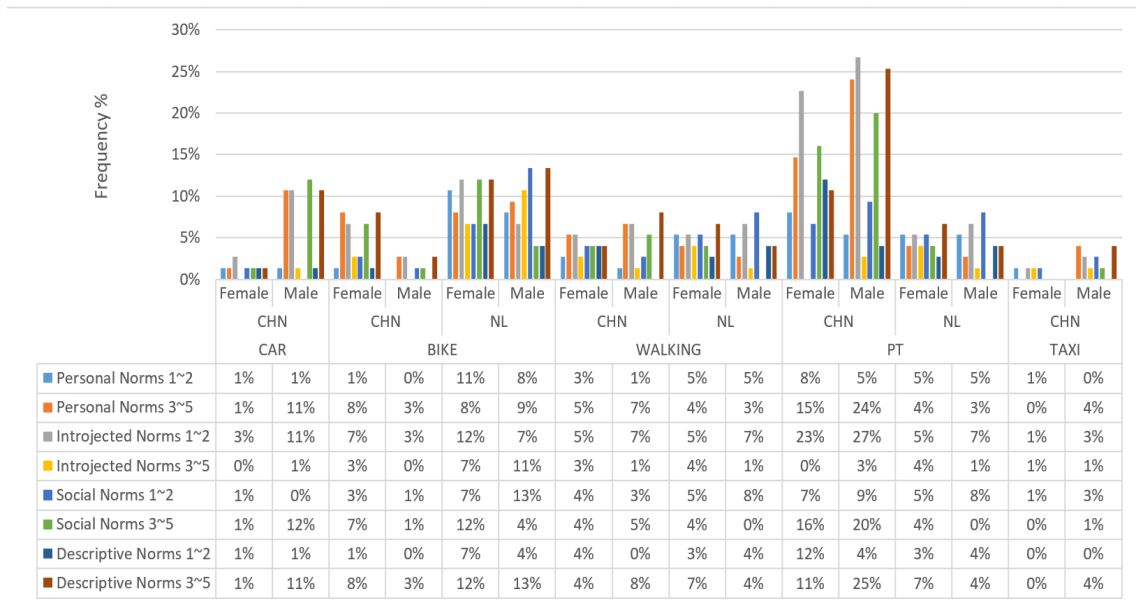


Figure 4.7: Mode Choice with Norms Variables and Gender

Figure 4.8 presents the variance within different age groups and their attitudes centring on four norms of the bike. For PT users, younger group who are younger than 26 years old shows much stronger attitudes towards four norms than the older group. The majority of all students who are younger indicate strong against attitudes towards Introjected norms of bikes (I feel guilty when I use the bike). Travellers who are younger than 26 years old perceive much more social expectations of using bikes than the older group. Generally, the younger group are more tend to believe in descriptive norms of bikes. And the people who chosen to cycle are more in favor of statements related to personal norms, social norms and descriptive norms than Chinese cyclists.

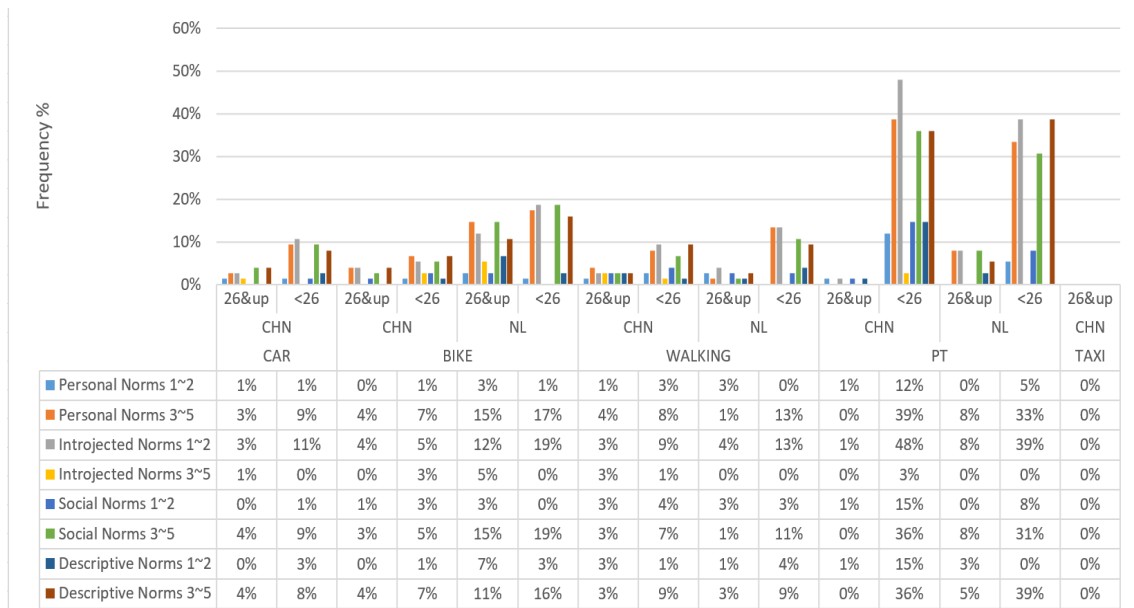


Figure 4.8: Mode Choice with Norms and Age

The differences of attitudes of norms with bike ownership can be found in Figure 4.9. Surprisingly, students in China cycled but own no bike show strong approval of PNbike than others. They are extremely convinced that their values drive them to use bicycles and the average score is higher than 4.5, as a counterpart, those who own a bike only gave PNbike an average score of 2.2. But students who ride bicycles in the Netherlands but do not own bicycles strongly oppose the statement (score of 1), and at the same time they feel least guilty of using bikes, meanwhile they are extremely agree that the whole society should use bikes (DNbike). Only students in China who owns a bike and walked feel they are expected to use bikes by people who are important to them (SNbike).

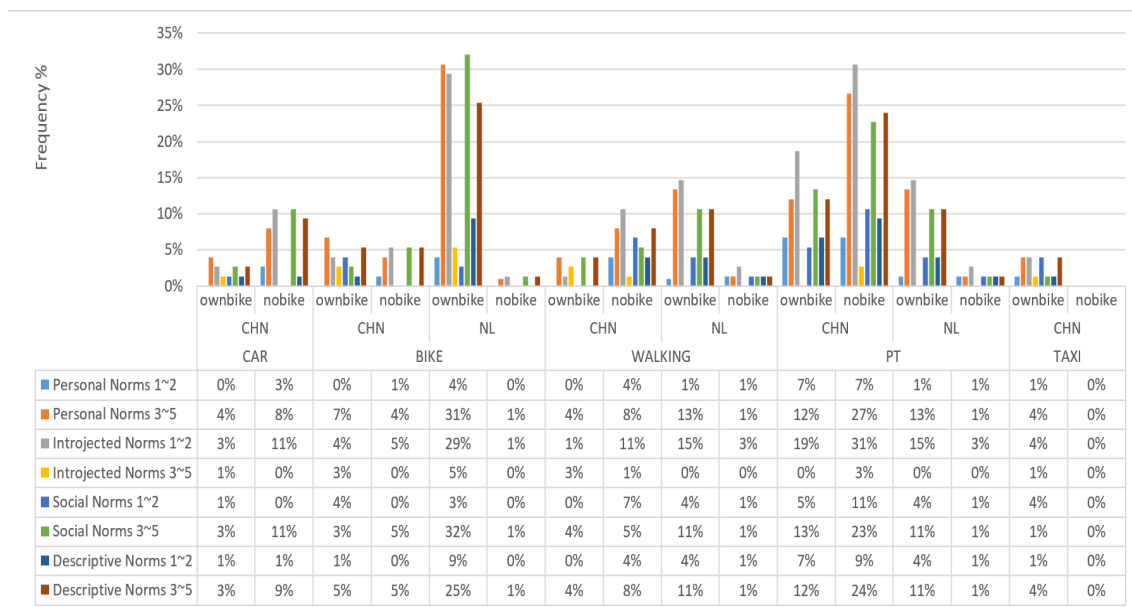


Figure 4.9: Mode Choice with norms Variables and Bike Ownership

Information in terms of attitudes differences and sharing bike subscription is displayed in Figure 4.10. Taxi users without sharing bike subscriptions demonstrate strongest disagreements toward four norms of bikes. Moreover, car users who do not use sharing bikes feel least guilty of using bikes. Interestingly, people who use bike and subscribed a sharing bike account do not show any strong belief towards bike norms, on the contrary, those who do not own a sharing bicycle account strongly agree with PNbike. For bike and PT users in the Netherlands who do not own this account indicate that they feel guilty of using bicycles. People own a sharing bike account perceive more social pressure of bike using than those who do not.

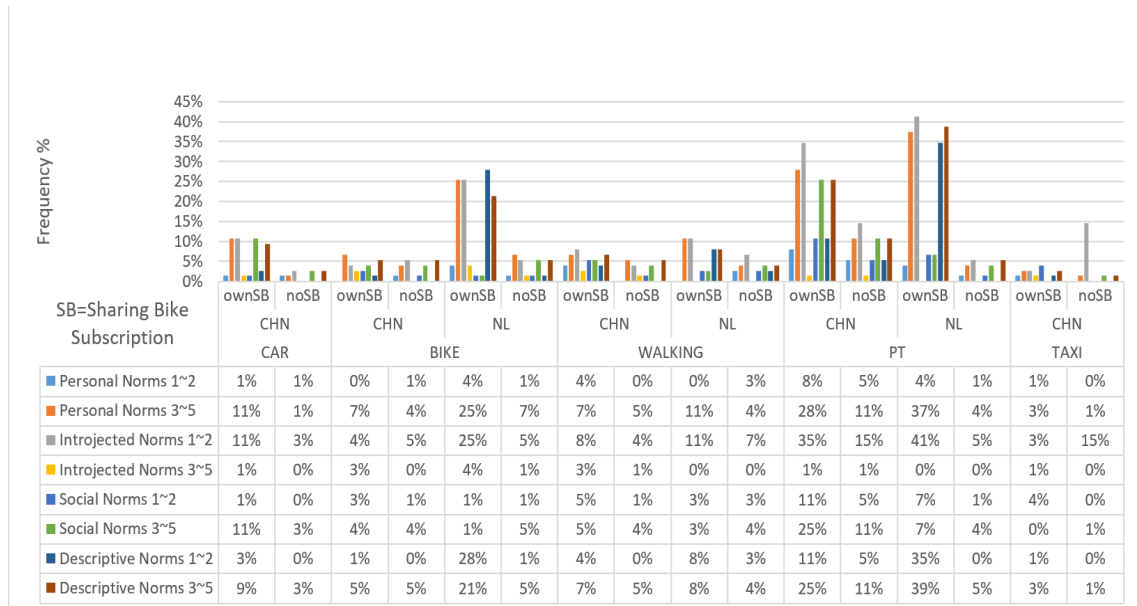


Figure 4.10: Mode Choice with norms Variables and Sharing Bike Subscription

With respect to norms of car, Figure 4.11 presents the relationships with car ownership and attitudes toward norms. People who have a car show a tendency to be more car-oriented, in this case they use it only if they own one. They show strong favor of PNcar and DNcar. To them, using car to travel is a normal concept to them and to the whole society. Moreover, not only drivers, walkers and cyclists both agree that their own value makes them to use a car. Students who use bikes in China but do not own a car extremely believe that the whole society should drive. Comparing to those in the Netherlands, they feel less guilty of driving a private car. In terms of guiltiness, walkers in the Netherlands who comes from a no car family feel least of driving a car. No-car PT users in China admit they feel more social pressure of using a car in China than those whose family own a car, The feelings are exactly the opposite for PT users in the Netherlands.

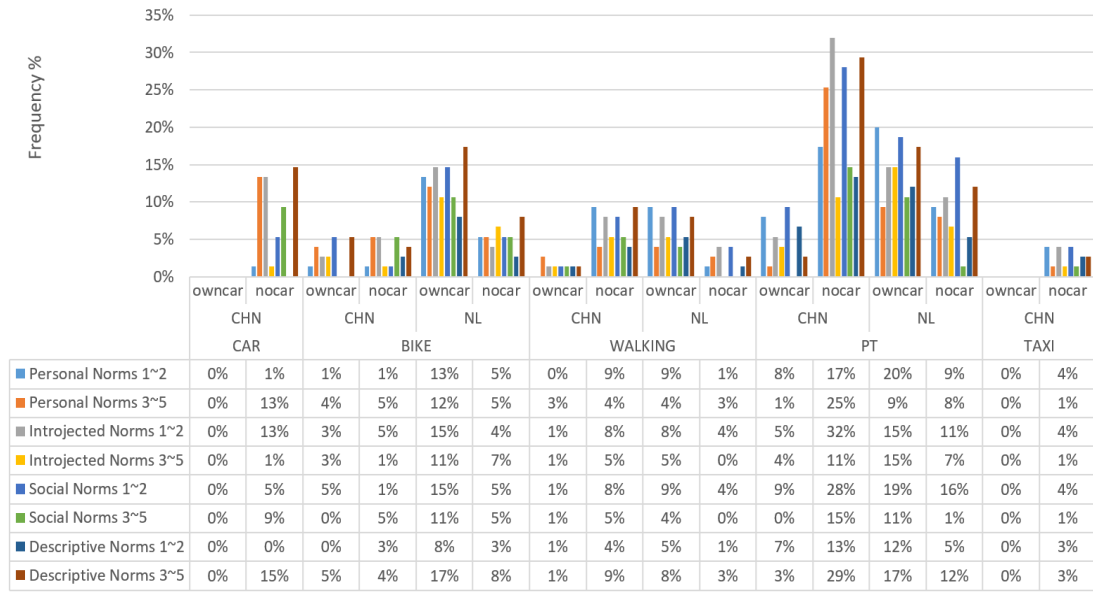


Figure 4.11: Mode Choice with norms Variables and Car Ownership

For the ownership of a driver’s license (Figure 4.12) in China, students who have obtained a driving license and used bike demonstrate substantial approval of PNcar. At the same time, not only the pressure from themselves, they also agree that they confront more judgements about other people expecting they drive a car, opposite pattern can be found in the students who used bike in the Netherlands. Same with Figure 4.11, none of them get a guilty feeling of car-using. Among all the walkers, people who do not own a driving license and walked agree that the whole society should use private cars. PT passengers, regardless of whether they have a driver’s license, they are not very recognized for driving, nor are they feel guilty of driving. Their feelings are more neutral.

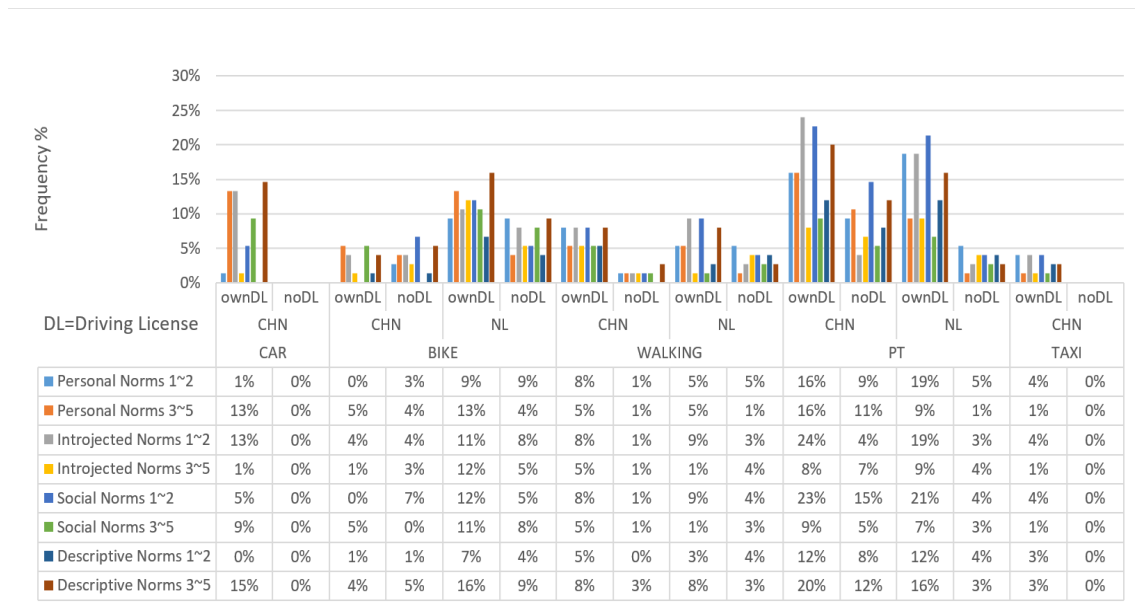


Figure 4.12: Mode Choice with norms Variables and Driving License (DL)

Overall, the respondents showed various attitudes towards norms of cars and of other modes. Students who live in China show approval of norms related to car norms and they experience less control from norms of limit car use. In the contrary, international Chinese students in the Netherlands agree more commonly that they get a guilty conscience when they use the private car. Additionally, they showed an relatively stronger recognition of bike-related norms. Moreover, one can find some patterns from the descriptive analysis of this case. For example, students who living in China perceive more social pressure than those who live in the Netherlands. People who take a taxi or private feel less guilty of using the car.

5 Analysis

5.1 The Model Result For Students in China

For the part of students study in China, the table 5.1 presents the results of the multinomial logit model.

Table 5.1: The Model Result For Chinese Sample

Variables	PT(base)	Bike	Car	Taxi	Walk
AGE					
<i>age26up</i>		2.24(1.43)		2.70(2.03)	
<i>age 18to25</i>	base				
Introjected Norms					
<i>DAinBike</i>		-3.43(-2.29)		2.79(1.79)	-2.27(-1.83)
<i>DAinPT</i>	base				
Social Norms					
<i>DAsnBike</i>				2.789(1.79)	
<i>DAsnPT</i>	base				
Household income					
<i>100k-150k RMB</i>			1.49(1.34)	-1.56(-1.43)	
<i>> 150k RMB</i>	base				
Yearly Budget					
<i>10k-20k RMB</i>					-1.56(-1.57)
<i>> 20k RMB</i>	base				
Consents	–	0.17(0.11)	1.20(0.00)	0.92(0.50)	0.83(0.06)
Adj R-squared	= 0.59				
Root MSE	= 0.48				

5.1.1 Goodness-of-fit Result Based on MNL Estimation For China Sample

In order to compare the prediction results with observed results, and to obtain the error of the performance, the adjusted R-square and Root Mean Square Error (RMSE). A RMSE stands for the standard deviation of the residuals (prediction errors), in other words, the

values of the RMSE, shows how good or bad the model estimated the data behavioral. For respondents in China, due to the limited sample, the RMSE is a bit high (1.09) with a adjusted R-square of 0.15.

Before interpreting the result, it is necessary to mention that the process of data running excluded many variables. Even though some of the variables are significant exclusively, neither of them are found statistically significant by the end. It represents that variables, for example, income and household income are not jointly significant ($t < 1.4$). It is also noteworthy that the flat region was yielded for the reason of conflict between variables. The attitude of introjected norms of bikes is always conflicted with the factor about living with household.

In this model, five variables are jointly significant. These are Age 26 up, Disagree in introjected norms of bikes, Disagree in social norms of bikes, and 100k to 150k Yuan of household income, and 10k to 20k Yuan for a yearly budget. The data in Table 5.1 show how those variables influence individuals' choice. Age, social norms of bikes and Household Income have a positive influence, and descriptive norms and yearly budget play negative roles.

5.1.2 Utility Functions

The utility functions for Chinese students mode choices are presented below:

$$V(bike) = 0.17 + 2.24Age(26up) - 3.43DAinBike \quad (5.1)$$

$$V(car) = 1.2 + 1.49HouseholdIncome(100k\ 150k) \quad (5.2)$$

$$\begin{aligned} V(taxi) = & 0.92 + 2.7Age(26up) - 2.788DAinBike \\ & + 2.789DAsnBike - 1.56HouseholdIncome(100k\ 150k) \end{aligned} \quad (5.3)$$

$$\begin{aligned} V(walk) = & 0.83 - 2.27DAinBike \\ & - 1.56YearlyBudget(10k\ 20kRMB) \end{aligned} \quad (5.4)$$

where V is the systematic portion of utility of alternative mode in the choice set.

5.1.2.1 People Who Chose Bike

For the people who use a bike, the attitudes toward introjected norms of using bike are the most influential factor. Comparing to people who took public transportation, students who don't get guilty conscious when they use bicycles are less likely to use bikes. Introjected norm is stated as I feel guilty when I use bikes/public transportation/cars. The multinomial logistic model for DAinBike relative to DAinPT and DAinCar is 3.43 units lower for using bikes relative to public transportation given all other predictor variables in the model are held consent. In other words, it denotes that the more people believe in many people in the society should use bikes, the more likely they would choose to use bicycles. The age factor represents that compared with taking a bus or train, young people over the age of 26 prefer to use a bike. This possibility is 2.23 times that of people under the age of 26. In the literature of biking using in China, the golden times of bikes were in the 1980s (Liu et al., 1993). It makes sense that older people prefer using bikes more than the young generation. And comparing household who earns 100k to 150k yuan in the year of 2018 to other household income group, they are 1.49 units more possibly to choose cycling.

5.1.2.2 People Who Chose Walking

Four variables work significantly for walkers. Predictor of age makes the most potent influence by giving a beta of 2.7. Which means relative to younger respondents, people who are older than 26 years old is 2.7 units high for choosing walk as their primary modes during weekends. Similar to people who chose bike, the more they disbelieve in descriptive norms of bikes, the less likely they would walk. As for the predictors in terms of economy, variables of household income and yearly budget are jointly significant. Specifically, the effect of them is differential. On the one hand, students whose family annual income is between 100k to 150k Yuan, preferring walking rather than public transportation. On the other hand, the impact of the yearly budget (10k to 20k yuan) is shown to decrease the probability of walking.

5.1.2.3 People Who Chose Car Or Taxi

Only 4 of the 75 respondents chose a car as their main traffic modes, which is understandable due to the ownership of private car among Chinese college students is relatively low (Zhu et al., 2012). Unlike in the Netherlands, taxi in China is relatively cheaper. For example, the price of Uber in Beijing (the capital of China) is 1.5 yuan per kilometer or 0.25 yuan per minute. It costs you less than five euros for a distance of five kilometers. Taxi is a popular choice for students in China. The effect of descriptive norms is substantial with a coefficient of minus 2.789. Interestingly, people who disagree to the introjected norm of bikes are roughly 2.788 units low for using taxi relative to public transportation. In short, people who don't feel guilty of using bikes appear to refrain from using a taxi. Either way, the beta of *DasnBike* provide information regarding the social pressure of bike handling. *DasnBike* indicates their disagreement of social norms of bikes, which stated as people who I care about believe I should use a bicycle. This result is a manifestation of the fact that people who don't feel peer pressures are more likely to use a taxi, they are not afraid of judgments.

5.2 The Model Result For Students in the Netherlands

Students who are living in the Netherlands do not have accessibility to five different traffic choice. According to the answer, no one has chose to use a taxi or private car. This fact is understandable because of the high cost of a taxi. Apart from the ownership of a private car, a certificated driving license is also be r equired. But due to the OV-bike system in the Netherlands, students can rent a bike with a reasonable expense. Therefore, bikes are accessible to all respondents. See details in Table 5.2

Table 5.2: The Model Result For The Netherlands Sample

Variables	Bike	Walk
PT(base)		
Purpose		
<i>Sports</i>	-0.077 (-2.42)	-1.36(-3.19)
<i>Shopping</i>		-1.26(-2.59)
<i>HH mtn</i>	base	
Descriptive Norms		
<i>DAdnBike</i>	0.58(1.82)	0.88(2.31)
<i>DAdnCar</i>	0.194	0.58(1.82)
<i>DAdnPT</i>	base	
Introjected Norms		
<i>DAinBike</i>	0.58(1.82)	1.35(2.34)
<i>DAinPT</i>	0.53(2.37)	
<i>DAinCar</i>	base	
Personal Norms		
<i>DApnCar</i>		-0.19(-1.39)
<i>DAsnPT</i>	base	
Cost		
<i>cost 7 euros up</i>	-0.12(-2.55)	
Household income		
<i>100k-150k RMB</i>	0.36(2.07)	-0.55(-2.42)
<i>< 100k RMB</i>	base	
Transpass CHN	0.38(2.07)	
No roommate	-0.33(-1.36)	-0.75(-2.37)
Female	-0.46(-1.49)	-0.12(-2.37)
Consents	-	0.41(1.49)
Adj $R^2=0.15$		
Root MSE =1.09		

5.2.1 Goodness-of-fit Result Based on MNL Estimation For The Netherlands Sample

The model, as a whole, is significant. The value of Prob>Chi is equal to 0.000. This value denotes that the probability of getting an LR test statistic as extreme as, or more so, than the observed under the null hypothesis, is zero; The goodness of fit is good in this model. The adjusted R-square is 0.6, which is relatively good.. Also the RMSE is only 0.47, which stands for the error of the whole model for students in the Netherlands is low.

5.2.2 Utility Functions

The utility functions for mode choices of Chinese students who living in the Netherlands are presented below are:

$$\begin{aligned}
 V(bike) = & 0.41 - 0.76port + 0.58DAdnBike \\
 & +0.19DAdnCar + 0.58DAinBike \\
 & +0.53DAinPT - 0.12Cost(7eurosup) \\
 & +0.36HouseholdIncome(100k\ 150k) \\
 & +0.38TranspassCHN - 0.33NoRoommate \\
 & -0.46Female
 \end{aligned} \tag{5.5}$$

$$\begin{aligned}
 V(walk) = & 0.29 - 1.3641Sport + 1.255Shopping+ \\
 & 0.8789DAdnBike + 0.5845DAdnCar \\
 & +1.3527DAinBike - 0.1948DApnCar \\
 & -0.5479HouseholdIncome(100k\ 150k) \\
 & -0.7502NoRoommate - 0.1172Female
 \end{aligned} \tag{5.6}$$

where V is the systematic portion of utility of alternative mode in the choice set,

β_{i0} is the modal bias constant for mode i (i = bike, walk),

5.2.2.1 People Who Chose Bikes

The purpose of shopping and in this model is the most statistically significant, with a p-value of 0.005. Four norms variables are calculated to be effective. Unlike the model of students in China, more socio-demographic variables are estimated significant, namely Household income, Transpass CHN, No roommate, and Female. Among all the variables, the introjected norms of the bike displayed the most substantial positive effect on the choice of using. With every extra point in AinBike, the log-odds of being a cyclist increases 1.38 units. The strongest negative effected are presented by the shopping purpose (-1.23). However, sport-related activities influence the choice of bike negatively. And following the AinBike, the second strongest (positive) is cost. The Effect of Cost on dependent variables declines at higher levels of travel cost (more than 7 euros). Except for AinBIke, the rest

of the norms variables show a less strong intervene to the bike using, with coefficients with -0.2 to 0.58 approximately. Gender and No roommate are significant and negatively related to the choice of bikes. One units increase of household income (100k to 150k) variables will lead to 0.36 unit increase in the dependent variable.

5.2.2.2 People Chose walking

Comparing to cyclists group in the Netherlands, only eight variables appear to be statistically significant for walkers. Sports activities are most negatively influential variable, with a -1.36 coefficient. Female also inclines to not walking obviously. Different from the cyclist, both no roommate and Household income plays a negative role in the choice of walking. The norms variables are significant and positive correlated for walk trips.

5.3 Model Results Comparison Between China and The Netherlands

5.3.1 Trip Characteristics

Respondents in the Netherlands are less likely to exercises by bike or walking. On the contrary, researches that walking is an important component of both the active transportation and leisure domains. Studies have shown that walking is the most common form of leisure-time physical activity in Canada (Gilmour, 2007). But, a trip mainly for exercises may generate the need for carrying sports gears, so referencing to PT, bikes, and walking are not convenient enough. Furthermore, the professional sports space are limited in the Netherlands, and students may travel a longer distance, and which decrease the probability of using a bike and walking. And considering the tiredness after sport, PT seems to be more easy and relieving. Also, bike users are less likely cycling to shopping places. It related to the limited parking spaces and the charge of parking. It is also wise to take the bus to avoid the parking fee. Moreover, after shopping, one will take a few paper bags, which is inconvenient to cycling and walking.

5.3.2 Norms Variables

Both in the Netherlands and China, the belief in introjected norms of bikes are most significant and contribute to increasing the probability of using bikes and walking. Which means, the less they feel using bikes will give them a guilty feeling, the more they will use bikes and walk. Similar research found that moral norms and awareness of the problems caused by car use contributed significantly to the prediction of intention to take the bus (Heath and Gifford, 2002). Social norms are found important in the studies of mode transformed from motorized to active. The positiveness of cycling can incentive people cycling more: scholars found that the cycling-friendly social environment gives more supports to cyclists than non-cyclists (Panis et al., 2010). Additionally, Dill and Voros suggested that people get encouraged to cycle if they can see other cyclists on the street (Dill and Voros, 2007). However, social norms are not significant in the model of NL. In the CHN model, people who do not feel social pressure from others for bike using are more likely to grab a taxi. Indeed and similar, in a specifically context, if one works in a company where colleagues expect people to commute by car, this person is less incline to commute by a bike than if the individual's colleagues put an expectation on him or her to commute by a bike (Heinen et al., 2013).

In some research context, scholars are also considered descriptive norms as social norms, so the effect of descriptive norms on intention through personal norms are even more significant than personal norms. Descriptive norms are proved to affect past behavior strongly. Students who disagree with people in society should use a car are more likely to walk and cycle. But they don't think that the idea of using bicycles should be promoted to the whole society. The more they disagree people should all used bike, the more they tend to walk and use a bike. The disagreement of personal norms of the car significantly increases the propensity of bike using. People whose own value system does not make them drive are more likely to cycling. This also contributes to prove that personal norm is an essential determinant factor of reducing car-use (Nordlund and Garvill, 2003).

5.3.3 Socio-demographics

Female students are less inclined to walk or to cycle in the Netherlands. Which is understandable that women tend to lack security feelings (Maslow, 1942). And they are

more distance-sensitive (Bou Serhal et al., 2013). Thus PT is relative to a better mode choice for them. A research found that people who live alone tend to take less familial responsibilities than individuals who live with family members. The bigger the household size is, the more responsibilities are (Sener et al., 2010). Hence, they can conduct more activities during the home returning. However, the variable of No roommate in the NL works as a financial factor. No roommate is highly in line with income level; students who live alone tend to be financially adequate. They are less likely to walk or cycle for the reason of pursuing more comfortable traffic modes. Similar, scholars found that an increase in income decline cycling uses (Witlox and Tindemans, 2004; Plaut, 2005).

This chapter explain and analyze this results of two MNL models for both students in China and in the Netherlands. Also, one may find correspondingly explanation from previous researches. The more conclusive and further discussions will be given in the next chapter.

6 Discussion

6.1 Summary, limitation, and future

On the whole, the frequency of non-motorized vehicles used by immigrant Chinese students in the Netherlands is much higher than that of the control group. Many students choose to buy bicycles for commuting to control the cost of travel in the Netherlands. But during the weekend, the frequency of bicycle use by immigrant Chinese students is not as high as expected for a non-work related purpose. Because the transfer of buses and trains is very convenient in the Netherlands, many immigrant students would choose to use the train to travel on weekends. Cross-city travel is much easier for them. While for students living in China, if they want to travel long distances on weekends, private cars remain their first choice.

Moreover, an undeniable phenomenon in the descriptive statistical analysis is that many trips conducted on weekends in the Netherlands are for household maintenance purpose. This phenomenon may be because international students generally do not live with family members. Due to busy school and limited time in weekdays, they have to carry out various house maintenance activities on weekends, such as purchasing daily necessities. Moreover, immigrant Chinese students in the Netherlands prefer to shop by walking. One can speculate that for them, the meaning of shopping may also include pastimes. Also, unlike China's large shopping complex, shopping places in the Netherlands are generally more dispersed. Walking to shopping is a more popular option. The limited free bicycle parking facilities in the city center and the fear of being stolen are also a hindrance to reducing their use of bicycles to shopping.

Unlike the expected, social norms have no significant impact on bike use for Chinese students studying in the Netherlands. Immigrant Chinese students who have undergone a context change do not care about the judgments of others in the society about whether they use bicycles. It is partially because that international students in the Netherlands generally live in the student houses which are segregated sometimes. Hence, they have a relatively low degree of integration with the local neighborhood. And it is worth noting that immigrant Chinese students give a higher score to personal norms of the bike than

students who live in China. In other words, their values are more in line with the use of bicycles. One can make bold guesses that the motivation to use bikes has been internalized by peer pressure or social pressure into part of the own values systems. Conversely, for students who live in China, the mode choice of taxis is significantly negatively correlated with social norms. The less the peer pressure of bike using, the more inclined to use a more relaxed, less environmentally friendly traffic mode. It may also be due to those people who are less sensitive to judgments from others are tend to choose the mode which gives comfort priority. Similar to expectations, Chinese students in the Netherlands do not agree with car-oriented travel habits. But at the same time, they rarely have the opportunity to travel in private cars or taxis in the Netherlands. First, it may because the cost is expensive, and also partially due to the supply is limited. Some students also mentioned that the procedure for getting driving permission in the Netherlands is troublesome. But it is still arguable whether the limited use of cars affects their recognition of the use of private cars or whether the latter affects the former. Chinese female students in the Netherlands are more dependent on using public transportation comparing to male. Unfamiliar social environments reduce their desire to use active mode, and for safety reasons, in this case, PT is a better choice. For the sample in China, Household income level and yearly budge factors intervene their choice, but the detailed mechanism behind it remains tangible.

6.2 Study Limitations And Future Research

The result of this research shows some unanticipated factors, The social norms factors are not sadistically significant. Instead, personal norms are effective in both samples. Future study should explore the causality between personal norms and social norms on how they influence people's mode choice.

Also, it would contribute to current research if one takes dependent variable as a multi-dimensional variables. It means explore all the independent variables including trip purpose with mode choice in associate with other factors, such as mode choice with activity participation.

In terms of model, although MNL is an useful tool for predicting decisions, its status has gradually been replaced. As mentioned above, it has a constrain of IIA, which not apply

into more sophisticated reality context. Hausman and McFadden (1981b) developed his MNL model in order to analyze the case where the particular mode is more primal than others. Otherwise, it would lead to erroneous results of predictions (Ewing et al., 2004). Integration of Choice and Latent Variable Models is more applicable to this research topic if more research time is available. Also, the accuracy of prediction is relatively higher, because it relaxes the strict constraints given by assumptions of Multinomial Logit model, and solves the problem of IIA.

In addition, the bigger the sample is, the better the model become. Apart from Chinese group and Dutch context, one can conduct this research in different countries with certain transportation culture.

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Appendix

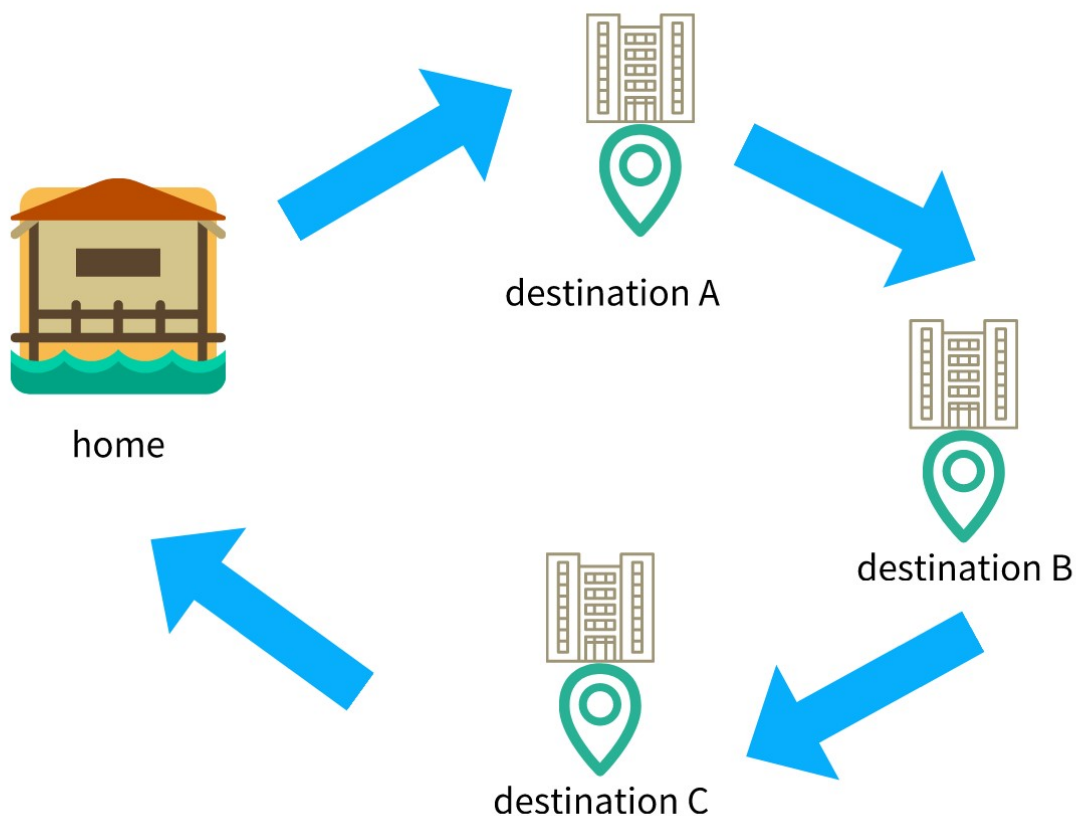
A Survey of Traffic mode choice in the Netherlands This survey is been sent to Chinese international students who study in the Netherlands now. The major aim of my research is to explore how social norms influence Chinese students' traffic mode choice. Thus your cooperation in completing this survey will ensure the success of this effort. This survey can be divided into five sections. In the first three sections, you are required to provide information about three home-based trips. Next, please follow the instructions to grade some statements about social norms. In the end, you just need to answer some simple questions. Thank you in advance for your participation. There are 54 questions in this survey.

A Survey of Traffic mode choice in the Netherlands

This survey is been sent to Chinese international students who study in the Netherlands now. The major aim of my research is to explore how social norms influence Chinese students' traffic mode choice. Thus your cooperation in completing this survey will ensure the success of this effort. This survey can be divided into five sections. In the first three sections, you are required to provide information about three home-based trips. Next, please follow the instructions to grade some statements about social norms. In the end, you just need to answer some simple questions.

Thank you in advance for your participation.
There are 54 questions in this survey.

section0



Dear respondents, I would like you to provide me with some details of your daily trips on one day of the past two weekends. All daily trips should be non-work or non-study related. For example, you went to the supermarket buying grocery can be a daily trip.

In the past two weekends, have you ever conducted any daily trips? *

❗ Choose one of the following answers

Please choose **only one** of the following:

- yes
- no

The trips on which day would you like to provide me?

❗ Choose one of the following answers

Please choose **only one** of the following:

- 25th April Sat
- 26th April Sun
- 1st May Sat
- 2nd May Sun
- 8th May Sat
- 9th May Sun
- 15th May Sat
- 16th May Sun

Section 1



In this very section, you need to recall your one day of last weekends and provide me with details (e. g. time in/out) about your trips from home.

Where is your home?

*

Please write your answer here:

Where is your first destination? *

Please write your answer here:

When did you leave your home? *

Please enter a date:

When did you arrive at your first destination? *

Please enter a date:

What is the main transportation method did you use for your first trip? *

🗖️ Choose one of the following answers

Please choose **only one** of the following:

- bikes/e-bikes
- walking
- private car
- public transport (bus/tram/metro)
- uber or taxi
- motorcycle/moped

Other

Who do you travel with? *

❗ Choose one of the following answers
Please choose **only one** of the following:

- alone
- with children (under 18 years old)
- with adult
- both

How many people did you travel with? *

❗ Choose one of the following answers
Please choose **only one** of the following:

- alone
- 1
- 2
- 3
- more

Select the main purpose of this trip. *

❗ Choose one of the following answers
Please choose **only one** of the following:

- house maintenance (e.g. buy food/groceries/dry clean/post)
- shopping (e.g. clothing/cosmetics/toys)
- social events (e.g. visit classmates/relatives, orientation day, ice-breaking)
- exercise
- leisure activities (e.g. visit parks/movies/bars/museums)
- health care (e.g. see a doctor/ regular check)
- child care

How much did you spend going to the first destination? *

🗨️ Choose one of the following answers

Please choose **only one** of the following:

- free
- 0~3 euros
- 3.01~5 euros
- more that 5.01 euros

Did you move to the next place? *

Please choose **only one** of the following:

- Yes
- No

What is the main transportation method did you use for going home? *

Only answer this question if the following conditions are met:

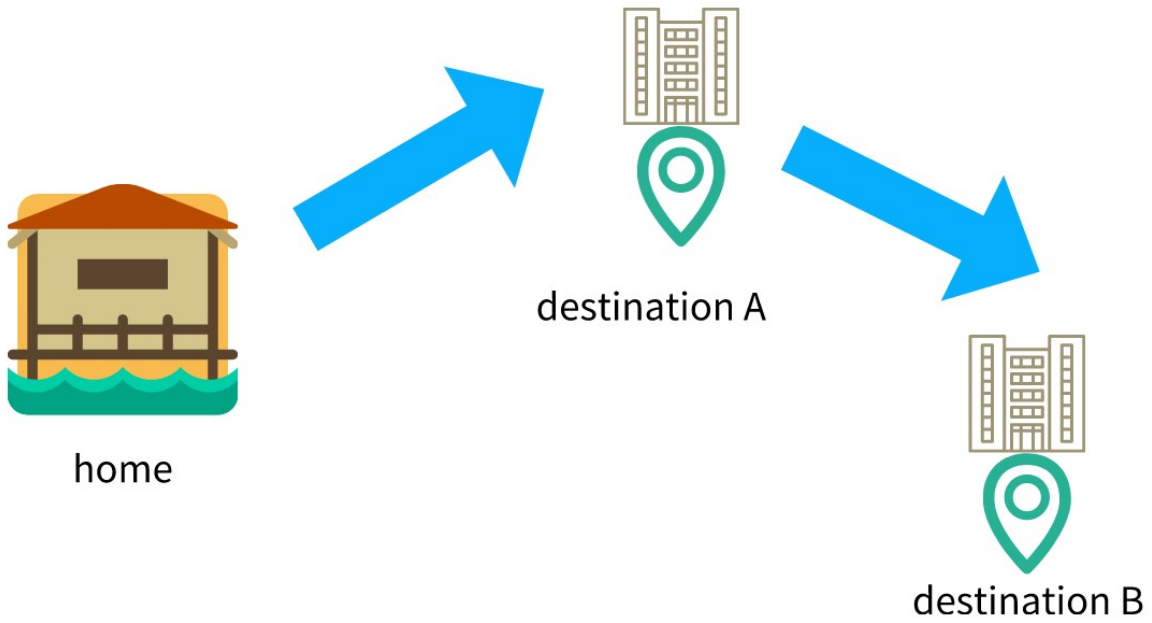
Answer was 'No' at question '12 [TripA10]' (Did you move to the next place?)

🗨️ Choose one of the following answers

Please choose **only one** of the following:

- bikes/e-bikes
- walking
- private car
- public transport (bus/tram/metro)
- uber or taxi
- motorcycle/moped
- Other

Section 2



In this very section, you need to provide me with details (e. g. time in/out) about your trips to the next destination.

Where is your second destination? *

Only answer this question if the following conditions are met:

Answer was 'Yes' at question '12 [TripA10]' (Did you move to the next place?)

Please write your answer here:

When did you leave your first destination? *

Only answer this question if the following conditions are met:

Answer was 'Yes' at question '12 [TripA10]' (Did you move to the next place?)

Please enter a date:

When did you arrive at your second destination? *

Only answer this question if the following conditions are met:

Answer was 'Yes' at question '12 [TripA10]' (Did you move to the next place?)

Please enter a date:

What is the main transportation method did you use? *

Only answer this question if the following conditions are met:

Answer was 'Yes' at question '12 [TripA10]' (Did you move to the next place?)

🗨️ Choose one of the following answers

Please choose **only one** of the following:

- bikes/e-bikes
- walking
- private car
- public transport (bus/tram/metro)
- uber or taxi
- motorcycle/moped

Other

Who do you travel with? *

Only answer this question if the following conditions are met:

Answer was 'Yes' at question '12 [TripA10]' (Did you move to the next place?)

🗨️ Choose one of the following answers

Please choose **only one** of the following:

- alone
- with children (under 18 years old)
- with adult
- both

How many people did you travel with? *

Only answer this question if the following conditions are met:

Answer was 'Yes' at question '12 [TripA10]' (Did you move to the next place?)

🗨️ Choose one of the following answers

Please choose **only one** of the following:

- alone
- 1
- 2
- 3
- more

Select the main purpose of this trip. *

Only answer this question if the following conditions are met:

Answer was 'Yes' at question '12 [TripA10]' (Did you move to the next place?)

🗳️ Choose one of the following answers

Please choose **only one** of the following:

- house maintenance (e.g. buy food/groceries/dry clean/post)
- shopping (e.g. clothing/cosmetics/toys)
- social events (e.g. visit classmates/relatives, orientation day, ice-breaking)
- exercise
- leisure activities (e.g. visit parks/movies/bars/museums)
- health care (e.g. see a doctor/ regular check)
- child care

How much did you spend going to the second destination?

*

Only answer this question if the following conditions are met:

Answer was 'Yes' at question '12 [TripA10]' (Did you move to the next place?)

🗳️ Choose one of the following answers

Please choose **only one** of the following:

- free
- 0~3 euros
- 3.01~5 euros
- more that 5.01 euros

Did you move to the next place? *

Only answer this question if the following conditions are met:

Answer was 'Yes' at question '12 [TripA10]' (Did you move to the next place?)

Please choose **only one** of the following:

- Yes
- No

What is the main transportation method did you use for going home?

Only answer this question if the following conditions are met:

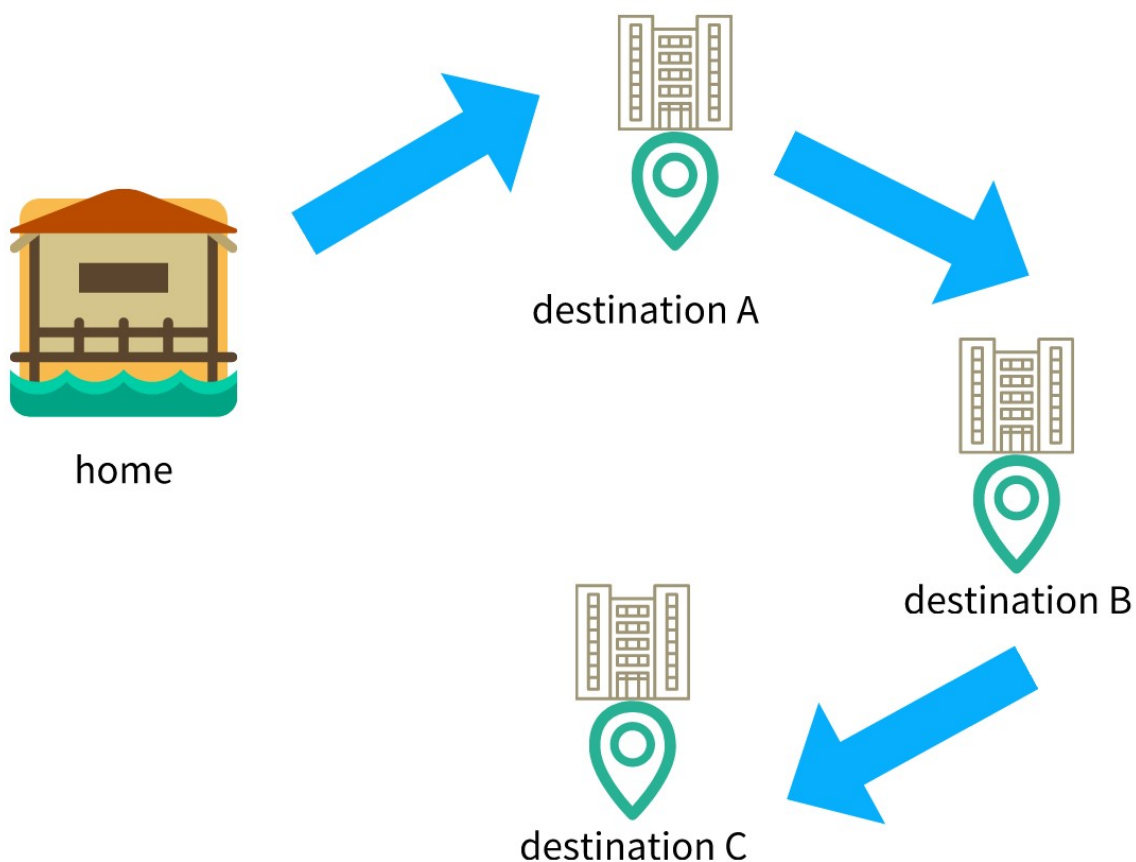
Answer was 'No' at question '22 [TripA10]' (Did you move to the next place?)

🗨️ Choose one of the following answers

Please choose **only one** of the following:

- bikes/e-bikes
- walking
- private car
- public transport (bus/tram/metro)
- uber or taxi
- motorcycle/moped

Section 3



In this very section, you need to provide me with details (e. g. time in/out) about your trips to the next destination.

Where is your third destination? *

Only answer this question if the following conditions are met:

Answer was 'Yes' at question '22 [TripA10]' (Did you move to the next place?)

Please write your answer here:

When did you leave your last destination? *

Only answer this question if the following conditions are met:

Answer was 'Yes' at question '22 [TripA10]' (Did you move to the next place?)

Please enter a date:

When did you arrive at your third destination? *

Only answer this question if the following conditions are met:

Answer was 'Yes' at question '12 [TripA10]' (Did you move to the next place?)

Please enter a date:

What is the main transportation method did you use? *

Only answer this question if the following conditions are met:

Answer was 'Yes' at question '22 [TripA10]' (Did you move to the next place?)

🗳️ Choose one of the following answers

Please choose **only one** of the following:

- bikes/e-bikes
- walking
- private car
- public transport (bus/tram/metro)
- uber or taxi
- motorcycle/moped

Other

Select the main purpose of this trip. *

Only answer this question if the following conditions are met:

Answer was 'Yes' at question '22 [TripA10]' (Did you move to the next place?)

🚫 Choose one of the following answers

Please choose **only one** of the following:

- house maintenance (e.g. buy food/groceries/dry clean/post)
- shopping (e.g. clothing/cosmetics/toys)
- social events (e.g. visit classmates/relatives, orientation day, ice-breaking)
- exercise
- leisure activities (e.g. visit parks/movies/bars/museums)
- health care (e.g. see a doctor/ regular check)
- child care

Who do you travel with? *

Only answer this question if the following conditions are met:

Answer was 'Yes' at question '22 [TripA10]' (Did you move to the next place?)

🚫 Choose one of the following answers

Please choose **only one** of the following:

- alone
- with children (under 18 years old)
- with adult
- both

How many people did you travel with? *

Only answer this question if the following conditions are met:

Answer was 'Yes' at question '22 [TripA10]' (Did you move to the next place?)

🗳️ Choose one of the following answers

Please choose **only one** of the following:

- alone
- 1
- 2
- 3
- more

How much did you spend going to the third destination? *

Only answer this question if the following conditions are met:

Answer was 'Yes' at question '22 [TripA10]' (Did you move to the next place?)

🗳️ Choose one of the following answers

Please choose **only one** of the following:

- free
- 0~3 euros
- 3.01~5 euros
- more that 5.01 euros

Did you move to the next place? *

Only answer this question if the following conditions are met:

Answer was 'Yes' at question '22 [TripA10]' (Did you move to the next place?)

Please choose **only one** of the following:

- Yes
- No

What is the main transportation method did you use for going home?

Only answer this question if the following conditions are met:

Answer was 'No' at question '32 [TripA10]' (Did you move to the next place?)

❗ Choose one of the following answers

Please choose **only one** of the following:

- bikes/e-bikes
- walking
- private car
- public transport (bus/tram/metro)
- uber or taxi
- motorcycle/moped

Section 4

In this section, you are kindly asked to indicate the extent to which you agreed or disagreed (“I definitely disagree”, “I somewhat disagree”, “I neither agree nor disagree”, “I somewhat agree”, “I definitely agree”)

“1-I definitely disagree”, “2-I somewhat disagree”, “3-I neither agree nor disagree”, “4-I somewhat agree”, “5-I definitely agree” *

Please choose the appropriate response for each item:

	1-I definitely disagree	2-I somewhat disagree	3-I neither agree nor disagree	4-I somewhat agree	5-I definitely agree
My own value makes me feel obligated to use private car	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My own value makes me feel obligated to use public transport	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My own value makes me feel obligated to use bikes	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I get a guilty conscience when I use private car	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I get a guilty conscience when I use public transport	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I get a guilty conscience when I use bikes	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
People who are important to me expect me to use private car	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
People who are important to me expect me to use public transport	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

	1-I definitely disagree	2-I somewhat disagree	3-I neither agree nor disagree	4-I somewhat agree	5-I definitely agree
People who are important to me expect me to use bikes	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I think using private car is something everyone should do	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I think using public transport is something everyone should do	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I think using bikes is something everyone	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Section 5 Socio-demographic information

Gender *

Please choose **only one** of the following:

Female

Male

How old are you? *

🗳️ Choose one of the following answers
Please choose **only one** of the following:

- 18-20
- 21-25
- 26-30
- 31-40
- 41 and above

What is your Study Status *

🗳️ Choose one of the following answers
Please choose **only one** of the following:

- Bachelor
- Master
- PhD
- Other

What is your marital status? *

🗳️ Choose one of the following answers
Please choose **only one** of the following:

- unmarried
- married
- separated
- divorced
- widow

What is your approximate yearly living budget? (excluding tuition fee) *

🗳️ Choose one of the following answers

Please choose **only one** of the following:

- 10000~15000 euros
- 15001~20000 euros
- more than 20001 euros

What is your monthly approximate income? *

🗳️ Choose one of the following answers

Please choose **only one** of the following:

- less than 1000 euros
- 1001~1500 euros
- more than 1501 euros

Who covers your expenditures in the Netherlands? *

🗳️ Choose one of the following answers

Please choose **only one** of the following:

- Family supporting
- employer/organization
- saving
- Other

How much total combined money did all members of your household earn in 2018? *

🗳️ Choose one of the following answers

Please choose **only one** of the following:

- lower than 100000 rmb
- 100000~150000 rmb
- 150000~200000 rmb
- 200000~300000 rmb
- above 300000rmb

How many people live in your household in China? *

🗳️ Choose one of the following answers

Please choose **only one** of the following:

- 1~3
- 3
- 3~5
- 5 and above

How many adults live in your household in China? *

🗳️ Choose one of the following answers

Please choose **only one** of the following:

- 1~3
- 3
- 3~5
- 5 and above

Are you mainly living with your family members now? *

Please choose **only one** of the following:

- Yes
- No

Except for them, how many people you are living with now? (in the NL) *

Only answer this question if the following conditions are met:

Answer was 'No' at question '45 [SD12]' (Are you mainly living with your family members now?)

🗳️ Choose one of the following answers

Please choose **only one** of the following:

- 1
- 2
- 3
- more than 3

How many cars your household own in China? *

🗳️ Choose one of the following answers

Please choose **only one** of the following:

- 0
- 1
- 2
- 3 and above

How many cars do you have in the Netherlands? *

❗ Choose one of the following answers

Please choose **only one** of the following:

- 0
- 1
- 2
- above 2

Do you have a bike in the Netherland? *

Please choose **only one** of the following:

- Yes
- No

Do you have a bike in China? *

Please choose **only one** of the following:

- Yes
- No

Do you have transport pass-card in the NL? *

Please choose **only one** of the following:

- Yes
- No

Do you have transport pass-card in China? *

Please choose **only one** of the following:

- Yes
 No

Do you have a driving licence in China? *

Please choose **only one** of the following:

- Yes
 No

Do you have a driving license in the NL? *

Please choose **only one** of the following:

- Yes
 No

Thanks for your participation and your time. Your information will only be used in this research. If there remain any further questions, please contact me via t.fu@students.uu.nl. Hope you have a happy life.

04.10.2019 – 12:47

Submit your survey.

Thank you for completing this survey.