# Factors Influencing Non-Motorized Transportation (NMT) Modes in Manila, Philippines

## フィリピン国マニラにおける徒歩・自転車交通への影響要因に関する研究

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ABSTRACT

This study focused on the perceptions of the people with respect to the existing condition of the Non-Motorized Transportation (NMT) infrastructures in Manila, Philippines. This research acknowledged that there are many factors influencing the people's perceptions, depending on specific environments. Socio demographic and travel behaviors characteristics were identified to have significant influence on the perceptions of the people regarding the existing NMT infrastructures, which was measured by how they rated specified indicators. It was found thatpeople generally perceive the safety of the NMT environment negatively. Provisions for PWDs and weather protection were the main concerns in terms of ambulation, while exposure to pollution was the major deterrent to the attractiveness of NMT. Results also indicate that if improvements in the NMT infrastructures and environments are made, people are willing to use NMT modes more.

要　旨

本研究は，フィリピン，マニラにおける現在の非動力交通(NMT)に対する人々の認識に着目したものである．本研究は，特定の環境下では人々の認識に影響を与える要因が存在するという考えに基づいている．人々が NMT に関する指標を評価するかによって観測された統計学的交通行動の特性は，マニラの人々の NMT に対する認識に重要な影響力を持っている示した．また，マニラにおいて人々が徐々にではあるが NMT の安全性についても認識していることを明らかにした．障害者の交通環境と天候が歩行者を考える上では重要である．公害問題についても NMT を使用する上での妨げとなっている. 本研究では結果として, NMT のインフラと環境を改善することで人々は NMT の使用を促すことができることを示した.

# 1 Introduction

## 1.1 Background of the Study

The world has entered a new phase, wherein the global urban population has exceeded more than half of the world's total population. According to the World Urbanization Prospects Report,an estimateof 2.5 billion people willmove to the urban areas by 2050 andAsia is expected to host more than 50% of the future urban population(UN, 2014). The same report disclosed that the Philippines is one of the countries which will have a significant contribution to the future global urban population being one of the fastest urbanizing countries in Asia. Urbanization in the country is projected to rise up to 77% by 2030, from 58% in 2000, higher than the projections for Thailand, Indonesia, and even Japan.

Metro Manila, the Philippines' largest urbanized area, has a major role in the scheme of these projections. All the sixteen cities of Metro Manila are highly urbanized and all are experiencing high population growth rate at 2.02% (1990-2010)(PSA, 2015). Metro Manila had a record population density of 19,137 persons per square kilometer, greater than that of Tokyo and Seoul, 13,100 and 17,000 persons per square kilometer respectively(DOTC & JICA, 2015).

Along with the growing urban population in the country, the Philippines is experiencing fast economic growth. Metro Manila, the country's economic center, contributing to almost a third of the country's GDP, is in overdrive. Parallel to these growth is the rise of motorization. Metro Manila has the largest concentration of registered vehicles, increasing at the rate of 3.86% annually.

High population density, high road density, high motorization rates and comparatively low land area in a developing world, are disastrous combinations. In 2005, traffic accident rates went up to 281.12 per 100,000 population (DOTC & JICA, 2015), compared to the 18 per 100,000 population global average (UNEP, 2010). The air quality in

Manila City, wherein 90% of the total emissions are from mobile sources, are still currently higher than acceptable values set by the World Health Organization(DENR, 2014). JICA reported that the country's economy is losing 2 Billion Pesos daily, from loss of opportunity, productivity, and wasted energy, due to traffic congestion in Metro Manila alone (NEDA & JICA, 2014). This number could go up to 6 Billion Pesos per day by 2030 if business as usual conditions are sustained. These problems are hindering the country's efforts to develop and enhance to quality of life for its people. Building more roads to accommodate more vehicular traffic will never solve the traffic congestion problem, especially if demand is not well managed (Boarnet, 2008). Specifically in Manila where most of the land area is already built up, it may be high time to rethink the current transportation policies and options.

In spite of all these developments, the transportation infrastructure was not able to cope up. Infrastructure developments did not grow as fast as the economy, the population and the rate of motorization. This has become one of the biggest obstacles, hampering the further growth and development, degrading the natural environment, weakening the urban social fabric, and making urban areas in the country less friendly(Leather, Fabian, Gota, & Meija, 2011).

## 1.2 Context and Problem Statement

The city of Manila, the Philippines' capital city, is a component city of Metro Manila. Manila City has a land area (built-up area) of 25 square kilometers, which has a population density of 66,429 persons per square kilometer. The total number of registered vehicles, as of 2008, was recorded at 239,192 (Javier, 2008) and is continuously growing unrestricted. The comparatively small land area of Manila with the unrestricted growth of motorization is causing premature congestion.

The total road length, as of the same year, was 491 kilometers. This means that the road density of the city, in terms of kilometers of road per square kilometer of land, was 20 – 300% higher than Metro Manila average. This is the highest in Metro Manila, as well as the whole country. Currently, Manila's traffic congestion situation is seen as one of the most pressing problem facing the country. Traffic congestion is sustained all throughout the day, and almost all roads are operating beyond its design capacity (NEDA & JICA, 2014). The city just does not have enough space to build more roads.

In the latest transportation study in Manila (DOTC & JICA, 2015), it was found that almost 49% of commuters use Public Transportation (PT), 20% use private modes and the rest of the commuting public, 31%, are dependent on non-motorized as their principal modes. However, it is interesting to see that, if you look at the distance being traveled by commuters, almost 30% of the motorized travels, both the public and the private modes, are traveling less than 2 kilometers. The private mode shares have increased from 16% in 1999 to 20% in 2015 (DOTC & JICA, 2015). The motorization rate has also significantly increased in Manila. This means that more people are shifting to private modes as their primary mode of travel, even for short distance commutes. This shifting phenomenon is adding more vehicles in Manila's already congested roads and streets. Amidst all these, NMT is seen as an important mode to consider in order to address the traffic congestion problem (Boarnet, 2008).

The Philippine government tried to address these problems through the creation of Administrative Oder 254. This law mandated the Department of Transportation and Communications (DOTC) and the Department of Public Works and Highways (DPWH) to formulate the National Environmentally Sustainable Transportation (EST) Strategy for the Philippines. This law reiterated that NMT locomotion, such as walking and bicycling shall be favored in the transformation of roads.

This study focused on considering the most fundamental form of transportation, as part of the solution to the complex traffic problem of the Philippines' capital city. Non-Motorized Transportation (NMT) modes, specifically walking and bicycling, are the most natural and energy efficient forms of transportation, considering short distance travel(Walker, 2012).

In order to understand why these observations occur, this study was conducted. The main interest of this study is to determine the behavioral factors of the people towards the use of non-motorized modes. Specifically, this research seeks to answer the following questions:

1. How do the people perceive the existing non-motorized transportation (NMT) infrastructures?
2. What are the factors affecting the people's perceptions on existing NMT infrastructures?
3. What are the configuration of mode use of the people, if improvement on the existing NMT infrastructures and environment are made?

## 1.3 Objectives and Significance of the Study

Manila's traffic congestion problem has been a major concern of the people, and the whole country. The transportation policies and provisions, over the past decades, seem not to work. As the country goes forward to develop, and the population and movement demand increases, the traffic congestion becomes worse day by day.

The main objective of this study is to give insights on how to solve the traffic congestion problem in Manila. It is important to look at different personal and environmental factors that influence certain behaviors and attitudes of the people, and understand how transportation infrastructures are perceived. Specifically, this study aims to:

1. Determine the people's perceptions regarding the existing NMT infrastructures;

2. Identify the influencing factors affecting the people's perception of existing NMT infrastructures;
3. Analyze these factors in terms of their relationships with each other; and
4. Determine the people's configuration of mode use if improvements in the existing NMT infrastructures and environment are made.

## 1.4 Operational Definition

This study used some terms whose definitions are limited only to this research. It is important to understand such terms in order to clarify and understand the limits of this study. This section defined different terminologies used.

*Ambulation* refers to the condition of having the ability to move freely and with ease and comfort from origin to destination, along and within the pedestrian/bicycling environment.

*Attractiveness* is the condition of having feeling of pleasure and delight, particularly appealing to emotions and especially in terms of appearance and amenities along the pedestrian/bicycling environment.

*Non-Motorized Transportation (NMT)* refers, specifically, to walking and bicycling modes.

*Safety* refers to the condition of being, or having the feeling of security from vehicular traffic, crimes and other road traffic related environmental factors along pedestrian/bicycling environment.

# 2 Literature Review

In the latest transportation study for Manila (DOTC & JICA, 2015), it showed that 31% of the people's trips were by walking mode. The study also showed that 49% of the modal share were by public transportation mode. 88.50% of the households in Manila does not own private vehicles. Majority of the population are reliant to non-motorized and public

transportation modes for their daily life activities. Based from these data, the NMT modes play a huge role in the transportation sector of Manila.

## 2.1 Non-Motorized Transportation (NMT) Modes

There has been a growing research interest for NMT, most especially in the urban areas. In areas where traffic congestion is a serious problem, solutions aimed at providing alternative for motorized travel often points to NMT modes as the most important mode (Boarnet, 2008). NMT researches are particularly in line with the concepts of sustainability and sustainable transportation, which has increasingly been among the popular research topics all over the world, in the recent decades. In the Philippines, NMT is gaining popularity in transportation studies, especially during these past few years.

NMT modes are fundamental parts in almost all trips, most especially the trips concerning public transportation modes. Essentially, all public transportation riders are NMT users. The success of public transportation policies highly hinge on the quality of the NMT mode experience of the riders (Walker, 2012). Therefore, NMT should be taken as an integral part of the transportation planning and policy making.

Different modes of transportation serve different purposes and are effective depending on the distance and nature of trip. Literatures regarding the effective and efficient distances suitable for NMT modes suggest that a 20 minute walk or bicycle ride is the maximum time that people are willing to take (NY DOT, 2008). Research reveals that a distance of 0.50 to 1.60 kilometers (Agrawal et.al, 2008; McNiel, 2010; Walker, 2012; Yang et.al, 2013) and 2.40 to 3 kilometers (McNiel, 2010; NY DOT, 2008) are acceptable walking and bicycling distances, respectively. These distances vary, and are influenced by socio-demographic (age, gender, vehicle ownership, etc.) and environmental factors (vehicular traffic situation, exposure to pollution, etc.) (Park, Choi, & Lee, 2014).

Although the northern countries have long recognized the impact of NMT in the overall transportation system, the southern world is just starting to recognize this. The Asian Development Bank (ADB) reported that a big chunk of the problem in the development of NMT in Asian countries, as well as the other developing countries, is the lack of relevant policies and political support that cater for the needs of the NMT users (Leather, Fabian, Gota, & Meija, 2011). In the Philippines, the National Environmentally Sustainable Transport Strategy was formulated through Administrative Order 254 (AO254). This recognized the role of NMT in the country's goal to achieve sustainable development.

## 2.2 Perceptions on NMT Modes and Transportation Mode Preferences

Pedestrians and bicyclists often choose their transportation mode and route based from how they perceive the route's environmental characteristics and attributes. Considerations, such as safety (Stangl, 2011; Alaira, 2014), ambulation and attractiveness (Fujii, 2005; Agrawal et.al, 2008; Park et.al, 2013), greatly affects decisions regarding route and mode choice (Mehta, 2008; Appleyard, 1976; Guinn & Stangl, 2014).

How people perceive the character of their environment is based on their site awareness and situational characteristics (White, 1980). Understanding how individuals perceive things or their environment is necessary to determine their preferences. Individual preferences are the result of individual's assessments of the compatibility of one's environment with his anticipated needs and goals (Kaplan, 1985). Therefore, understanding the characteristics of the public, their attitudes, goals and needs may be key in addressing the problems of the society.

## 2.3 Factors Influencing NMT Mode Choice

NMT studies involve human flow behaviors (Gupta & Pundir, 2015). NMT modes are influenced by many factors, both internal and external. NMT models highly depend on the attributes of the local environment (Agrawal et.al, 2008; Mehta, 2008). The physical environment contribute significantly to the person's decision to choose NMT modes (Lee & Moudon, 2006; Welle et.al. 2015; Palmiano et.al, 2015). The psychological attributes of the person has also been associated with the individual's travel behavior (Erikson, 2008). Kitamura et.al (1997) found that attitudinal factors have a very significant effect on a person's travel behavior. Gozun (2001) integrated social aspects to his research regarding NMT. He related the attitudinal factors of NMT users greatly affect implementation of NMT policies.

Relationships lie between travel behavior and the attributes of the physical environment (Yazid et.al, 2011; Grengs, 2014). Many researches have investigated the intricate relationships between the attributes of the physical environment, and the social and behavioral characteristics of the people (Guinn & Stangl, 2014; Mehta, 2008; Stangl, 2011; Millonig & Schechtner, 2006; Portland State University, 2015). Mostly, these researches focused on modeling the person's decision to select a mode or a route towards his destination (Agrawal et.al, 2008; Park et.al, 2013; Dill & Glieb, 2008; Yang et.al, 2013). NMT access trips were influenced by the individual's socio-economic profile, as well as by the built environment characteristics, both of the origin and the destination (Park, Kang, & Choi, 2013). Other researches advocated the importance of incorporating more qualitative elements to the planning and the design of NMT infrastructures. These elements include factors such as safety, security, convenience and comfort, continuity, system coherence, and attractiveness (Sarkar, 1993).

Gupta and Pundir (2015) recognized that there is a lack of global and detailed consideration of pedestrian and bicyclist behavior along trips, especially in urban areas.

Majority of the experimental studies were conducted in developed countries and does not necessarily mean, considering many differences in many aspects, that they are applicable in the developing world. NMT travel characteristics vary depending on the location. Different cities or neighborhoods have different assets, and different problems, one must pay attention to what the people want (Jacobs, 1961). Guinn & Stangl (2014) concluded that there is a constellation of factors influencing pedestrian and bicycling behavior depending on specific environments. Researches regarding NMT behavior lack transdisciplinary theoretical models which explain how individuals, groups, environmental, regional and other factors affect NMT (Mehta, 2008).

Using the findings from the previous studies conducted, this study considered the interplay of different socio-demographic factors, travel behavior characteristics, and their effect to the perception of the people, in terms of safety, ambulation and attractiveness, measured by the environmental attributes of their typical commuting route in Manila. Perception is a latent variable which will be measured by environmental factors (indicators).

## 3 Methodology

### 3.1 Sources of Data

This research collected primary and secondary data to understand and solve the problems at hand. Questionnaire survey was used to gather the primary data for this study. The questionnaires were administered using two types of methods, on-line and paper questionnaire surveys. The on-line questionnaires were generated using Google Forms, and were distributed via e-mail system. The researcher conducted the paper questionnaire survey which were distributed to the different households within the survey area.

Information regarding the sociodemographics, travel behavior characteristics and perceptions with regard to specific environmental attributes of the people's typical commuting

route and the mode preference if NMT infrastructure provisions and improvements in the NMT environment were asked in the questionnaires. A Four-Point Likert scale was used to rate how the citizens feel about certain NMT attributes of their typical commuting route.

Secondary data were sourced from the existing Philippine government reports and statistics, published articles and journals, as well as on-line databases, specifically the Google maps application. These were used to support the primary data of this study.

Table 3.1 Sources of Research Data

<table>
<tr><th colspan="3">Sources of Data</th><th>Information Gathered</th></tr>
<tr><td rowspan="2">Primary</td><td rowspan="2">Questionnaire Survey</td><td>Online</td><td rowspan="2">Socio Demographic, Travel Behavior, Perception, Mode Preference</td></tr>
<tr><td>Paper</td></tr>
<tr><td rowspan="6">Secondary</td><td rowspan="4">Government Reports</td><td>DPWH</td><td rowspan="6">Supporting Data (Statistics, Maps, Related Literatures, others)</td></tr>
<tr><td>DOTC</td></tr>
<tr><td>NEDA</td></tr>
<tr><td>PSA</td></tr>
<tr><td colspan="2">Published Journals</td></tr>
<tr><td colspan="2">Google Maps</td></tr>
</table>

*Note: DPWH - Department of Public Works and Highways; DOTC - Department of Transportation and Communications; NEDA - National Economic Development Authority; PSA - Philippine Statistics Authority*

## 3.2 Research Location

This study was set in Manila, Philippines. Two zones were selected, Pandacan and Malate. Specific areas within the two zones were selected, such that they satisfy the condition that they shall be within a combination of zones (Residential,

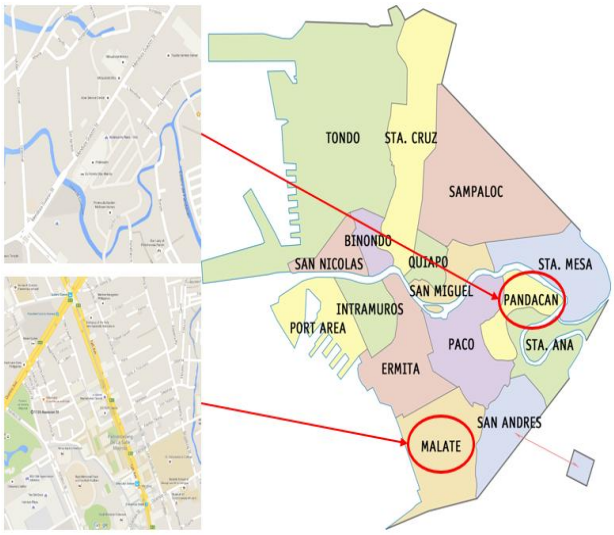


Figure 3.1 Research Location – Map of Manila

*Source: Google Maps*

Commercial, Recreational, Business, Educational and Area around Public Transport Stops). Finally, the areas along corner Ocampo Street until Quirino Station in Malate area, and along Mendoza Guazon Street in Pandacan, were chosen. The map of the study location is shown in Figure 3.1.

## 3.3 Sampling Methodology

The combination of convenience and voluntary response methods were used for the paper questionnaire survey, and the snowball sampling technique was used for the on-line questionnaire survey. This study focused on specific groups, which were targeted as the respondents of this research. People who work or study and reside within the study area, are, most likely, the people who have the most knowledge about the characteristics and attributes of the NMT environment in that area. Non-Probability methods were considered because of their potential to capture the perception of hidden groups of people that may not be directly available with the regular sampling methodologies (Atkinson & Flint, 2001; Battaglia, 2011; Fox, 2011).

### 3.3.1Sample Size

This study used the SEM to analyze the problem. Therefore, sample size assumptions to carry out SEM analysis were necessary. Although there is no correct or specified rule with regard estimating the sample size for SEM (Reisinger & Mavondo, 2008), Hair et.al. (1995) recommended that of having a sample size range from 100 to 200, with an absolute minimum of 50 samples. There was a total of 167 sample gathered, 41% (68 samples) responded to the on-line survey and 59% (99 samples) answered the paper survey questionnaires.

3.4 Data Gathering Procedure

Upon the determination of the survey location, coordination with the local officials and authorities at the survey area was necessary. The schedule of the questionnaire survey was arranged, as well as the local officials who would assist during the conduct of the questionnaire survey.After the questionnaire forms were finalized, the actual survey was conduct. The on-line questionnaire survey, through google forms, was launched and opened, and paper questionnaire survey was conducted. Respondents were instructed to share the questionnaire forms to people who reside or commute to the study area. Data validation and ensuring the completeness of information required in the accomplished questionnaires was done at the end of each survey day. The accomplished and checked survey questionnaires were encoded in the Google forms.

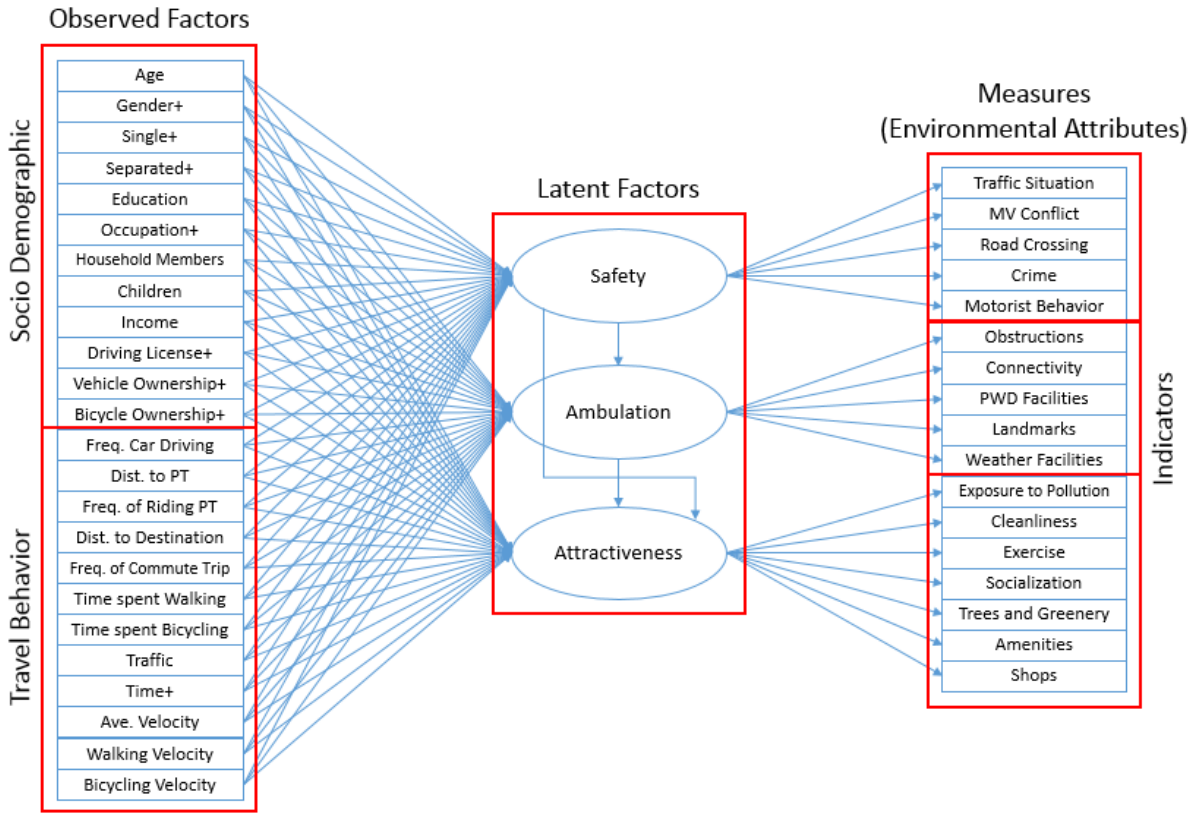


Figure 3.2 Structural Equation Model, + *Dummy Variables, Gender 1=male 0=otherwise, Single 1=single 0=otherwise, Separated 1=separated 0=otherwise, Occupation 1=employed 0=otherwise, Driving License 1=licensed 0=otherwise, Vehicle Ownership 1=owner 0=otherwise, Bicycle Ownership 1=owner 0=otherwise, Time 1=AM 0=otherwise*

## 3.5 Hypothesis of the Study

This study synthesized the different factors identified in the related literatures reviewed to formulate the hypothesis of this research. This study sought to prove the following hypotheses:

1. There are significant relationships between the socio-demographic and travel behavior characteristics (considered in this study as observed factors) and the latent factors (perceptions in terms of safety, ambulation and attractiveness).
2. Environmental attributes (indicators) measure the perceptions of the people, in terms of safety, ambulation and attractiveness.
3. There is a significant relationship among the perception on safety, the perception on ambulation the perception on attractiveness.

Path diagram (Figure 3.2) was derived based on these hypotheses. By taking into consideration these factors, in a localized level, traffic congestion problems may be addressed more effectively.

## 3.6 Factors Introduced

Different sets of factors were considered which were all derived from the literatures reviewed in this study. The observed factors included the socio-demographic and the travel behavior characteristics of the respondents. Socio-demographic characteristics included information about age, gender, civil status, education, occupation, household members, children members, income, driving license, and vehicle and bicycle ownership. The travel behavior factors included information regarding frequency of driving, riding PT and commuting trip, distance to PT station and commuting destination, time spent walking and bicycling, time of commute trip, average total commuting velocity, walking velocity and bicycling velocity, and traffic congestion situation along commuting route (Traffic).

The latent factors (unobserved) include perception on safety, perception on ambulation and perception on attractiveness. Alfonso (2005) introduced the Hierarchy of Walking Needs. He suggested that accessibility and feasibility are the primary needs of the people, then comes usefulness, safety, comfort and sensory pleasure, then finally the sense of belonging. This study argues that safety is the basic need of the NMT users in Manila, next is comfort (Ambulation) and finally the feeling of pleasure (Attractiveness). They were measured using indicators, which reflected the respondents' thoughts and feelings regarding the environmental attributes of their typical commuting route. The attributes were qualitatively assessed by the respondents

There were five indicators used to measure the perception on safety (Table 3.2). These are the environmental attributes of the typical commuting routes of the respondents relating to their personal feeling of safety and security.

Table 3.2 Indicators for Perception on Safety

| Indicators | Definition | Source |
|---|---|---|
| Traffic Situation | assessment of the vehicular traffic situation along NMT routes (vehicular traffic volume, speed) | Yang, et.al, 2013 |
| MV Conflict | assessment of the conflict between Vehicular and NMT traffic along NMT routes (existence of deicated NMT lanes/paths, barriers and buffers) | Guinn&Stangl, 2014; Welle, et.al, 2015; Dill&Glieb, 2008 |
| Road Crossing | assessment of the safety in cross paths (existtense of marked road crossings, traffic claming devices and light signals) | Choi, et.al, 2015; Guinn&Stangl, 2014; Welle, et.al, 2015) |
| Crime | assessment on the level of security against crimes along NMT routes (existence of street lighting, security cameras, law enforcement officers) | PSU, 2015; Guinn&Stangl, 2015 |
| Motorists' Behavior | assessment of the behavior of mototrists towards NMT users (respect afforded by motorists to pedestrians and bicyclists) | Leather, et.al, 2011 |

There were five indicators used to measure the perception on ambulation (Table 3.3). These were the environmental attributes of the respondents' typical commuting route with

regard to the ease and comfort of navigating from origin to their typical commuting destination. These factors generally relate to the feeling comfort the respondents feel when travelling along pedestrian/bicycling environments.

There were seven indicators used to measure the perception on attractiveness (Table 3.4). These were the environmental attributes of the respondents' typical commuting route with regards to the aesthetics and appearance of the pedestrian/bicycling environment, generally appealing to emotion and sensory pleasure.

Table 3.3 Indicators for Perception on Ambulation

| Indicators | Definition | Source |
|---|---|---|
| Obstructions | assessment of the obstructions along NMT routes (existence of illegally parked vehicles, shops, misconstructed utility posts along NMT routes and appropriate width of the NMT routes) | Yang, et.al, 2013; Guinn&Stangl, 2014 |
| Connectivity | assesment of the continuity of the NMT route network (continuity of the NMT network in the area) | Welle, et.al, 2015 |
| PWD Facilities | assessement of the existence of facility provisions for vulnerable people (existence of ramps, barriers, studed tiles, etc.) | Leather, et.al, 2011 |
| Landmarks | assessment of the easiness of navigation along NMT routes (existence of landmarks, direction signs and markers, etc) | Millonig&Schechtner, 2006 |
| Weather Facilities | assessment of the provision of facilities for protection of weather (existence of covered walk lanes, shaded paths, etc.) | Yang, et.al, 2013; Guinn&Stangl, 2014 |

Table 3.4 Indicators for Perception on Attractiveness

| Indicators | Definition | Source |
|---|---|---|
| Exposure to Pollution | assessment of the level exposure of the pedestrians/bicyclists to pollution and noise laong NMT routes (existence of pollution buffers and noise barriers, etc.) | Choi, et.al, 2015; Yang, et.al, 2013; Millonig&Schechtner, 2006 |
| Cleanliness | assessment of the cleaniliness and maintenace of the NMT routes | Guinn&Stangl, 2014 |
| Social | assessment of the opportunities for socialization and meeting friends along NMT routes | PSU, 2015; Park, et.al, 2013 |
| Exercise | assessment of the opportunities to engage in physical activity and exercise for health improvement along NMT routes | Guinn&Stangl, 2014 |
| Trees and Greenery | assessment of the existence of trees and green spaces along NMT routes | Palmiano, et.al, 2015; Choi, et.al, 2015; Agrawal, et.al, |
| Amenities | assessments of the availability of amenities along NMT routes (existence of seating, street lighting, bicycle rack and parking, etc.) | Millonig&Schechtner, 2006; Park, et.al, 2014; Palmiano, et.al, 2015 |
| Shops | assessment of the existence of shops and other attractions along NMT routes | Choi, et.al, 2015; Millonig&Schechtner, 2006 |

## 3.7 Structural Equation Modeling

### 3.7.1 Treatment and Diagnosis of Non-Normality

Structural Equation Modeling (SEM) assumes that data has multivariate normality. It is commonly assumed that data for SEM exhibit normal skewness or kurtosis. However, the assumption of a normal distribution of data often does not hold in reality. LISREL 9.10 (Joreskog & Sorbom, 2016) was used to normalize of the data to be used in SEM. The normal scores were used to fit the structural equation models, rather than the original data. Factors which did not meet the multivariate normality assumptions were removed from the model.

### 3.7.2 Model Identification

It is important that data is sufficient to ensure the estimation of factors identified. The t rule, which is a necessary condition for model identification for structural model, was used. The t rule is given by the following equations:

$$t \leq \qquad (3.1)$$

Where t = number of independent parameters

s = no. of elements of sample matrix of covariance of observed variables

$$s = \frac{1}{2}(p+q)(p+q+1 \qquad (3.2)$$

Where p = number of y-variables

q = number of x-variables

The identification of the measurement model was also examined. The condition of independent cluster basis was employed. Each latent factor should have at least two pure indicators. LISREL 9.10 analyzed these assumptions.

### 3.7.3 Structural Model

The relationships and interrelationships between the observed factors (socio-demographic characteristics and travel behavior characteristics) and the latent factors (perception in terms of safety, ambulation and attractiveness) were explored. These relationships were part of the Structural Model of the study. This was analyzed by the given equation:

$$\eta = \beta\eta + \gamma x + \qquad (3.3)$$

Where η = Latent Variable

β = Relationship between Latent Variables

γ = Relationship between Observed and Latent Variables

x = Observed Variables

ζ = Error Terms

### 3.7.4 Measurement Model

The Measurement model were the relationships between the latent factors and their respective indicators. Both structural and model equations were analyzed simultaneously using LISREL 9.10. This was analyzed using the given equation:

$$y = \lambda_y \eta + \quad (3.4)$$

Where y = Indicators

$\lambda_y$ = Relationship between Latent Variables and Indicators

ε = Error Terms

### 3.7.5 Result Parameters

Exploratory Factor Analysis (EFA) approach was performed between all the identified observed factors, and the three latent factors to analyze the Structural Model, while Confirmatory Factor Analysis (CFA) was used for the Measurement Model. Confirmatory Factor Analysis (CFA) was performed, simultaneously with the EFA in the Structural Model, through LISREL 9.10 (Joreskog & Sorbom, 2016). A Level of Significance of 10% maximum (minimum t values of 1.65) was accepted as the maximum in this study.

## 4 Data and Results of the Study

This study aimed to identify the factors influencing the people's perception regarding the existing NMT infrastructures, analyze their inter-relationships, and determine the mode preference of the people if NMT infrastructure provisions and improvement in NMT environment. The respondents' profiles and their responses to the perception questions were interpreted.

4.1 Profile of Respondents

The profile of the respondents of the study were analyzed based from the responses on the questionnaire survey. The total samples gathered were 167, wherein 41% answered the on line survey and 59% answered the paper survey. Majority of the respondents were young aged between 10 to 39 years old (72%). The mean age of the respondents was 33 years old, with the minimum of 14 and maximum of 75 years old. 49% of the respondents were female and 51% are male. 40% finished college level, and 38% finished High School level. In terms of employment, 62% of the respondents were employed and 38% of themwere not employed (either not employed or students). The average number of household members is 5 and the average number of children in household is 2. 41% of the respondents are considered poor, having a monthly household income of <₱20,000.00 per month (PSA, 2015). The mean income of the respondents is between ₱25,000 to ₱30,000 monthly. 62% of the respondents do not own private vehicles (motorcycle and/or private car).

Table 4.1 Socio Demographic and Travel Behavior Characteristics of Respondents

| Socio Demographic | | | | Travel Behavior | | | |
|---|---|---|---|---|---|---|---|
| **Factor** | | **Frequency** | **%** | **Factor** | | **Frequency** | **%** |
| Age | | | | Time | | | |
| *10-39* | *Young Age* | 121 | 72% | *Morning* | | 140 | 84% |
| *40-59* | *Middle Age* | 33 | 20% | *Afternoon* | | 27 | 16% |
| *60-79* | *Old Age* | 13 | 8% | Frequency of Commuting Trip | | | |
| Gender | | | | *None* | | 0 | 0% |
| *Male* | *Dummy,1=Male* | 82 | 49% | *Once* | | 23 | 14% |
| *Female* | *0=otherwise* | 85 | 51% | *Twice* | | 12 | 7% |
| Educational Attainment | | | | *3 Times* | | 22 | 13% |
| *6 years* | *Elementary* | 11 | 7% | *4 Times* | | 7 | 4% |
| *10 years* | *Highschool* | 63 | 38% | *5 Times* | | 48 | 29% |
| *12 years* | *Vocational* | 12 | 7% | *6 Times* | | 17 | 10% |
| *16 years* | *College* | 67 | 40% | *Daily* | | 38 | 23% |
| *18 years* | *Graduate* | 10 | 6% | Frequency of Riding PT | | | |
| *> 19 years* | *Post Graduate* | 4 | 2% | *None* | | 19 | 11% |
| Employment | | | | *Once* | | 27 | 16% |
| *Employed* | *Dummy, 1=Employed* | 103 | 62% | *Twice* | | 17 | 10% |
| *Non-Employed* | *0=otherwise* | 64 | 38% | *3 Times* | | 15 | 9% |
| Household Income | | | | *4 Times* | | 7 | 4% |
| *No Income* | | 4 | 2% | *5 Times* | | 17 | 10% |
| *< P 5,000* | | 6 | 4% | *6 Times* | | 12 | 7% |
| *P 5,000 - P 9,999* | | 21 | 13% | *Daily* | | 53 | 32% |
| *P 10,000 - P 14,999* | | 28 | 17% | Frequency of Car Driving | | | |
| *P 15,000 - P 19,999* | | 10 | 6% | *None* | | 141 | 84% |
| *P 20,000 - P 24,999* | | 24 | 14% | *Once* | | 3 | 2% |
| *P 25,000 - P 29,999* | | 12 | 7% | *Twice* | | 5 | 3% |
| *P 30,000 - P 34,999* | | 10 | 6% | *3 Times* | | 4 | 2% |
| *P 35,000 - P 39,999* | | 5 | 3% | *4 Times* | | 2 | 1% |
| *P 40,000 - P 44,999* | | 10 | 6% | *5 Times* | | 2 | 1% |
| *P 45,000 - P 50,000* | | 5 | 3% | *6 Times* | | 0 | 0% |
| *> 50,000* | | 32 | 19% | *Daily* | | 10 | 6% |
| Vehicle Ownership | | | | | | | |
| *Owner* | *Dummy, 1=Owner* | 63 | 38% | | | | |
| *Non-Owner* | *0=otehrwise* | 104 | 62% | | | | |

4.2 Travel Behavior Characteristics

The travel behavior of the respondents was extracted from the questionnaire survey. Only one way (Home to Destination) commuting trips were considered. Results indicate that the average distance between the respondents' homes to the PT stations is 8.6 minutes and the average distance to their typical commuting destination is 9.4 kilometers. Most of the

respondents travel during the morning mostly 5 times per week. Almost all of the respondents are dependent to PT modes and very few drive their own private vehicles. The results also indicated that the average total velocity of commuting is 9 kilometers per hour, the average speed of walking is 4.35 kilometers per hour and average speed of bicycling is 10.59 kilometers per hour. It is interesting to note that the average commuting velocity is less than the average velocity of bicycling.

## 4.3 Responses to the Perception Questions

The results of the perception questions in the survey conducted showed that people feel generally negative about the current attributes of the pedestrian/bicycling environment in Manila.

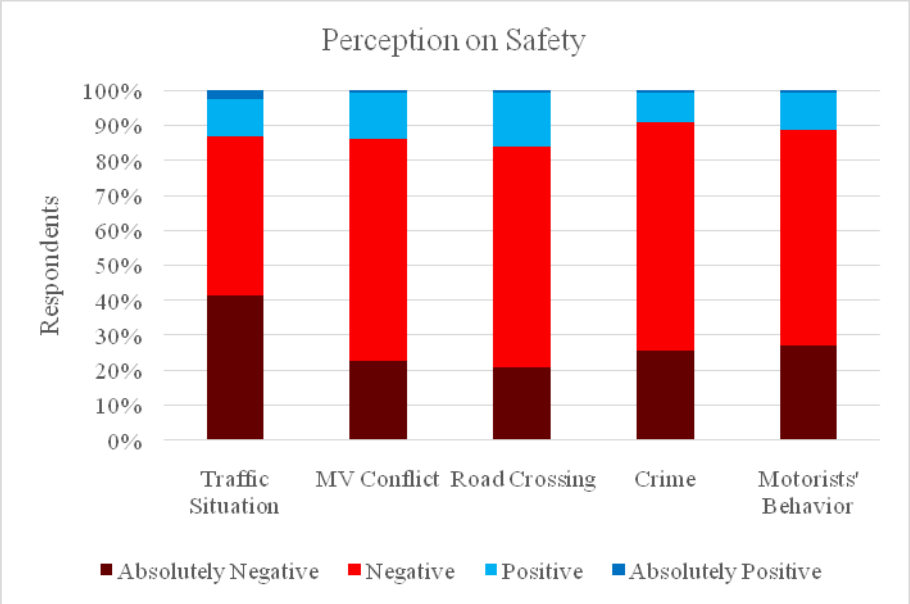


Figure 4.1 Responses to Perception on Safety

### 4.3.1 Perception on Safety

Figure 4.1 shows that most of the respondents feel negatively regarding the safety of the NMT environments in Manila. Particularly, the traffic congestion situation was seen as the most intimidating factor the respondents were most concerned of.

### 4.3.2 Perception on Ambulation

Figure 4.2 summarizes the responses of the respondents with regard to how they rated the indicators for the perception on ambulation. The major concern of the respondents were the nonexistence of facilities that aid vulnerable people – Persons with Disabilities (PWDs), children and elderly. While, most of the respondents has shown a positive response with regard to the existence of landmarks and the connectivity of the pedestrian/bicycling environments. This positive response of the respondents was an unexpected result. Manila's roads and streets are lacking in terms of pedestrian/bicycling network.

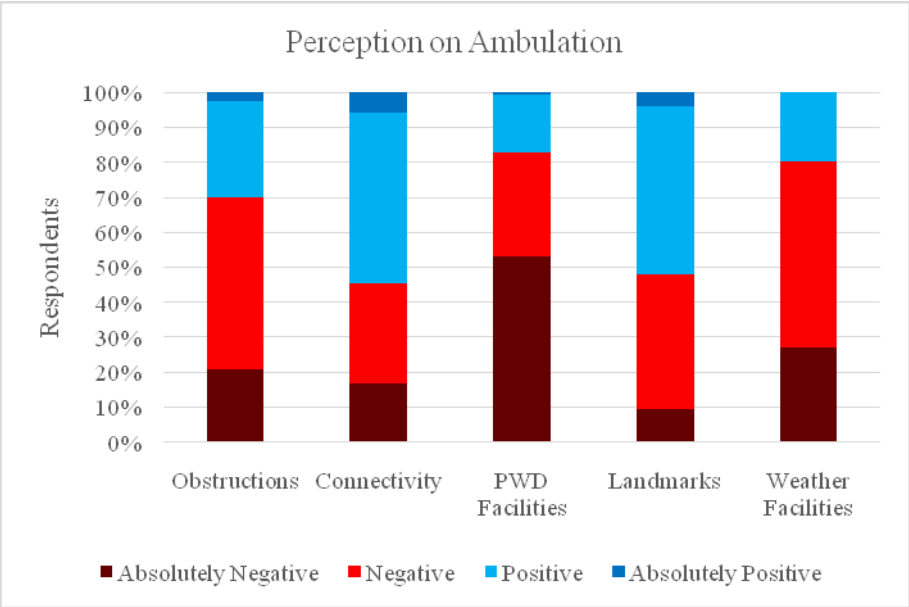


Figure 4.2 Responses to Perception on Ambulation

### 4.3.3 Perception on Attractiveness

Exposure to pollution and the cleanliness were the most pressing concerns of the respondents with regard to the attractiveness of the pedestrian/bicycling environments, as shown in Figure 4.3. Respondents were also concerned about the lack of amenities, such as street lighting, seating and bicycle parking and the lack of trees and greenery along the pedestrian/bicycling environment.

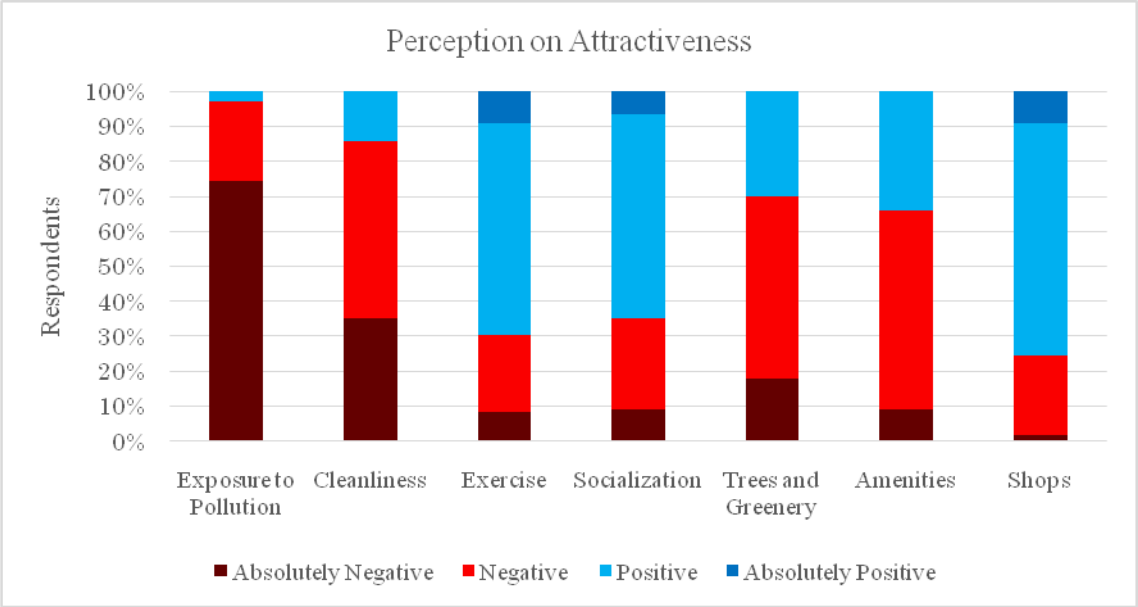


Figure 4.3 Responses to Perception on Attractiveness

Respondents are fairly positive about the existence of shops along the pedestrian/bicycling environment, and the point that the pedestrian/bicycling environments in Manila allows them to have physical activities and exercise, as well as allows them to socialize and meet friend along their typical commuting route.

## 4.4 Estimated Model

The relationships with the above mentioned indicators, and the effects of the socio demographic characteristics and travel behavior characteristics to the latent factors were analyzed using the MIMIC model. The path diagram of the estimated model is shown in Figure 4.4. Several observed factors significantly influences perceptions on safety, ambulation and attractiveness. Summarized in Table 4.2, Table 4.3 and Table 4.4 are the estimated direct effects, the t values and level of significance between the observed factors and the latent factors, safety, ambulation and attractiveness respectively.

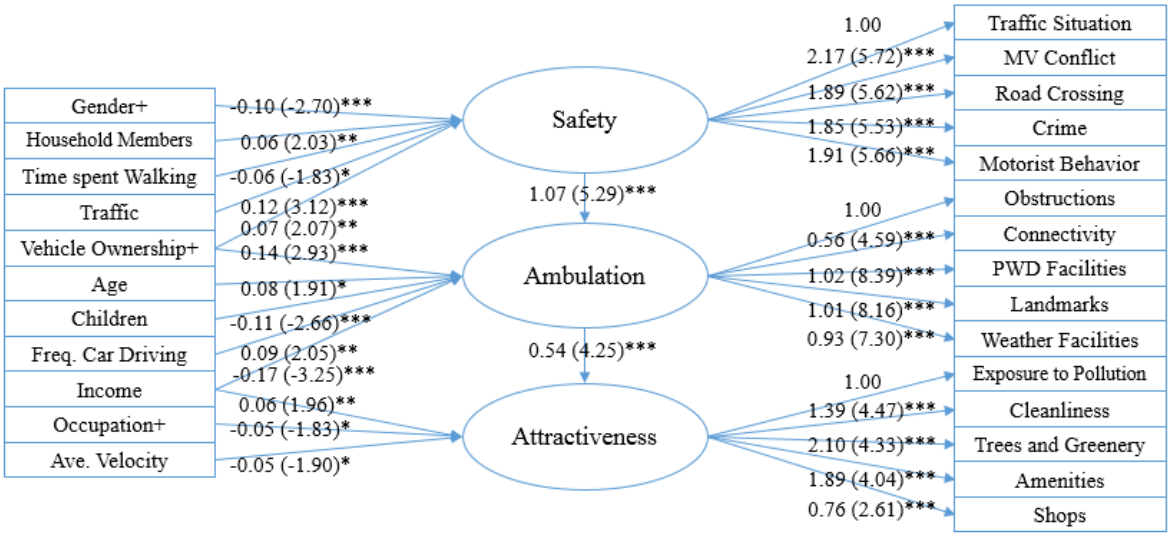


Figure 4.4 Estimated Model,*Estimate (t value), Level of Significance ***1% **5% *10%, +Dummy Variable, Gender 1=male 0=otherwise, Vehicle Ownership 1=owner 0=otherwise, Occupation 1=employed 0=otherwise*

### 4.4.1 Structural Model

The result of the MIMIC model, summarized in Table 4.2, indicated that the number of household member has a positive direct relationship with perception of safety. This suggests that people who have many household members has a more positive perception, such that they feel safer along pedestrian/bicycling environments.

The traffic congestion situation along the typical commuting route of the respondents also has a significant positive direct effect on the perception on safety. This result indicates that respondents feel much safer if the traffic situation along their typical commuting route is smoothly running. The amount of time spent walking along the typical commuting route has a significant negative direct effect to the perception on safety. This indicates that the more time the respondents spends on walking when going to his typical commuting destination, the perception on safety goes to the negative side, which suggests that respondents feel less safe. Furthermore, the results reveal that female respondents and vehicle owners have stronger influence to the perception on safety.

Table 4.2 Direct Effects of Observed Factors to Perception on Safety *Level of Significance ***1% **5% *10%, +Dummy Variable, Gender 1=male 0=otherwise, Vehicle Ownership 1=owner 0=otherwise*

| **Parameters** | | **Estimated** | |
|---|---|---|---|
| | | **Direct Effect** | |
| **Observed Factors** | **tent Fact** | **Est** | **t value** |
| Gender+ | Safety | -0.1 | -2.696*** |
| Household Members | | 0.065 | 2.0322** |
| Vehicle Ownership+ | | 0.075 | 2.0674** |
| Time spent Walking | | -0.06 | -1.830* |
| Traffic | | 0.124 | 3.1201*** |

Results (Table 4.3) for the perception on ambulation reveals that there is a significant direct positive relationship between the respondents' age and their perception on ambulation. This indicates that the older respondents have a more positive perception on ambulation compared to the younger respondents. The frequency of driving cars also has a significant positive relationship with the perception on ambulation. This result mean that the more the respondents drive private vehicles, the more they comfortable walking/bicycling and navigating around their typical commuting route. This result was not expected.

Table 4.3 Direct Effects of Observed Factors to Perception on Ambulation, *Level of Significance ***1% **5% *10%, +Dummy Variable, Vehicle Ownership 1=owner 0=otherwise*

| **Parameters** | | **Estimated Model** | |
|---|---|---|---|
| | | **Direct Effect** | |
| **Observed Factors** | **Latent Factors** | **Est** | **t value** |
| Age | Ambulation | 0.0756 | 1.9057* |
| Children | | -0.109 | -2.663*** |
| Income | | -0.1713 | -3.246*** |
| Vehicle Ownership+ | | 0.1432 | 2.9301** |
| Freq. Car Driving | | 0.0922 | 2.0462** |

There is a significant negative direct relationship between the perception on ambulation and the number of children members in household. This suggests that respondents who belong to households with more children members do not feel not comfortable walking/bicycling and navigating along pedestrian/bicycling environments.

Perception on ambulation has a significant direct negative relationship with the household income level of the household. This result suggests that people whose households earn more are less comfortable to walk/bicycle. Furthermore, the results also reveal that vehicle owners have a stronger influence to the perception on ambulation compared to those who do not own vehicles.

In terms of the perception on attractiveness (Table 4.4), results revealed that it has a significant positive direct relationship with income. This means that respondents whose households earn more have a more positive perception on attractiveness to the pedestrian/bicycling environment of their typical commuting route. This is an interesting result, primarily because of household income has a significant direct negative relationship with the perception on ambulation.

Table 4.4 Direct Effects of Observed Factors to Perception on Attractiveness, *Level of Significance ***1% **5% *10%, +Dummy Variable, Occupation 1=employed 0=otherwise*

| **Parameters** | | **Estimated Model** | |
|---|---|---|---|
| | | **Direct Effect** | |
| **Observed Factors** | **Latent Factors** | **Est** | **t value** |
| Occupation+ | Attractiveness | -0.0451 | -1.8297* |
| Income | | 0.0571 | 1.9601** |
| Average Velocity | | -0.0484 | -1.8960* |

Results also indicate that there is a significant negative direct relationship between the average velocities of the respondents' commute with the perception on attractiveness. This result indicates that the lower the average commuting velocity, the higher the perception

onattractiveness is. This result is somehow surprising, since people generally like to make their commuting trip as fast as possible (Babiano, 2001). Finally, respondents that are not employed have a stronger influence to the perception on attractiveness compared to the employed respondents.

### 4.4.2 Path Model

Relationships between the latent factors were also analyzed. The relationships betweenthe perceptions of safety, ambulation and attractiveness are shown in Table 4.5. The direct relationship between safety and attractiveness as originally investigated. However, it was found that there was no significant direct relationship between the two latent variables, therefore it was removed from the model.

The results indicate that perception on safety directly and positively influences perception on ambulation, and perception on ambulation directly and positively influences perception on attractiveness. Although the direct influence of the perception on safety to the perception on attractiveness proved to be insignificant, it can be said that the perception on ambulation mediates the influence of the perception on safety to the perception on attractiveness.

Table 4.5 Relationships between Latent Factors, *Level of Significance* ****1%*

| **Parameters** | | **Estimated Model** | |
|---|---|---|---|
| | | **Direct Effect** | |
| **Latent Factors** | | **Est** | **t value** |
| Safety | Ambulation | 1.0729 | 5.2943*** |
| Ambulation | Attractiveness | 0.5411 | 4.2539*** |

4.4.3 Measurement Model

The results (Table 4.6) indicate a significant relationship between the latent variables and their respective indicators. In the case of Attractiveness, t-values for opportunities for physical activities/exercise (Exercise) and opportunities for socialization and meeting friends (Socialization) were not significant, and therefore were removed from the estimated model. However, it is interesting to note that exercise and socialization proved to have a generally positive perception from the answers of the survey.

Table 4.6 Direct Effects of Latent Factors to their respective Indicators, *Level of Significance* ***1% **5% *10%*

| **Parameters** | | **Estimated Model** | |
|---|---|---|---|
| | | **Direct Effect** | |
| **Indicators** | **Latent Factors** | **Est** | **t value** |
| Traffic Situation | Safety | 1 | |
| MV Conflict | | 2.165 | 5.7220*** |
| Road Crossing | | 1.8855 | 5.6224*** |
| Crime | | 1.8544 | 5.5347*** |
| Motorist Behavior | | 1.908 | 5.6620*** |
| Obstructions | Ambulation | 1 | |
| Connectivity | | 0.5578 | 4.5935*** |
| PWD Facilities | | 1.0204 | 8.3947*** |
| Landmarks | | 1.0133 | 8.1602*** |
| Weather Facilities | | 0.9335 | 7.2982*** |
| Exposure to Pollution | Attractiveness | 1 | |
| Cleanliness | | 1.3929 | 4.4714*** |
| Trees and Greenery | | 2.1037 | 4.3269*** |
| Amenities | | 1.8885 | 4.0384*** |
| Shops | | 0.7617 | 2.6144*** |

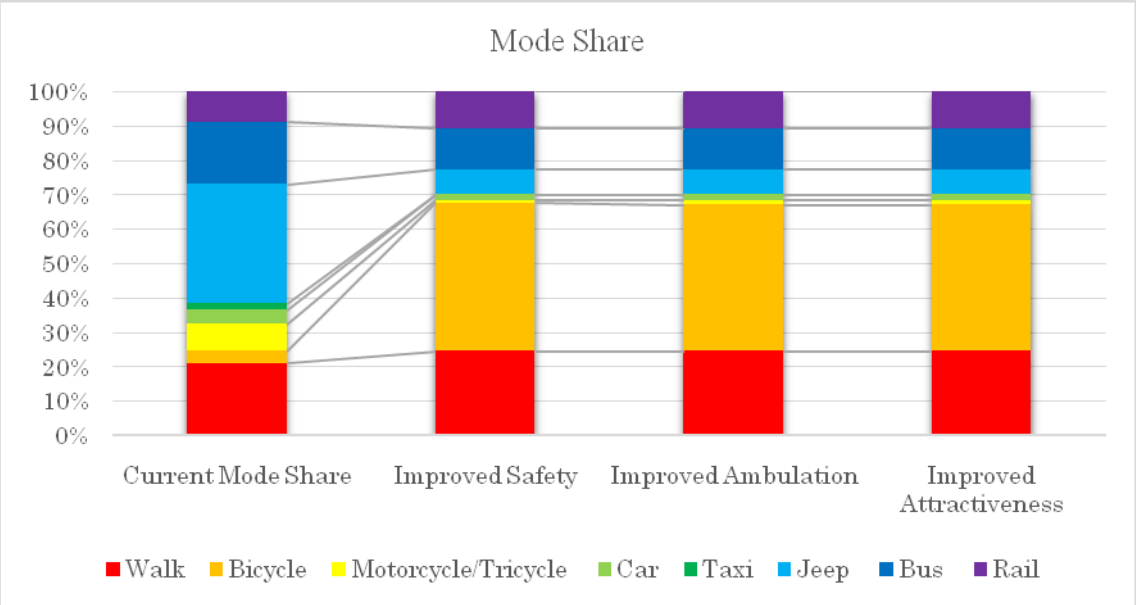


Figure 4.5 Mode Share

## 4.5 Mode Share

The mode share was computed using the representative mode of the people. The representative mode was based from the hierarchy: rail, bus, jeep, taxi, car, motorcycle/tricycle, bicycle and walk. Respondents were asked what modes they are willing to use if the Safety, Ambulation and Attractiveness, respectively were improved. The results show (Figure 4.5) that big reductions in the road based modes (bus, jeep, taxi, car and motorcycle/tricycle), while increase in the NMT modes as well as the rail mode, were observed.

It was also noted that 70% of the people who changed their representative mode from motorized to NMT are young aged (10-39 years old), 26% are middle aged (40-59 years old) and 4% are old people (greater than 60 years old). The current average travel distance of the young people who are willing to shift is 7.51 kilometers, while the middle and old aged travel 3.16 kilometers and 2.62 kilometers, respectively.

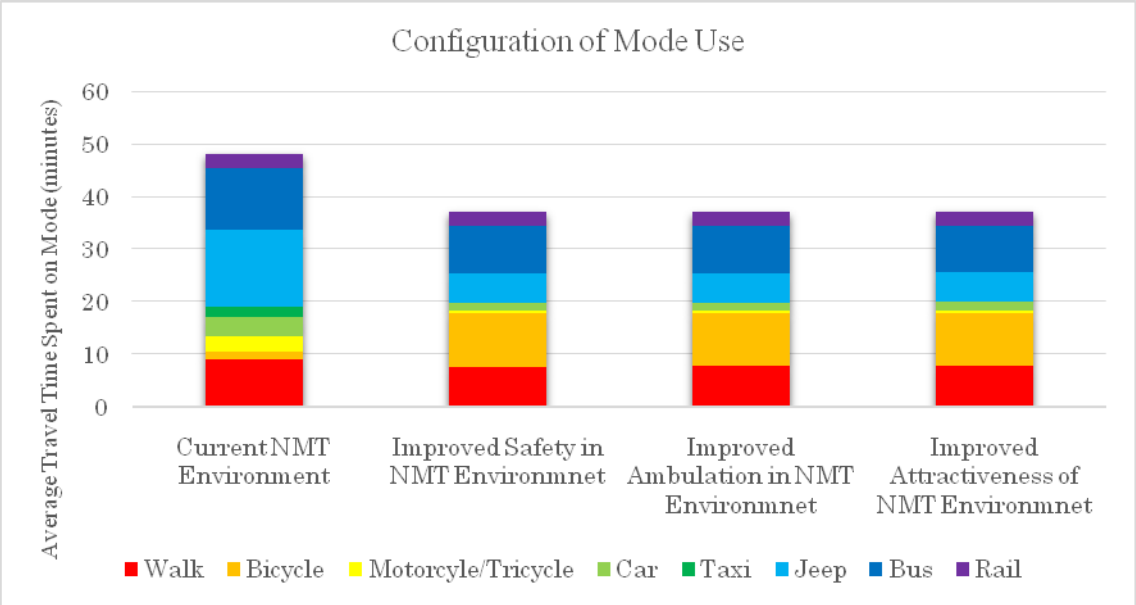


Figure 4.6 Responses for the Configuration of Mode Use

## 4.6 Stated Mode Preference

The responses of the respondents (Figure 4.6) show a very interesting result. People generally think that they will save on travel time if the NMT infrastructures are provided and the quality of the existing NMT infrastructure and environments were improved. There seems to have an optimistic response with regard to spending less time on motorized modes and more time on NMT modes. It is noteworthy that people seem to have difficulty identifying between the different improvement scenarios. Respondents, somehow, were unable to separate Safety, Ambulation and Attractiveness, as they are very closely related to each other.

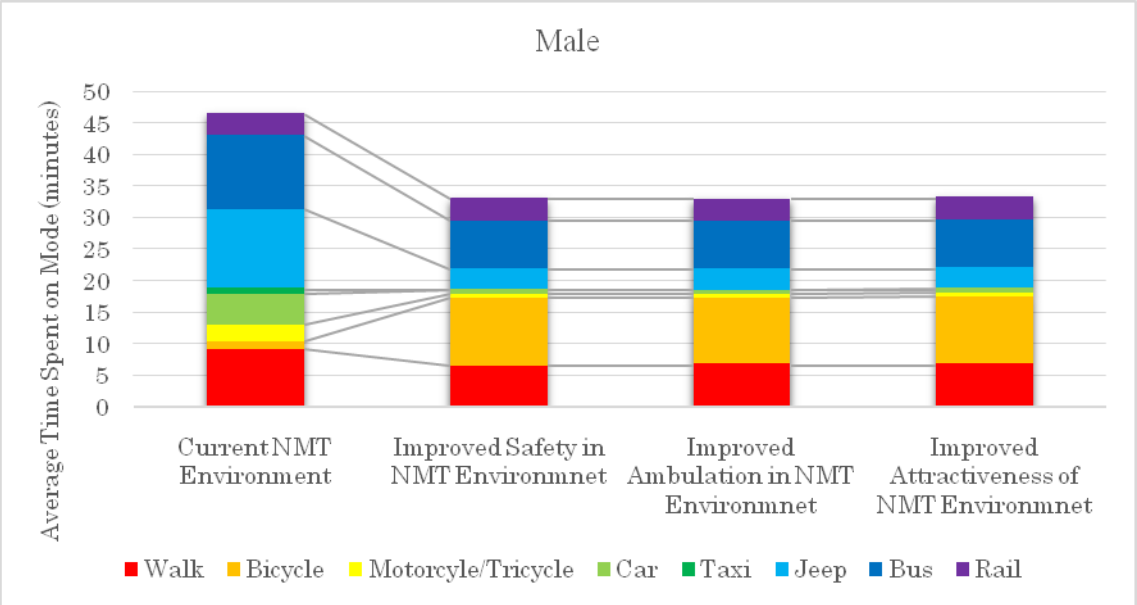


Figure 4.7 Configuration of Mode Use (Male)

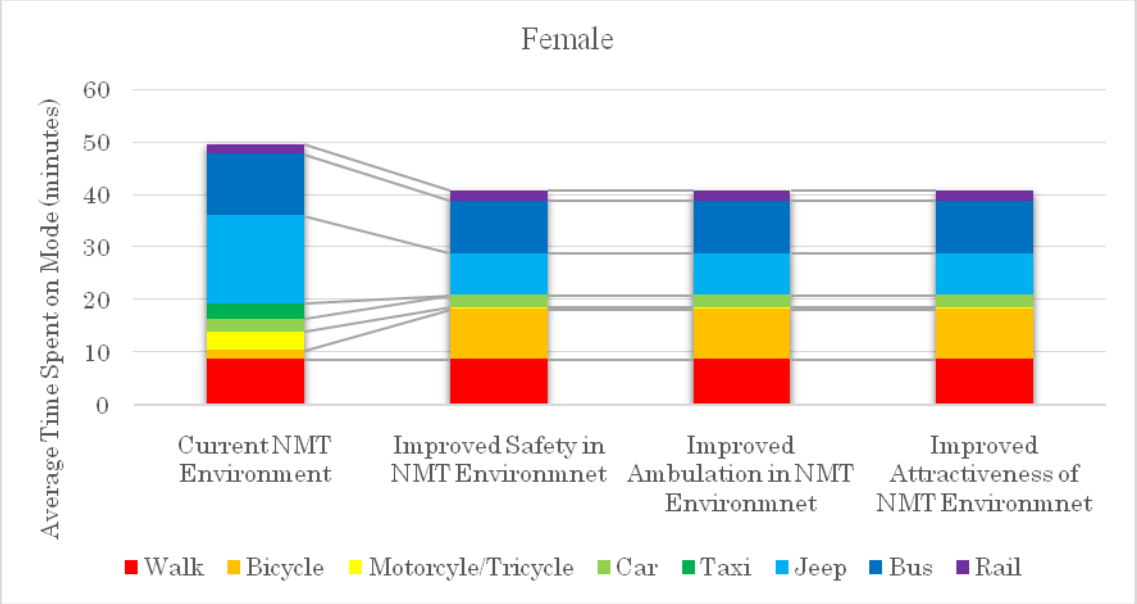


Figure 4.8 Configuration of Mode Use (Female)

### 4.6.1 Gender

In terms of gender, it was noted in Figure 4.7 and Figure 4.7 that males are willing to shift from driving private vehicle to the other modes of transportation while females seem to be reluctant to give up driving private vehicle even if NMT infrastructures will be provided and NMT environments will be improved. Males are more open to the idea of riding bicycles compared to the females given the proper NMT infrastructures.

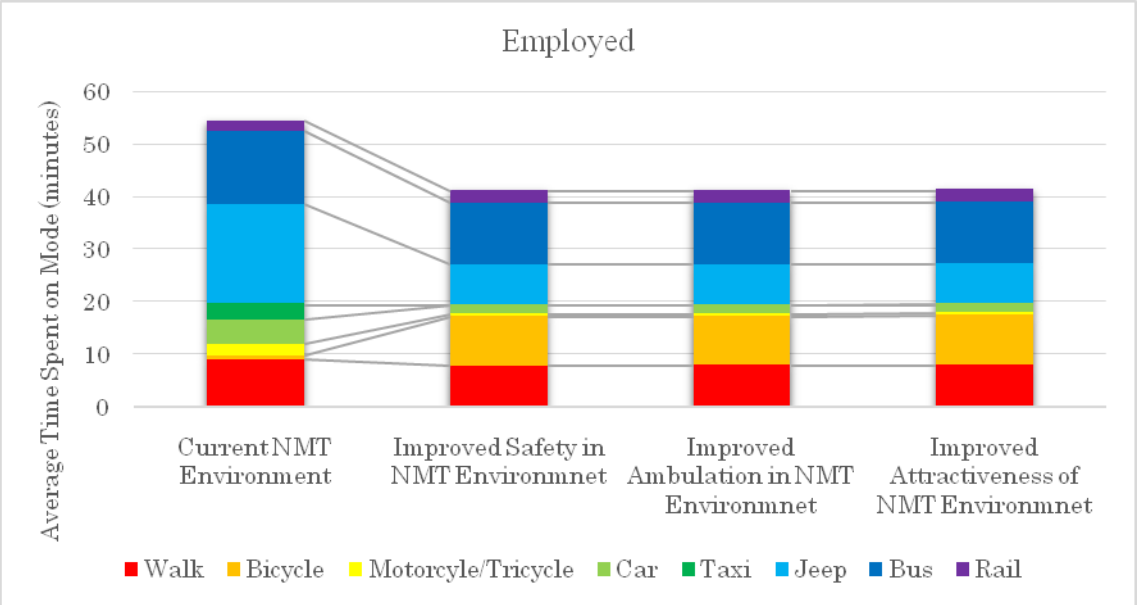


Figure 4.9 Configuration of Mode Use (Employed)

### 4.6.2 Employment

Shown in Figure 4.9 and Figure 4.10 are the responses based from employment status. The results suggest that, given the proper NMT infrastructures and improved NMT environments, majority of the unemployed respondents are willing to shift from motorized modes to the NMT modes. However, majority of the employed respondents still prefer to use motorized modes.

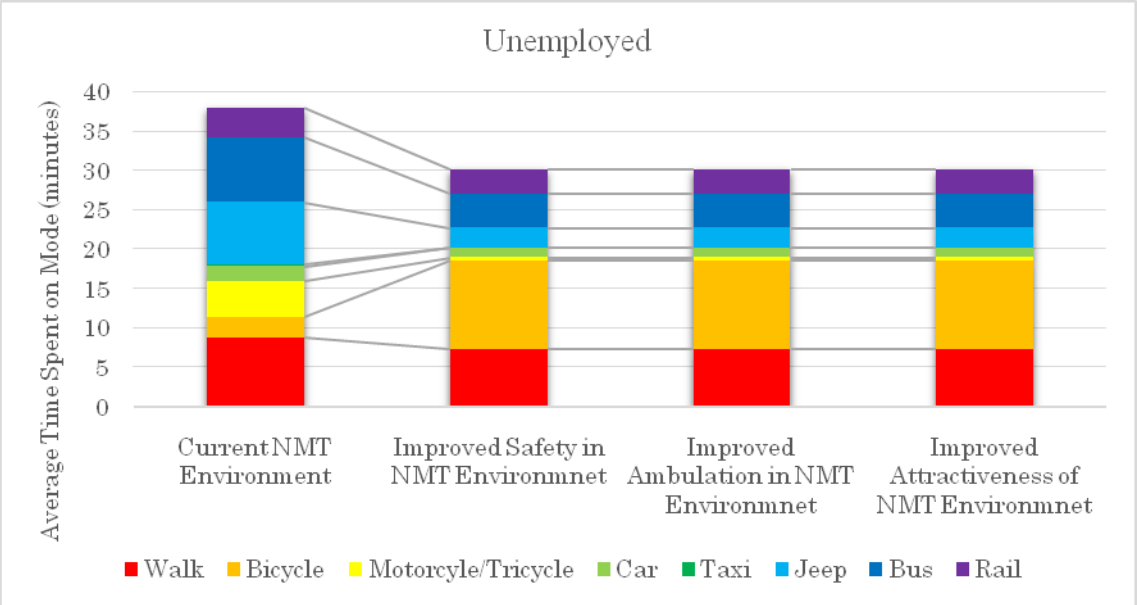


Figure 4.10Configuration of Mode Use(Unemployed)

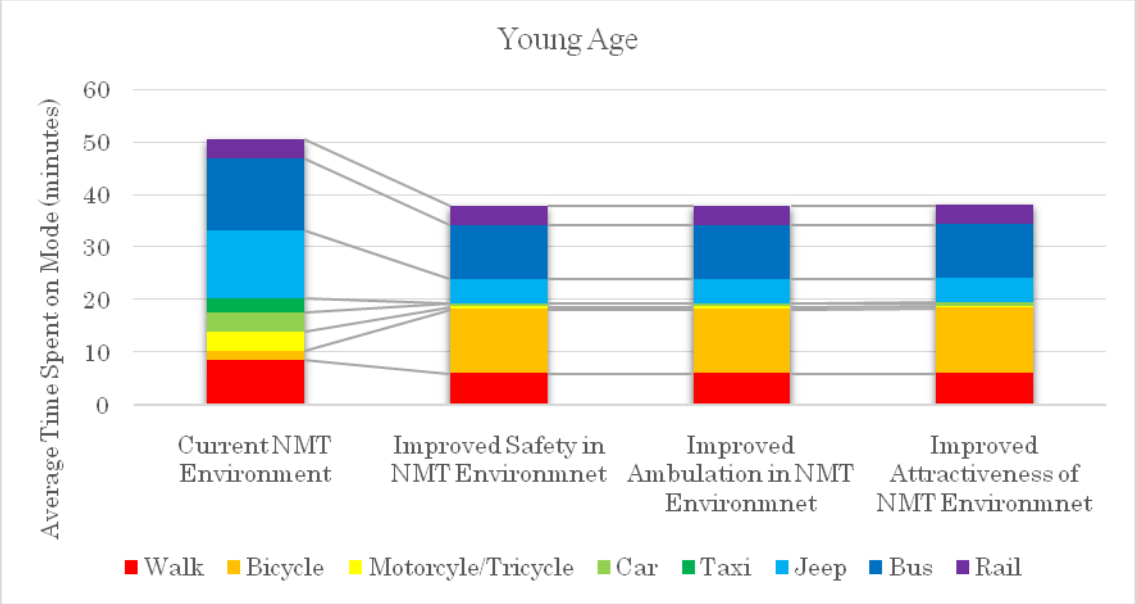


Figure 4.11Configuration of Mode Use(Young Aged)

### 4.6.3 Age

As shown in Figure 4.11, Figure 4.12 and Figure 4.13, given NMT infrastructures and improvements in the NMT environments, young respondents are willing to give up driving private vehicles for other modes of transportation. They are more open to shifting to bicycling mode. Middle aged respondents who drive private vehicles seem not to want to change to other modes. Old aged respondents would prefer walking modes more.

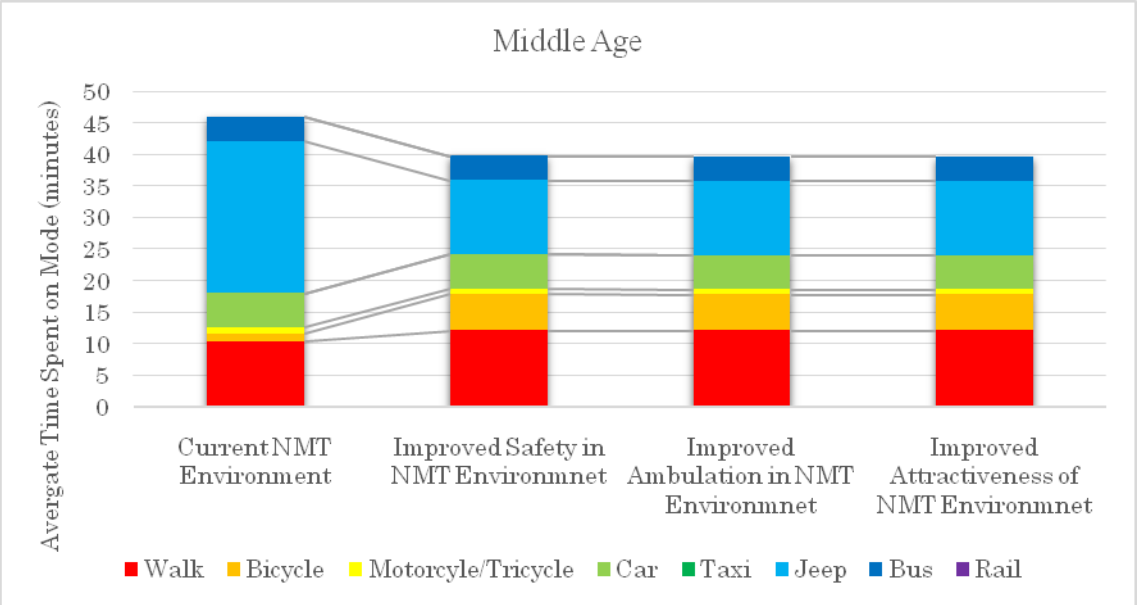


Figure 4.12 Configuration of Mode Use (Middle Aged)

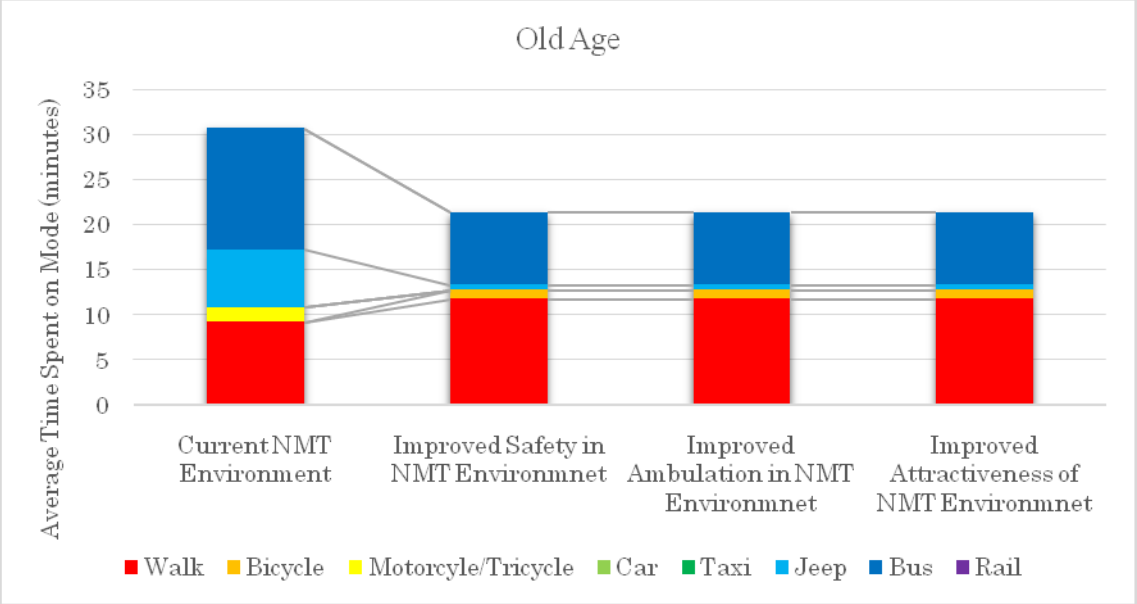


Figure 4.13 Configuration of Mode Use (Old Aged)

## 4.7 Model Goodness of Fit

Analysis was conducted by examining several fit indices. This determined whether the model fitted the data of the study. Ten fit indices were considered. Shown in Table 4.7 is the summary of the model goodness of fit indices used. Results suggest that there was an improvement from the hypothetical model to the estimated (final) model. Seven indices

showed a good and acceptable fit, while three indices (GFI, AGFI and RFI) showed a mediocre fit.

Table 4.7 Goodness of Fit Indices

| Goodness of Fit Criterion | Hypothetical Model Level | Estimated Model Level | Accepted Level | |
|---|---|---|---|---|
| Chi Square ($x^2$) | | | | |
| CMIN ($x^2$/df) | 1.91 | 1.91 | ≤ | 3 |
| GFI | 0.8 | 0.82 | ≥ | 0.9 |
| AGFI | 0.61 | 0.74 | ≥ | 0.9 |
| SRMR | 0.08 | 0.08 | ≤ | 0.08 |
| Model Comparison and Relative Fit Measures | | | | |
| NFI | 0.8 | 0.82 | ≥ | 0.8 |
| NNFI | 0.78 | 0.86 | ≥ | 0.8 |
| RFI | 0.63 | 0.75 | ≥ | 0.9 |
| IFI | 0.89 | 0.9 | ≥ | 0.9 |
| Non-Centrality Based Indices | | | | |
| RMSEA | 0.07 | 0.07 | ≤ | 0.8 |
| CFI | 0.88 | 0.9 | ≥ | 0.9 |

# 5 Discussion of Results

## 5.1 Factors Influencing Perception

The results of this study revealed that there is a generally negative perception with regard to the current NMT infrastructures in Manila. Moreover, there are significant relationships between the socio-demographic and travel behavior characteristics (observed factors) of the people and their perception (latent variable) of existing NMT infrastructures in terms of safety, ambulation and attractiveness. Specific factors significantly affecting perceptions were identified. The results further revealed that there are direct and significant relationship between the perception on safety and the perception on ambulation, and the perception on ambulation and the perception on attractiveness.

### 5.1.1 Perception on Safety

People generally perceive the NMT environment in Manila negatively. All of the

indicators identified for the perception on safety were rated negatively by the respondents. This indicates that the NMT infrastructure provisions in Manila were not able to properly address the safety concerns of the people. Although most NMT researches acknowledged the importance of personal safety (safety from motorized traffic) and security (safety from crime) as determining factors for NMT activities, it seems that this is poorly implemented and incorporated in the planning and design of NMT infrastructures. This may imply that safety was more important to the people using the pedestrian/bicycling infrastructures, than to the planners and the designers who made them (Stangl, 2014).

The negative perception on safety of the people meant that they felt vulnerable, both from vehicular traffic and criminal behavior. Females and owning vehicles strongly influence the perception on safety. This reinforced the previous claims regarding the theory of females having higher levels of fear of being victimized, and therefore females' activities are negatively associated with outdoor activities, such as walking and bicycling (Park et.al, 2014).

Owning private vehicles has a strong influence on the perception on safety. The availability of private vehicles decreases the intention of a person to use NMT modes (Park et.al, 2014; Babiano, 2001; Park et.al, 2013). This may be true, especially that private vehicles offer a sense of personal space, and buffs its driver and passengers from external factors. This may also be the very same reason why the time spent walking and the congested traffic situation along the typical commuting destination negatively influences perception on safety. The more time spent on NMT modes, and along routes with higher vehicular traffic suggests a higher probability of encountering events that might undermine personal safety and security.

Interestingly, the number of household members positively influences the perception on safety. This result may add to the axiom that there is safety in numbers. This suggests that there would be more people whom they could trust to guarantee their safety and wellbeing.

However, this research was not able to specify whether household members travel together or not. Therefore this factor needs further verification and analysis.

### 5.1.2Perception on Ambulation

Facilities for PWDs, children and elderly; weather protection provisions; and existence of obstructions; in that order, are the factors in which majority of the people felt negatively about. These results also suggest that infrastructure provisions in Manila were not able to properly address these concerns, most particularly the provisions for the vulnerable people (PWDs, children and elderly) However, these results were expected, especially the provision of the facilities for PWDs, children and elderly (82%). In the study conducted by the Asian Development Bank (Leather, Fabian, Gota, & Meija, 2011), the average rating of Asian cities in terms of the disability infrastructure is 39.17 out of 100. Manila, like other Asian cities suffer the lack of infrastructure provisions which cater to the need of the vulnerable people.

Understanding the attribute of the local environment, such as the weather conditions, is of vital importance in the design NMT infrastructures (Millonig & Schechtner, 2006; Yazid et.al, 2011).The high negative rating (80%) of the respondents with regard to the existence of provisions for protection against weather suggests that the planners and designers of the NMT infrastructures may have failed to understand this point. This is very important, especially to the 31% of the people using the NMT modes, as well as the 49% who are dependent on PT modes.

The high concern for the existence of obstructions (70%) also suggests that the maintenance and management of the NMT infrastructures may be lacking. People suffer from obstructions due to illegal and inappropriate parking of private vehicles, as well as illegally and improperly constructshops and posts along the pedestrian/bicycling environments. This

may be related to how the respondents rated the perception of safety's motorists' behavior (89%). This may be justified since it was found that there is a direct relationship between the perception on safety and the perception on ambulation.

In terms of the connectivity of the NMT networks in Manila, majority of the respondents rated this factor positively (55%). This, however, is an unexpected result. Like other cities in developing countries, Manila does not have an established network of NMT infrastructures. The reason for the positive perception of the citizens in terms of connectivity may be related to their familiarity with the existing NMT conditions. People have been exposed to the existing quality of the NMT environment for a very long time that it had become normal to them. Familiarity relates to social norms which reflects what, within groups, is seen and accepted as normal (Grieco & Urry, 2011). People may have accepted the quality of the existing NMT infrastructures. Familiarity may also be the reason why older people have more positive perceptions on ambulation.

The number of children members in household negatively influences perception on ambulation. Children's activities and movements are somehow unpredictable (Welle, et al., 2015). People may have difficulty and are not comfortable travelling with children in Manila. This is in line with the result that respondents have low perception with regards to facilities for the vulnerable people (PWDs, children and elderly). However, this result needs to needs to be further verified, since this study was not able to determine whether the respondents traveled with their children during their typical commuting trip.

People owning private vehicles and higher income strongly influences perception on ambulation. Owning private vehicles is a symbol of economic status, which means that income is directly related to private car ownership (Gozun, 2001). The influence of these factors to perception on ambulation may also be related to the lack of an established network of NMT infrastructure in Manila. Although the connectivity was rated positively, these may

be the people who do not own private vehicles. The influence of owning private vehicles and income over the perception on ambulation may be related to the fact that those who do not own private vehicles do not have a choice (Guinn & Stangl, 2014). This difference may also be because vehicle owners and higher income earners actually have a viable alternative to NMT modes, and that they are more comfortable with their choice (Grieco & Urry, 2011).

Interestingly though, the frequency of driving private vehicles has a positive influence on the perception on ambulation. Manila's traffic congestion problem is 6$^{th}$ worst globally with a very high dissatisfaction rating. This comes as no surprise that probably, those who are driving private vehicles often might think that NMT modes are faster and easier than being stuck for hours in traffic congestion, considering short distance commute.

### 5.1.3 Perception on Attractiveness

Exposure to pollution is the major environmental factor citizens are most concerned with (97%). Exposure to pollution is a major deterrent to a person's decision to use NMT modes (Millonig & Schechtner, 2006; Yang et.al, 2013; Choi et.al, 2015). This situation iscommon, especially in developing country's cities where environmental deterioration is still being experienced (Gwilliam, 2010).

Cleanliness (85%), the existence of trees and greenery (70%), and amenities (66%), such as street lighting, seating, bicycle racks etc. were perceived negatively by the majority of the respondents. These factors have a strong influence on the emotional experience of the people(Guinn & Stangl, 2014).They contribute to the pedestrians/bicyclists' sense of familiarity and belonging to a certain community or environment as Mehta (2008) observed in Massachusetts. Having trees and greenery, as well as roadside amenities, such as seating and bicycle racks creates a sense of symbolic ownership, which is very significant on a personal level. The cleanliness and maintenance of these symbolic things, somehow, becomes a shared

responsibility of its users. The negative ratings of these factors may indicate that the people may have lost or may be losing their emotional connection to their NMT environment due to the poor maintenance and absence of the factors that they hold important.

The existence of shops along the typical commuting route of the respondents was perceived positively (75%). This result was expected. This factor adds to the psychological and emotional characteristics of the NMT environments, which are very important for the NMT users (Choi et.al, 2015; Mehta, 2008; Millonig & Schechtner, 2006). Mehta (2008) discussed the importance of the usefulness of the NMT environment. Usefulness is the environmental characteristic that satisfies the individual's daily needs. Also, the existence of shops along the typical commuting route contributes to the sense of belonging to the community. This result indicates that the existence of shops along the typical commuting route of the people may be satisfying their need of usefulness in their NMT experience. However, the effect of illegally constructed shops, which cause obstructions along NMT routes needs further investigation.

This might also be the reason why the average velocity of the typical commute trip has a negative relationship with the perception on attractiveness. This suggests that the slower the commuting trip, the higher their perception on attractiveness is to the NMT infrastructures along their typical commuting route. It was expected that people would want to travel to their typical commuting destination as fast as possible, with the fastest mode available. The result of this research suggests otherwise. Mehta (2008) provided some insights with regard to this. He proved that even if people did not intend to spend time in stationary activity, people preferred to see streets which are attractive to look at, with more people and lingering activities. This suggests that maybe the sensory pleasures derived from the streets are of significant importance and are essential part of the typical commuting experience of the people.

Very interestingly, the opportunities for physical activities (exercise) and socialization, which proved to have a high positive rating from majority of the respondents (69% and 65% respectively), did not come out as significant factors as indicators for the perception onattractiveness. This suggests that these factors may be true across socio-demographic groups and different travel behavior characteristics. Literatures have discussed the importance of these factors in the walking and bicycling experience of the people. Many researches proved that these are basic factors that are very important for all NMT users (Park et.al, 2013; Guinn & Stangl, 2014; Portland State University, 2015). Gehl (1987) discussed that people basically use NMT modes because it is considered as necessary activity, rather than optional or social. This suggests that maybe the exercise and socialization factors which were discussed in this study are probably considered as basic and necessary activities of everyone. This result, however, warrants further analysis.

Being not employed has a stronger influence to the perception on attractiveness of NMT infrastructures. Also, the results showed that income have a positive influence to the perception on attractiveness. This indicates that people who earn more money, which are most likely the employed people, are the ones enjoying more of the sensory pleasures derived from NMT environments. It is also very interesting to note that income has a negative influence on the perception on ambulation. These results suggest that the perception on attractiveness of the NMT infrastructures probably complements the perception on ambulation. This is in line with the significant positive direct relationship between perception on ambulation and perception on attractiveness.

## 5.2 Configuration of Mode Use

There was an optimistic response from the people when transportation mode preferences were asked. If proper NMT infrastructures and improvements in the NMT

environment along the typical commuting route of the people are made, results revealed that people think that they will have travel time savings. This may be due to the existing routes of the PT in Manila, as well as the traffic flow configuration of the roads. There are many one-way roads, such that PT travel becomes very long. Manila has many roads and route that are unused, mainly because they are not walkable or bikeable. These routes are more direct to the destinations, and therefore cutting the travel time of the people.

Moreover, majority of the male respondents are open to NMT modes, especially bicycling mode. Males seem to be willing to shift from driving private vehicles for other transportation modes, while females are more reluctant. This may be related to the findings from the perception of safety that females have higher levels of fear and concern for personal safety and security (Park, Choi, & Lee, 2014).

Based on the employment status of the respondents, majority of the unemployed are very accepting to the idea of shifting to NMT modes, while the majority of the employed respondents seemed to like using motorized modes more. This may be related to the income level of the people. Employed people have more income compared to the unemployed; therefore, they have mode alternatives. The unemployed, usually from lower income groups, would prefer to have and use the most economic means of transportation for their mobility needs. NMT provides these for the lesser privileged people. In terms of age, young and old respondents are more open to using NMT modes than the middle aged respondents. Middle aged respondents seem to prefer using motorized modes more.

## 5.3 Limitations and Future Research Recommendations

This study focused on the factors influencing the people's perceptions of existing NMT infrastructures, and their relationships with each other. It is important that the results of this study be understood in the contexts of the following limitations

This study was conducted in Manila, Philippines, which is a high density, highly urbanized South East Asian city. The study area was specifically located at Pandacan and Malate. Hence, the results and learnings from this study are most likely applicable only to areas with similar characteristics. This study is also limited to the time frame from which it was conducted. The factors identified in this study may be regarded as legitimate if they would stay consistent over a period of time. Therefore, similar researches may be conducted to validate these factors and the influences and relationships they have.

Primary data was gathered using a questionnaire survey, with 167 respondents. Non Probability sampling methods were used – convenience and voluntary sampling for the paper survey and snowball sampling for the online survey. The results of this study is weak with respect to the biases of the sampling methods used. Majority of the respondent were aged below 30 years old, belonging to the low income category, do not own and drive private vehicles and are dependent on PT modes. The other socio demographic groups may not have been evenly represented. The number of respondents who use NMT modes as principal modes for their typical commuting trip was small. Furthermore, this study combined walking and bicycling modes as NMT mode. In reality, these modes have distinct characteristics which have different sets of factors influencing each mode. Future research should validate the findings of this study by using different sets of respondents, distinguishing between walking and bicycling and improving on the data collection and sampling methodology. A more detailed commuting trip study may be conducted to further understand the possibility of NMT mode shift.

The relationships between the perceptions on safety, ambulation and attractiveness were estimated in the model. However, the responses in the in the configuration of mode use if improvements in existing NMT infrastructures and environments are made was not clear. The respondents chose the same modes and allocated the same times for each scenario. This

may be a result of unclear instructions in the questionnaire during the conduct of the survey. Therefore it is recommended that future studies should improve the questionnaires in order to get more reliable results.

The analysis of the relationships focused on the direct effects of one factor to another. The indirect, as well as the total effects of each factor with other factors was not discussed in this study. Future researches should explore and evaluate these effects more deeply.

To facilitate improvements in the NMT provisions and policies social experiments may be conducted to cross validate the results of this study. Experiments should be conducted to address the needs pointed out in this study. The real test of a hypothesis is if it gets to be applied in the real world. More reliable results may be extracted from direct and real time observations.

## 6 Policy Implications

In order to solve traffic congestion problems in Manila, policy makers and transportation planners should recognize and understand the complexity of the problem they are trying to solve. Understanding attitudinal aspects, such as perceptions, is an essential step in identifying and addressing the needs of the commuters.

Safety in the pedestrian/bicycling environment, against both vehicular traffic and crimes, was the factor that concerned the great majority of the respondents. Policies that were meant to ensure the safety and security of the people of the NMT environment are already in place (Leather, Fabian, Gota, & Meija, 2011). The problems seem to lie on the implementation of these policies. Also, the results of these research showed that existing infrastructures were not able to address the safety and security concerns of the citizens, most especially to the safety concern related to the traffic situation along their commuting routes. Traffic calming devices and barriers that act as buffers between NMT users and vehicular

traffic should be installed along pedestrian/bicycling routes. Minimum distances between crossing paths should be established, especially along areas where the pedestrian/bicycle traffic is higher. The provision for the design of the widths of the vehicular traffic lanes, as well as the traffic speed limits should be reviewed, especially along areas and locations where there are high pedestrian/bicycling traffic. Special provisions should be provided in areas where there is significant pedestrian/bicycle volume. Gender sensitivity of the NMT infrastructure design, as well as special provisions for preventing the occurrence of crimes along the NMT routes should also be carefully considered.

Transportation planners and designers should keep in mind that in order to encourage people to take NMT modes is to address their ambulation concerns. The real test of the comfortable the NMT experience is dependent on how comfortable the vulnerable people can walk or cycle along the NMT routes. Policy makers, planners and designers should always take note that increasing the level of service, quality and comfort of the commuting experience of the people is always a major goal. By doing so, vehicle owners and frequent private vehicle drivers may be encouraged to shift to, or at least to consider NMT modes.

The emotional and sensorial pleasure of the people needs to be properly considered and incorporated in the crafting of policy and the planning and designing of infrastructures. simple things like providing seats, trees and greenery to provide shades and other things that will make the people feel that they are cared for, will go a long way.

The results of the configuration of mode use revealed the optimistic potential for the NMT modes in Manila. If the real needs of the NMT users (pedestrians and bicyclists) were addressed, which were revealed in the perception survey of this study, it is possible that many people will choose NMT modes over time. This study further revealed that a potential significant decrease in the road based modes and increase in the rail modes may be achieved

if NMT infrastructures and environments are made. This result warrants policy makers and planners to seriously consider and give appropriate attention to NMT.

It is very interesting that the solutions to these problems are very simple and quite inexpensive (NY DOT, 2008). Direct routes already exist, but unused because of many concerns. Existing routes do not meet the people's needs and are not walkable and bikeable. If these routes are fixed and improved, significant changes in the road traffic situation and behavior of the people may occur. The government should take a closer look at these for these entails not just economic benefits, but also environmental and social benefits as well.

## 7 Summary and Conclusion

Perceptions were measured in terms of their environmental attributes related to each factor. Some of the attributes were perceived negatively, and some positively. This reflects how the current NMT infrastructure provisions are affecting the mindset of the people, and therefore affecting their daily decisions. This adds to the argument that there is a link between the built environment and our state of wellbeing (Jacobs, 1961). The results of this study showed that certain sociodemographic, travel behavior characteristics influence the perception of the people.

The people generally perceived safety along NMT environments in Manila negatively. Among the threats are safety from vehicular accidents and crimes as they travel along the NMT routes in their typical commuting trip. Females and vehicle owners are strongly affected by this factor. People, generally, try to refrain from spending more time on NMT modes or along NMT environments.

The provisions for the PWDs, children and elderly; weather protection facilities; and obstructions were found out to be hindering the comfort and ambulation of the pedestrians/bicyclists, and therefore were perceived negatively. Connectivity and landmarks

were rated positively by majority of the respondents. This result should be treated carefully. Vehicle owners are strongly influenced by the perception on ambulation. The households with more children have negative perceptions in terms on ambulation. Interestingly, older people and frequent private vehicle drivers seem to have more positive perceptions on ambulation. This may be due to their familiarity with the existing environment.

The exposure to pollution had the highest negative perception rating in terms of attractiveness. Current state of cleanliness, existence of trees and greenery, and amenities along the roadside also had negative perception ratings. The existence of shops, and the opportunities for exercise and socialization were all rated positively, although exercise and socialization did not come out as significant indicators for the perception of attractiveness. Higher monthly income earners and employed people are more influenced by the attractiveness of the NMT environment.

It was very interesting to note that people seem to enjoy traveling slowly along attractive environments. In view of this finding, it may be time to rethink and revisit our typical thinking of streets should be used. It would seem that streets are more than just a place for commuting or traveling.

If the real needs of the NMT users, which were revealed in the perception survey, can be addressed through infrastructure provisions and environmental improvements, people are considering to use NMT modes more. It is very interesting to note that people seem to think that, if improvement are made in the NMT infrastructures and environment, their current commuting travel time will be reduced. They are actually willing to spend more time on NMT modes, especially bicycling. Transportation policy makers, planners and designers should look into this. Significant reduction to the share of the road based modes, which entails lesser road traffic congestion, and potential increase in the rail mode may be achieved. This is a picture of an efficient transportation system and NMT is in the center of it.

Finally, the planning and design procedures and principles of transportation infrastructures should be revisited and reviewed. This research revealed that the traditional way of planning and designing transportation infrastructures, as seen in how the people rated the existing NMT infrastructures, were not enough to address their real needs, and this keeps them from using NMT options. This study adds to the growing number of literatures suggesting that more qualitative factors, such as socio-demographic, travel behavior and perceptions, should be considered and incorporated in the actual planning and designing of our transportation infrastructures, as well as the crafting of our transportation policies.

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