

**MSc Programme in Urban Management and Development**

Rotterdam, The Netherlands

September 2014

**Thesis**

**Determinants for commuting to work by bicycle: the  
Dutch experience, a case of Erasmus University of  
Rotterdam, The Netherlands**

**Name**

**José Rafael Verduzco Torres**

Supervisor: Somesh Sharma

Specialization: Urban Climate Change Management

UMD 10



# **MASTER'S PROGRAMME IN URBAN MANAGEMENT AND DEVELOPMENT**

**(October 2013 – September 2014)**

## **Determinants for commuting to work by bicycle: the Dutch experience, a case of Erasmus University of Rotterdam, The Netherlands**

José Rafael Verduzco Torres  
Mexico

Supervisor:  
Somesh Sharma

UMD 10 Report number:

Rotterdam, September 2014

## Summary

Climate change mitigation is one of the challenges that many cities are currently facing. The transport sector is responsible of an important amount of the total CO<sub>2</sub> emissions globally. The sustainable mobility appears as part of the challenge in the reduction of green house gas emissions, however this also represents opportunities to improve cities. Bicycle as a mode of transport has recently caught the attention of research and public policies as an important part of the sustainable mobility paradigm. During the last four decades there has been a considerable amount of literature studying travel behavior and its relation with the built environment, although there are no consistent agreements in the effects of this relation. Within travel behavior research, little is focused on bicycle for commuting purposes. More recently it has been acknowledged the importance of ‘soft’ factors such as demographic and physiological, in determining travel behavior. The inclusion of this dimension may fill in the gaps that the previous studies of travel behavior have not been able to explain. In this research, the ‘hard’ and ‘soft’ dimensions were included with the aim to explain the extent that these factors may determine the use of bicycle for commuting to work. Since commuting to work has also been acknowledged as relevant in urban mobility systems, our scope is limited to this purpose. The ‘soft’ dimension in this study includes demographic characteristics and subjective individual attributes, these last taken from the social-cognitive studies. The research methodology included qualitative and quantitative data. An online survey and face-to-face interviews were conducted in those institutions among employees of the Erasmus University of Rotterdam, and The Erasmus Medical Center, in Rotterdam, The Netherlands. The results showed that subjective individual attributes played an important role to determine the choice to commute by bicycle. In the case of the frequency in the use of bicycling, few subjective attributes showed to be significant. The overall results suggested that the significance in ethnic background and commuting by bicycle might be due to the subjective individual attributes ‘behind’ these demographic aspects. The residential environment characteristics were significant to determine bicycle use mostly in long distances. The findings of residential environment might be understood as a complement of the soft dimension that showed to be significant for short and middle distances.

## Keywords

Urban mobility, travel behavior, urban cycling, commuting to work, climate change mitigation

## Abbreviations

C	Cyclists
Erasmus MC	Erasmus Medical Center
ESE	Erasmus School of Economics
ESHCC	Erasmus School of History, Culture, and Communication
ESL	Erasmus School of Law
EUR	Erasmus University of Rotterdam
FSW	Faculty of Social Sciences
FTC	Full time cyclists
GHGs	Green house gases
iBMG	Institute of Health Policy & Management, International Institute of Social Studies
IHS	Institute for Housing and Urban Development
NC	Non cyclists
NMT	Non-motorized transport
PBC	Perceived behavioral control
PTC	Part time cyclists
RSM	Rotterdam School of Management
VMT	Vehicle miles travelled

# Tables of contents

<b>Summary .....</b>	<b>4</b>
<b>Keywords.....</b>	<b>4</b>
<b>Tables of contents .....</b>	<b>6</b>
<b>List of Tables.....</b>	<b>7</b>
<b>List of Figures .....</b>	<b>8</b>
<b>Chapter 1: Introduction.....</b>	<b>9</b>
1.1 Background.....	9
1.2 Problem Statement.....	10
1.3 Aim .....	10
1.4 Research Objectives .....	11
1.5 Research Questions .....	11
<b>Chapter 2: Literature review .....</b>	<b>12</b>
2.1 Introduction .....	12
2.2 Urban mobility and cycling .....	13
Urban mobility.....	13
Non-motorized transport .....	15
Commuting to work.....	16
2.3 Urban form and transportation infrastructure.....	17
Compact and diverse city .....	17
Making room paradigm .....	18
The interaction of urban form and mobility .....	19
Conclusion.....	20
2.4 Intangible dimension and individual aspects.....	21
Subjective individual attributes and cycling.....	22
Objective demographic and household attributes.....	23
2.5 Mobility and bicycle culture.....	24
Conclusion.....	24
2.6 Conceptual framework.....	25
<b>Chapter 3: Research design and methods.....</b>	<b>27</b>
3.1 Selection of the case .....	27
3.2 Operationalization: Variables, Indicators .....	30
3.2.1 Bicycle commuting.....	30
3.2.2 Residential environment.....	31
3.2.4 Soft factors: Demographic and individual subjective attributes.....	32
3.3 Data Collection Methods.....	36
3.3.1 Quantitative data.....	36
3.3.2 Qualitative data.....	37
3.4 Sample Size and Selection.....	38
3.5 Validity and Reliability .....	39
3.6 Data Analysis Methods.....	40

<b>Chapter 4: Research Findings .....</b>	<b>42</b>
4.1 Description of the case .....	42
4.2 Description of the sample .....	43
4.3 Analysis .....	50
4.3.1 Demographic attributes and commuting by bicycle to work.....	50
4.3.2 Subjective individual attributes and commuting by bicycle over various distances .....	53
4.3.3 Ethnic background and length of residence affecting subjective individual attributes for commuting to work by bicycle .....	60
4.3.4 Residential area and commuting by bicycle to work.....	65
<b>Chapter 5: Conclusions and recommendations .....</b>	<b>69</b>
<b>Bibliography.....</b>	<b>74</b>
<b>Annex 1. Questionnaire.....</b>	<b>81</b>
<b>Annex 2. Interviews summary .....</b>	<b>104</b>

## List of Tables

<b>Table 1</b> Contrasting approaches.....	<b>14</b>
<b>Table 2</b> Main mode of transport according to the Dutch Census travel data.....	<b>28</b>
<b>Table 3</b> Operationalization matrix .....	<b>34</b>
<b>Table 4</b> Population of the study .....	<b>42</b>
<b>Table 5</b> Overall view.....	<b>45</b>
<b>Table 6</b> Total split by mode own data.....	<b>48</b>
<b>Table 7</b> Commuter type over various distances.....	<b>49</b>
<b>Table 8</b> Cyclists over various distances.....	<b>49</b>
<b>Table 9</b> Subjective norm at home and work by mode of transport.....	<b>54</b>
<b>Table 10</b> Subjective individual attributes for cyclists and non-cyclists.....	<b>56</b>
<b>Table 11</b> Subjective individual attributes for FTC and PTC .....	<b>57</b>
<b>Table 12</b> Being cyclist, subjective attributes as explanatory variables: binary logistic model results. ....	<b>58</b>
<b>Table 13</b> Full time cyclist and part-time cyclist, subjective attributes as explanatory variables: binary logistic model results. ....	<b>59</b>
<b>Table 14</b> Subjective individual attributes and ethnic background by commuter type.....	<b>61</b>
<b>Table 15</b> Subjective individual attributes and ethnic background by commuter type.....	<b>62</b>
<b>Table 16</b> Commuter type and year of immigration.....	<b>63</b>
<b>Table 17</b> Subjective attributes and year of immigration.....	<b>64</b>

## List of Figures

<b>Figure 1</b> Conceptual framework .....	<b>26</b>
<b>Figure 2</b> Research area .....	<b>29</b>
<b>Figure 3</b> Cyclists and demographic attributes over various distances .....	<b>52</b>
<b>Figure 4</b> Full time cyclist by demographic attributes .....	<b>53</b>
<b>Figure 5</b> Cyclists and residential characteristics over various commuting distances .....	<b>66</b>
<b>Figure 6</b> Full time cyclists and residential characteristics over various commuting distances .....	<b>67</b>



# Chapter 1: Introduction

## 1.1 Background

The transport sector is an important source of Green House Gas (GHG) emissions not only at the country level, but it is also an important contributor globally, as noted by the Intergovernmental Panel for the Climate Change (IPCC) in its latest report (Hartmann et al. 2013). The transport sector represents an opportunity in the efforts to mitigate the GHG emissions in which cities can play an important role (IPCC 2014). In addition to this, GHG emissions are not the only challenge that cities are currently facing regarding urban transport.

Even if climate change were not as important issue for the global community, there are still a number of reasons to move towards sustainable mobility. Peak oil, air and noise pollution, road traffic deaths and injuries, health impacts, negative psychological impacts, among others, are related to urban transportation that in turn impact the quality of life of the local and global community. Sustainable transport has been approached from different perspectives, such as sustainable transport infrastructure, e-mobility, transport economics, etc. (see Passafaro et al. 2014; Banister 2008; Newman & Kenworthy 1999; Vergragt & Brown 2007; Wang et al. 2013). The perspective of this research is on travel behavior, since a better comprehension of it might help to overcome some important challenges that sustainable transport poses.

Generally, travel behavior has been studied from two different streams. One stream has argued that the built environment notably influence people's travel behavior (see Cervero & Kockelman 1997; Cervero & Duncan 2003; Rodríguez & Joo 2004; Boarnet et al. 2011; Newman & Kenworthy 1999; Newman et al. 2009). It has been largely studied the relation between travel behavior and 'hard' factors such as urban design, density, and land use. Nonetheless, a different stream suggests that 'soft' factors such as demographic and physiological factors, might also influence transport behavior (Passafaro et al. 2014; Heinen et al. 2010; Bere et al. 2008). 'Soft' factors are not only objective attributes as socio-economic and socio-demographic attributes, but also subjective attributes at individual level, namely attitudes, perceived behavioral control, habit, and subjective norm, as suggested by social-cognitive studies (Ajzen 2005; Ajzen 1991; Triandis 1980).

Climate change, and sustainable mobility in specific, represents challenges for governments and societies, but also opportunities to improve cities. On one hand, the challenges that governments typically face are financial, managerial, and societal behavior. This last is particularly important, which in this case may refer to the social acceptance regarding the use of alternative modes for example. As an illustration of this, in some cases it has been observed resistance to restrict private automobiles, or bicycle infrastructure interventions have not always attracted cyclists (Pucher et al. 2010). On the other hand, opportunities to improve cities are represented by the implementation of some practices, such as collective

modes of transport, non-motorized transport, and in general integrated systems of transport. These practices in turn may help to mitigate environmental, economic, and social impacts at different scales. In particular, bicycle as a mode of transport has proved to be a very effective mode of transport in various senses especially in Europe (Pucher et al. 2012; Buehler & Pucher 2012; Pucher & Buehler 2008).

Commuting to work has been recognized in the literature and policies as a key component in urban mobility systems for various reasons (Susilo & Maat 2007; Nordback 2014; Stinson & Bhat 2004). In particular, commuting to work by bicycle has been acknowledged to have potential to overcome some of the transportation challenges mentioned above (this will be further discussed in Chapter 3). Yet, there is still little knowledge on the factors influencing the decision to commute to work by bicycle (Heinen et al. 2012; Stinson & Bhat 2004). Therefore, the focus of this thesis is on the use of bicycle only for transportation purposes. More specifically, it is targeted to study the use of bicycle for commuting to work among employees of two public organizations in Rotterdam, The Netherlands, viz. The Erasmus University of Rotterdam and The Erasmus Medical Center.

## **1.2 Problem Statement**

Ideally, the use of bicycle in cities can help to overcome many of the problems derived from the overuse of private vehicles. The habitual use of bicycle, as it is commuting to work, can provide direct benefits to users and citizens, regarding health, economic, and environmental aspects. However, if the global tendency of car overuse persists, the related problems are expected to continue increasing. These problems can impact the local and global levels, as it is CO<sub>2</sub> emissions, noise and air pollution, traffic accident rates, and hasty use of financial and natural resources. Even though some academicians and governments have acknowledged the potential of bicycle as a mode of transport, the efforts made have usually been conceived from a rigid perspective focused only on hard interventions. This thesis intends to explain the determinants that influence the decision to use bicycle from a broader perspective than the 'classic' research, which considered mainly characteristics of the built environment. Our research approach included objective factors of the built environment but also commuters' individual characteristics among employees of two important public organizations in Rotterdam, The Netherlands. Thus, the results generated by this kind of research might allow policy makers to design more effective cycling strategies and to target them more accurately.

## **1.3 Aim**

The aim of this work is to explain and understand the extent of influence that individual factors and residential characteristics have over bicycle commuting in two specific working centers in Rotterdam, The Netherlands. More specifically, this research intends to explain the extent that demographics, attitudes, social norms, perceived behavioral control, habit, and residential characteristics have over the decision to commute to work by bicycle. For this purpose, the case of the Erasmus University of Rotterdam (EUR) and the Erasmus Medical

Center (Erasmus MC), in Rotterdam, The Netherlands will be analyzed. The results of this work may help policy makers who intend to support cycling for commuting to focus on the aspects that are more relevant for the topic.

## 1.4 Research Objectives

This work intends to better understand the different group of factors influencing travel behavior for commuting to work by bicycle in the area of Rotterdam, the Netherlands. Other studies are largely relying on ‘hard’ factors as influential for determining the use of bicycle. However, few studies have searched into deep in the individual characteristics of commuters. In this study we are emphasizing the importance of the socio-demographic and subjective individual attributes, as influential factors for commuting by bicycle. This is in order to obtain a better understanding of commuting by bicycle.

## 1.5 Research Questions

Main research question

- *To what extent do subjective individual attributes, socio-demographic attributes, and residential characteristics affect choice of bicycle for commuting to work over various distances in the Erasmus University of Rotterdam and the Erasmus Medical Center?*

Sub-Research questions

- *What are the socio-demographic attributes that affect the choice of bicycle for commuting to work over various distances?*
- *To what extent do subjective individual attributes affect the choice of bicycle for commuting to work over various distances?*
- *How do length of residence in The Netherlands and ethnic background affect the subjective individual attributes in the choice of bicycle for commuting to work?*
- *Which residential characteristics affect choice of bicycle for commuting to work over various distances?*

## Chapter 2: Literature review

### 2.1 Introduction

Travel behavior in general has been largely studied in the last two decades (i.e. Cervero & Kockelman 1997; Cervero & Radisch 1996; Handy 1996; Dieleman et al. 1999). Most of these studies are empirical and quasi-experimental. Additionally, the majority of them construct their own index and variables. The most common focus is on the relation between built environment (in the different level of characterization) and travel behavior, emphasizing on motorized transport (public or private transport). The general conclusions are diverse, depending on the context and type of variables used. In travel behavior literature, a shift in the last decade in the inclusion of soft factors was observed (Dieleman et al. 2002; Heinen et al. 2011; de Bruijn et al. 2005; Pelzer 2010; Klinger et al. 2013).

Before moving on, some important concepts should be clarified. In travel behavior literature two broad concepts are being studied from different approaches. First, built environment has been referred to in literature with various terms: spatial, urban form, urban shape, ‘hard’ factors, ‘infrastructural’ interventions, etc. In the same way, intangible factors have been referred to as culture, life style, ‘soft’ factors, individual attributes. For our own research we distinguish the intangible factors mainly in socio-demographic attributes, and subjective individual attributes. Then, built environment was considered as the residential environment built characteristics. These both will be discussed in more detail in the *Operationalization* subsection of Chapter 3.

In this review, it has been observed a transition in the travel behavior literature of the last decade. This transition mainly refers to the addition of household characterization, demographic aspects, and psychological attributes at individual level. From the literature reviewed, it seems fair to say that earlier researches, which included only spatial attributes, were not able to provide plausible conclusions over travel behavior. Thus, the inclusion of subjective and demographic variables is necessary to better explain a *quasi*-neglected side of the multiple factors that shape travel behavior (Pelzer 2010; Van Acker et al. 2010).

For this review, it is also relevant to mention some positions in the urban planning field, as well as different approaches to overcome mobility challenges. Hence, in Chapter 2 contrasting postulates of urban theories, such as the *Compact and diverse city* (Rueda 2002; Dieleman et al. 1999), as well as the *Making room paradigm* (Angel et al. 2011), are discussed. Additionally, some of these authors often base their proposals on urban mobility. Therefore, these influential streams in the contemporary urban planning field become relevant to better understand urban cycling.

Finally, in Chapter 2 the *mobility culture* concept is reviewed. It can be said that this stream ‘conciliates’ the different perspectives that approach ‘soft’ and ‘hard’ interventions to support

mobility. The mobility culture concept includes ‘hard’ characteristics, such as urban form or built environment in conjunction with attitudes or lifestyles to adequately understand travel behavior (Klinger et al. 2013; Van Acker et al. 2010). More recently there has been attention over the definition of *cycling culture*, which is based on a similar ideology of mobility culture, and considers tangible and intangible components (Pelzer 2010).

## 2.2 Urban mobility and cycling

### *Urban mobility*

Movement is an essential component of any society, thus of any human settlement (Taipale 2012). The essence of human agglomeration has the objective to exchange goods, knowledge, and information to facilitate human daily life. Hence, mobility is a way to enable contact and regulation in the city (Rueda 2002). Mobility also facilitates political, economical and societal processes (Fotel 2006). These concepts cannot be understood without the physical exchange. Cities’ economy, for instance, strongly relies on the mobility of goods, but also on the face-to-face contact. Thus, for cities to work as we currently know them, it is essential to enable mobility.

Mobility has been considered as a right in some of the literature. Along this line, the cities that do not enable accessible mobility are discriminating its citizens (Fotel 2006). Opportunities such as jobs, commerce, and recreation are dispersed around the city. Thus, it is believed that if one individual faces difficulties to access any of those functions of the city, the individual would have fewer opportunities. Hence, this individual is being excluded. In some societies mobility is stratified by economical reasons. Hence, when cities prioritize the highest income sector (in many cases private motorized transport), it would be likely to find a polarized society due to lack of accessible opportunities for the low-income level.

The concept of mobility has been used sometimes to replace the concept of urban transport. Nonetheless, the sustainable mobility concept has a different connotation. In table 1, Banister (2008) made a comparative analysis between the two different approaches. One is the transportation as usual, which looks at the mobility as in ‘engineering’ vision. This approach is concerned mostly on moving vehicles from A to B in shorter time. The conventional approach is limited to look at the physical characteristics of the streets as a canal, forecast traffic, and speed up traffic. More importantly, the conventional approach loses the essence of mobility, which is people, not the capacity of roads or rails.

It can be said that the most substantial difference in the concept of sustainable mobility and the conventional transport approach is the inclusion of the social dimension (Banister 2008). In this conceptualization people are the main focus, since it talks about enabling people to commute with the best option in function to the characteristics of their trip and individual preferences. Sustainable mobility has an integrative vision of the different modes of transport. Additionally, it considers the street as a space, in this sense it refers to it as a livable space

(Rueda 2002; Banister 2008). Within this additional dimension, other aspects such as air and noise pollution, physical and mental health are contemplated (Cervero & Duncan 2003). More importantly, the fact of land use and the city itself as a travel generator is also considered (Banister 2008). In short, sustainable mobility has an integral vision of many additional issues around transport. Furthermore, it approaches the challenge from a different perspective, “Sustainable mobility provides an alternative paradigm within which to investigate the complexity of cities, and to strengthen the links between land use and transport”. (Banister, 2008, p. 73)

**Table 1** Contrasting approaches to transport planning

The conventional approach— transport planning and engineering	An alternative approach—sustainable mobility
Physical dimensions	Social dimensions
Mobility	Accessibility
Traffic focus, particularly on the car	People focus, either in (or on) a vehicle or on foot
Large in scale	Local in scale
Street as a road	Street as a space
Motorised transport	All modes of transport often in a hierarchy with pedestrian and cyclist at the top and car users at the bottom
Forecasting traffic	Visioning on cities
Modelling approaches	Scenario development and modelling
Economic evaluation	Multicriteria analysis to take account of environmental and social concerns
Travel as a derived demand	Travel as a valued activity as well as a derived demand
Demand based	Management based
Speeding up traffic	Slowing movement down
Travel time minimisation	Reasonable travel times and travel time reliability
Segregation of people and traffic	Integration of people and traffic

Source: Banister, 2008, p. 75.

Some of the sustainable mobility literature proposes that improvements to support mobility should be accomplished through urban spaces. This literature is pointing out *mobility* as a precursor to improve cities development. They talk about attractive urban spaces, human scale, urban quality characteristics, and diversity, among others, the last with the aim to generate complexity in the city and increase probabilities of social contact. It is claimed that these aspects are key to sustainable mobility (Rueda 2002; Banister 2008; Cervero & Kockelman 1997).

### *Non-motorized transport*

In the past two decades the literature of mobility, urban design, urbanism, transportation, governments at different levels, and even medical bodies, are conferring more attention to non-motorized transport (NMT), and urban cycling specifically (Cervero & Ewing 2010; Saelens et al. 2003; Pelzer 2010). In concrete, NMT has been defined as all “human-powered” modes of travel (Saelens et al. 2003). In this sense, the NMT literature is mostly focused on walking and cycling, since those are the most common forms found in cities. Even though there are NGOs and academics that support the inclusion of NMT all types, those will not be discussed in this work.

Some academicians and public audience are skeptical of the bicycle potential. A fact in which the potential relies is that 80% of the trips within cities are short trips (Saelens et al. 2003). Even though walking is obviously limited in distance (around 1 km in average), as shown in most of the studies (Cervero & Ewing 2010; Cervero & Duncan 2003; Dieleman et al. 2002), cycling can reach middle and short distance trips within the city. In contrast, it is remarkable to say that even in the Netherlands, where bicycle plays an important role, some of the trips shorter than 3km are completed by motorized transport modes (Heinen et al. 2010; Pucher & Buehler 2008). Nonetheless, the share of car trips in journeys shorter than 3 km in The Netherlands or Germany is far less than it is in the United States on average (Pucher & Buehler 2008; Buehler 2011). In general, bicycle has shown to be effective and efficient for commuting even in big cities such as Copenhagen, Amsterdam, or Berlin among others (Buehler & Pucher 2012).

In spite of the fact that recent literature has discussed the bicycle use as an important issue, most of it refers to bicycle in general terms. Few of the literature have made clear distinction of bicycle for utilitarian purposes, with the exception of Heinen et al. (2011; Heinen et al. 2012) and Sener et al. (2009), to the extent of our knowledge. Those two studies clearly make distinction of purpose, and remark the importance of this distinction. In general terms, purpose can be grouped in utilitarian and recreational uses. This distinction is important for our research, since our work mainly aims to better understand urban mobility challenges and its consequent CO<sub>2</sub> emissions. Thus, the potential in urban cycling relies on utilitarian purposes, more specifically commuting, as it is also noted by Heinen et al. (2011) and Sener et al. (2009).

It can be said that much of the travel behavior literature has been making efforts on explaining the relation of motorized transport and built environment. Yet, few of the literature explained the interaction between bicycle commuting and what influences it (Heinen et al. 2011; Heinen et al. 2010; Heinen et al. 2012; Sener et al. 2010). Consequently, there is little knowledge on the extent of this interaction. This gap of knowledge regarding bicycle use has been identified in different researches and studies conducted to the date. In this specific relation, different variables such as endogenous and natural factors should be

considered, since bicycling is more sensible to changes from external factors (Cervero & Duncan 2003; Heinen et al. 2010; Duncan et al. 2012; Rodríguez & Joo 2004).

### *Commuting to work*

Travel purpose is identified as an important factor that contributes to shape travel behavior. From the literature, all travel purposes were differentiated in two large groups: utilitarian and non-utilitarian. In the former the main purpose was commuting, but it also can be for shopping purposes for example. In the non-utilitarian, leisure trips and recreational motives were identified, among others. It has been studied that leisure trips, for example, are usually longer in distance and time, and furthermore may determine the transport mode selected (Dieleman et al. 2002; Susilo & Maat 2007). Additionally, other studies have found relation between travel purpose and the weather to determine travel behavior (Amiri & Sadeghpour 2013).

Commuting to work has been recognized in literature and policies as important component in mobility systems for various reasons, yet there is still few knowledge of commuting to work by bicycle. From the literature the relevance of commuting to work was grouped in two levels, namely social and individual level. In both levels, the relevance is largely derived from two main facts: 1) commuting to work is a large contributor of the total trips in many cities (Heinen et al. 2012; Heinen et al. 2011; Stinson & Bhat 2004; Nordback 2014); and 2) commuting to work is compulsory for many employees almost at the same time, thus causing congestion (Heinen et al. 2012; Nordback 2014).

At the social level, evidence that suggest larger focus on commuting to work by bicycle was found. At first instance, the environmental impacts caused by traffic at local and global level are widely known, namely local air and noise pollution, and GHG emissions at the global scale (background of this work). Then, a recent study conducted in Colorado (Nordback 2014), illustrated the potential to decrease traffic congestion of commuting to work by bicycle, that in turn may help to reduce many of the car-related negative impacts. Another research in the Netherlands studied the relationship between bicycle commuting and non-work trips across the time (Kroesen & Handy 2013). Even they found a reciprocal influence between these two activities, they found stronger influence from bicycle commuting over non-work trips. In that study was concluded that “both bicycle commuting and non-work cycling may thus be increased by enhancing work-related cycling conditions” (Kroesen & Handy 2013, p.524). To conclude this social level, the position of various authors supporting NMT as a driver for equity is recalled. It is suggested that accessibility to jobs (in terms of urban mobility) is also a important contributor to achieve social equity (see Rueda 2002; Banister 2008; Fotel 2006; Kenworthy & Laube 1996).

At the individual level, important conclusions suggesting more attention on bicycle commuting were found. In recent years active commuting modes have attracted the attention from the medical perspective too, in both psychological and physical activity fields. There are



several studies examining the impact on commuting and stress levels. One example is the one conducted by Haider et al. (2013). Positive relation between longer commuting trips and stress levels was found. More importantly, they also found a relation in the mode of transport selected. Commuters traveling by transit or car had similar (high) stress levels, than those that commuted to work by bicycle or on foot. Moreover, since commuting is a routine activity, active modes of transport represent a potential for increasing commuters' physical health, especially bicycling which has been recognized for its significant health benefits (Saelens et al. 2003; Bere et al. 2008; Stinson & Bhat 2004). Lastly, given the routinely characteristics of commuting, traveling by bicycle can directly be reflected in commuters' savings in fuel or public transport. As shown, these two levels (social and individual) are frequently interrelated. In conclusion, it can be said that there is substantial coincidence of authors from different fields pointing out the relevance of commuting to work.

## 2.3 Urban form and transportation infrastructure

In the contemporary literature there are different streams approaching urban development. As expected, there is a debate around much of their positions. This section reviews the most influencing urban development streams that might be related to urban mobility and travel behavior. In general, it will briefly be reviewed the points supporting the compact and diverse city, and the urban expansion approach. Later, it will be discussed the relation between urban form and travel behavior.

It is necessary to clarify that, at least for this work, these theories should not be taken as dichotomy. In this work they are referenced because of the potential to influence travel behavior from a land use perspective. Additionally, these theories frequently rely their postulates on sustainable mobility, which is the background topic for this work.

### *Compact and diverse city*

The contemporary urban literature has been highly influenced by ideologies of compact and diverse city. Its proponents, in attempts to define it, usually go beyond talking about fix urban spatial structure. Anderson et al. (1996) identifies four important meanings to define the compact city as follows: fixed environment, land use, transport networks, and flows of goods and people. Others, like Christensen (2013), refer to containment of urban form and the characteristics and functions of the city, namely connectivity, accessibility, land use mix, and central land infill. In specific, urban containment can be understood as the group of policies limiting urban expansion and encouraging urban infill (Nelson et al. 2004). From these, two important concepts of the spatial characteristics were distinguished: *limiting* and *infill* of cities. It is equally interesting to find coincidence in the inclusion of *land use* and *flows* in cities, as part of the conceptual definitions of the compact city.

The general idea behind the compact city is to increase densities and land uses to generate more concentration; consequently, reduce travel distance, and simultaneously improve access

and connectivity. Rueda (2002) believes that when increasing mixture of uses and densities, the complexity of the cities increase. Thus, he assumes there is a higher probability to fulfill citizens' needs in smaller areas. In broad, Saelens et al. (2003) identified proximity and connectivity as basic concepts that in combination may support shorter trips. They refer to proximity as two variables of land use: population density and land use mix, and connectivity as how direct, or similar to a straight line a trip is.

Many of the literature attribute benefits to the compact cities, most of this benefits are related to sustainability and urban mobility. Among them, they say that compact cities can make shorter travel time and distance, save energy, reduce car dependence and CO2 emissions, protect country side, increase walkability, etc. (Newman & Kenworthy 1999; Rueda 2002; Christensen 2013; Morelli et al. 2014). In a study of 46 cities around the world, Newman & Kenworthy (1999) found direct relation between increasing population densities and saving energy consumption for transport. Nonetheless, there has been criticism around, suggesting more careful assessments, as noted by some authors (i.e. Angel 2012; Boarnet et al. 2011) .

### *Making room paradigm*

The *making room paradigm* offers an alternative urban growth strategy, based in 'realistic' projections that look forward to accommodate growth. Angel et al. (2011) support the paradigm in two basic facts: rapid urbanization and declining urban population densities. First, it is a fact that currently most of the cities are rapidly urbanizing, mostly in developing countries, where population growth can reach even 8% annually. Second, in global studies of 120 cities around the world a global tendency of declining urban densities was shown. Furthermore, the importance of making distinction between rapid urbanizing cities was remarked. Thus, it is said that densification cannot be understood as a generic solution for every city, since there are cities that are already dense enough if not overcrowded (Angel 2012; Angel et al. 2011).

The proposal by Angel et al. (2011) is given in a context of developing countries and urbanizing cities where it is also recognized the limited capacity of governments. In general, the paradigm consist in five key concepts: 1) realistic projections of urban land needs; 2) generous metropolitan limits; 3) selective protection of open space; and 4) an arterial grid of roads spaced one kilometer apart that can support public transit. Additionally for this approach, it is important to understand that the suggestion to do not encourage urban containing for every city should not be interpreted as laissez-faire allowing urban developers, guided by market forces, to shape the city (Angel et al. 2011).

Regarding the compact city, it seems that there are still questions around. Some detractors have claimed that it might lead to an increase in land prices, shortage of land, ignores householders preferences, and furthermore displaces urban development to satellite towns, thus increasing travel distances instead of reducing them (Angel et al. 2011). From past experiences, it is known that Seoul, for example, has shown some of these constraints

mentioned when the city implemented strong containing policies. This city now is facing increases in land prices, thus making housing less affordable, and the rapid growth led to the proliferation of satellite cities (Angel et al. 2011). In the Netherlands, in spite of the fact that there has been a strong policy of compact urbanization, Dieleman et al. (1999, p. 619) concluded: “it seems fair to say that we should not expect great benefits from urban compactness on mobility patterns and thus on energy use”.

In addition to what mentioned above, some authors note the difficulty to implement urban containing. For example, the Dutch experience can be considered a success in the achievement of compact urbanization. Nonetheless, it is important to say that this could only be possible in specific contextual conditions, in terms of land tenure and the political structure to provide housing, etc. Thus, it would be very difficult to replicate a containment policy in every context. It would be a challenging effort even in the Netherlands, where the conditions that allowed these policies have already changed (Dieleman et al. 2002; Dieleman et al. 1999).

### *The interaction of urban form and mobility*

This subsection will discuss how the approaches and theories of built environment might affect mobility. This perspective from the built environment may help to understand travel behavior from one viewpoint. Then, it will be discussed from other perspectives, in order to generate a broad view of how travel behavior is affected. Built environment is the group of factors that has been studied the most in relation with travel behavior. Since early studies, referred by Klinger et al. (2013), dating from the 70s researchers have been investigating the relations between the infrastructure and travel choice. However, after decades of research there has not been consistent agreements (Klinger et al. 2013; Dieleman et al. 1999; Dieleman et al. 2002; Cervero & Ewing 2010; Van Acker et al. 2010). The fixed environment has been characterized from the general urban form (referring to aggregate urban spatial attributes) to the urban micro-design components. The most common variables referred to in the literature in relation to travel behavior study are density, diversity, and design, known as the ‘3Ds’ (Klinger et al. 2013; Cervero & Kockelman 1997). Moreover, other studies have added more Ds, as ‘access to destination’, and ‘distance from transit’ (i.e. Boarnet et al., 2011).

According to Newman and Kenworthy (1999; Newman et al. 2009) there are three main priorities that influence city shape: cultural, economic, and transportation, which are interlinked each other. Cultural priorities refer to the preferences and perceptions of citizens, for example, preference of certain characteristics of housing, yet this can be linked also to the affordability and offer. The economic priorities can be targeted to redevelop and improve existing urban areas or in other cases to sub urbanization according to the economic capacities and political context. Finally, transportation priorities have to do with the available technology in the specific context, and the policy priorities supporting the different modes of transportation.

Following this idea, it is said that these factors and city shape has a bidirectional influence. Newman and Kenworthy (1999; Banister 2008) explain, in accordance with previous studies, the relation between transport and city form based on the theory of traveled time vs. distance traveled. This theory proposes that commuters are willing to commute no more than half an hour for ordinary purposes on average (Manning, 1978; Pederson, 1980; Zahavi and Ryan, 1980; Neff, 1996 in Newman & Kenworthy 1999; Banister 2008). Said this, Newman and Kenworthy (1999; Newman et al. 2009) relate the evolution of cities form with the evolution of the transport available. For instance, in medieval cities the main mode of transport was walking, thus cities were limited in extension to the ability of people to walk in half an hour. Thus, this could generate higher densities. Then, the introduction of rail transport allowed cities to grow along the railways, with longer distances, limited to the same statement, creating city nodes in the intersections of these. Later, the introduction of car and buses allowed expanding the city even more and everywhere, leading to city 'sprawl'.

From what stated above, it has been said that transport priorities and its most common modes of transport can influence the city shape, or in some cases *sprawling* of cities. The *sprawling* concept has been widely used in literature (Rueda 2002; Cervero & Ewing 2010; Dieleman et al. 1999; Cervero & Radisch 1996; Newman & Kenworthy 1999). Nevertheless, few cases have concretely defined it or determined the extent to consider it as *sprawl*. In these efforts, a global study to measure urban expansion Angel et al. (2011, p.6) defined *city attributes* (instead of sprawling) as "patterns of urban land use—spatial configurations of a metropolitan area at a point in time—and urban expansion and its attributes as processes—changes in the spatial structure of cities over time".

In the analysis conducted by Angel et al. (2011) they defined in an objective and measurable way the urban form. They distinguish five key urban spatial attributes that characterize cities: urban land cover, density, centrality, fragmentation, and compactness. They point out that these characteristics are relative and not absolute attributes. This means that what could be considered as low density in a particular point in time, for example, can in any other be perceived differently. In general, the characterizations given by the study have the strength that are comparable among cities and are objective characteristics.

Urban form and car dependency have been associated many times. In turn, energy used in transport has been associated with urban form too. Different analysis concluded that lower densities increased energy consumption related to transport (Newman & Kenworthy 1999). A study in the United states by Ewing et al. (2003), positively related *sprawling* with car-ownership, VMT, and fatalities. On the other hand, this study coincide with the results found in the Netherlands (Susilo & Maat 2007). Where, even though the average distance per trip was shorter in more urbanized areas than those living in suburban and rural areas, commuters travelled longer time in average regardless the mode of transport.

## Conclusion

From our review, it was noted that there is a wide range of characteristics used to study the built environment within the present phenomena. For the studies that use aggregate data Cervero & Ewing (2010) criticize that “it is inappropriate to make causal and associative inferences about individuals based on results obtained from aggregate data, an error called the ecological fallacy”. Whereas Cervero & Duncan (2003) argue that micro-design attributes are not significant components affecting NMT, Rodríguez & Joo (2004) affirmed that NMT is specially sensitive to small factors in the environment (natural or built). In any case, what most of the studies possibly bewilder is the individuals’ self-selection of location and the relation in travel behavior patterns (Saelens et al. 2003). A possible alternative approach, as suggested by the same author, could be to analyze pre-post design changes in relation to these patterns in order to minimize possible distortion.

There is disagreement in how travel behavior and urban form interacts (Dieleman et al. 1999; Dieleman et al. 2002). It is difficult to associate each other due to the multiple factors interacting simultaneously. One constraint to accurately measure the impact of built environment is the non-separation of socioeconomic conditions, which plays an important role in travel behavior and trends (Dieleman et al. 1999). For example, households with higher income tend to consume more, this in terms of space and car ownership, hence are likely to drive more (Angel 2012; Dieleman et al. 1999). Then, if high-income households are agglomerated in particular areas, there could be relation between a studied area and their travel behavior patterns, for example. This, in turn, could not necessary be directly related with the built environment characteristics.

## **2.4 Intangible dimension and individual aspects**

In recent studies there has been more reliance on social factors and individual preferences as factors to influence travel behavior (Pelzer 2010). In policy debates culture appears as an alternative or ‘antithesis’ of infrastructure. Aldred & Jungnickel (2014), in a qualitative study comparison of cities in the UK, argue that culture plays a substantial role for shaping cyclist practices. They affirmed that ‘cultural interventions’ should complement other ‘hard’ interventions, and should not be an alternative for cycling infrastructure provision. Studies in the Netherlands have found clear influence from demographic factors over cycling behavior (see Bere et al. 2008; de Bruijn et al. 2005). In the same sense, Heinen et al. (2011) argue that not only ‘hard’ factors influence commuting by bicycle, but work-related and personal aspects too.

Explaining travel behavior is complex and there are many factors influencing it to different extents according to particular conditions of each context. As example of this, the fact of residential self-selection was found. This fact might be playing an important role in defining travel behavior. As shown above, there is literature establishing direct relation between the residential environment and travel behavior, by inferring that the characteristics of the built environment directly influence people’s travel behavior on individuals.

From the review, it can be said that many studies that considered only conditions of the built environment fail in taking into consideration the individual's residential self-selection. In other words, it is possible that there is a substantial influence of the individual's transport preferences and choosing their residential location, as pointed out before by Saelens et al. (2003). "The observed differences in pedestrian behavior in those two types of neighborhoods may be more a matter of residential choice than travel choice" (Mokhtarian & Cao 2008, p. 205). If so, these studies might be overestimating the influence of the built environment and the potential effects over travel behavior (Mokhtarian & Cao 2008).

### *Subjective individual attributes and cycling*

Most of the studies that included subjective individual attributes have departed from social-cognitive theories. More, specifically, the Theory of planned behavior is often used in travel behavior studies (Ajzen 1991; Ajzen 2005). This theory states that attitudes, subjective norms, and perceived behavioral control can predict intentions. In turn, intentions can predict actual behavior, to the extent that perceived behavioral control enables a specific behavior.

A research conducted in Rotterdam, The Netherlands by de Bruijn et al. (2005), studied both intentions and actual behavior of young scholars in relation to bicycle use to commute to school. In this study they include "distal" and "proximal" factors as the explanatory variables. These factors were taken from the Theory of Triadic Influence and Theory of Planned Behavior (Ajzen 1991) respectively. The *distal* includes cultural environment, the social environment, and biological and personality factors. The *proximal* factors consider attitudes, subjective norm, and perceived behavioral control. Their results found that the distal factors: particularly ethnicity, school type, degree of urbanization; were explaining better the actual behavior of students than the proximal factors over bicycle use.

Another study in the Netherlands found relevance in the role that attitudes play in the decision to commute by bicycle (Heinen et al. 2011). In their study, proximal factors discussed above plus *habit* were included. It is argued that the decision to cycle does not necessarily respond to a rational choice; past behavior might also play an important role in this decision. In the study, it was concluded that cyclist that had more positive attitudes towards cycling tend to cycle more frequent and longer distances on average. Finally, a study in Rome, Italy (Passafaro et al. 2014), studied the desire to ride bicycle in this city. In their study they include prescriptive norms, descriptive norms, perceived behavioral control, negative anticipated emotions, positive anticipated emotions, and past behavior. Similarly, they found that past behavior and anticipated emotions were largely helping to predict intentions to use bicycle.

Despite of the growing amount of literature including the subjective individual characteristics to study travel behavior, it seems that subjective concepts are being interpreted differently. First, attitudes are not straightforward to measure and analyze (Mokhtarian & Cao 2008). Attitudes are often misunderstood as personal beliefs or/and opinions, and sometimes are measured in unipolar constructs (i.e. from 0 to 7) (Lubian 2010). Attitudes are a controversial

topic are not easy to capture accurately (Lubian 2010). For Klinger et al. (2013) “Perceptions are often considered to be an adequate indicator for underlying attitudes (Schuitema et al., 2013)”. Lastly, in this review it was found that many contemporary studies have used the following definition for attitudes (i.e. de Bruijn et al. 2005; Heinen et al. 2011; Passafaro et al. 2014): “A person’s attitude towards a specific behavior is a result of their beliefs about the consequences of that behavior and the person’s evaluation of those beliefs.” as defined by Ajzen (1988). In Chapter 3, it is discussed how attitudes were conceptualized and measured for this research in more in detail.

### *Objective demographic and household attributes*

Another important part of the intangible dimension is understood within the individual demographic characteristics mainly. This often includes the study of socio-economic factors, household attributes, and household composition. The most important difference with the attributes discussed above is that these attributes are an objective component of the intangible dimension. Thus, the demographic and household attributes are easier to capture and are often included in travel behavior studies. In this sense, studies that have related age, income, gender, etc. with cycling behavior have found different and diverse results (see Pucher & Buehler 2008; Dieleman et al. 2002; Cervero & Duncan 2003).

Some of the typical examples to illustrate the range of outcomes are age and income in relation to cycling levels. It has been found that income and age have a negative impact, this mainly in countries where cycling has not been ‘normalized’ or the odds are not very representative (Pucher & Buehler 2008). Regarding gender, the outcomes are very context specific. For example, Heinen et al. (2011) found that male bicycle commuters in The Netherlands cycle much longer distances. Even though the usage of bicycle is more gender homogenous where bicycle use is ‘normalized’ (Buehler & Pucher 2012).

Other demographic attributes such as ethnic background, and length of residence in a foreign country also affect travel behavior. Immigration year might be testing the influence of the hard factors. In other words, it might be the case that when the built environment characteristics and mode options are the same for a diverse group (ethnicity and geographical origin speaking), commuters might follow different patterns of travel behavior depending on ethnic background and immigration status. The previous idea may indicate that in those cases the ‘soft’ factors are determining the travel behavior over the ‘hard’ ones. In other words, this variance in patterns of travel behavior are likely to be related with attitudes, preferences, previous experiences, and cultural background and “it is hard to come up with a plausible explanation” (Tal & Handy 2005, p.33).

Some studies that included ethnicity and immigrant status in relation to travel behavior have made relevant contributions to the topic. In a study conducted in the United States concluded that after ten years of residence, immigrants’ behavior did change. It was shown that immigrants’ behavior became similar the US born population (Tal & Handy 2005). On the

other hand, ethnicity (as categorized in the study by black, Asians, Latin Americans, and whites) was not consistently significant. In that study, it resulted to be more relevant the geographical origin and the length of residence to determine travel behavior.

Research in The Netherlands has also studied the relation between ethnicity and travel behavior. A research conducted in Rotterdam, The Netherlands clearly found that young students (aged between 12-15) with foreign background were less prone to commute to school by active modes (walking and cycling) (Bere et al. 2008). Similarly, an earlier study by de Bruijn et al. (2005) in the same city found coincident results. More particular, it was found that native Dutch students were almost three times more likely to commute by bicycle to school than non-Dutch background students.

## **2.5 Mobility and bicycle culture**

An intermediate stream in the literature suggests that hard and soft factors influence travel behavior simultaneously (Van Acker et al. 2010; Pelzer 2010; Klinger et al. 2013). Klinger et al. (2013) argue that *mobility culture* is defined by objective and subjective factors. Neither objective factors such as urban structure, special characteristics, and socio-demographics, nor the subjective factors such as attitudes, lifestyle, habits, can be understood in isolation, both components are highly interconnected.

Along this line, other authors have been developing the concept of ‘cycling culture’ (i.e. Pelzer 2010; Bonham & Koth 2010). It is said that many studies from transport geography are trying to understand cycling behavior from spatial contexts. This approach emphasizes the inclusion of the social dimension, understood as the subjective and objective attributes. Furthermore, Pelzer (2010) argues that bicycle is more sensitive to intangible factors than other modes. Thus, the inclusion of this dimension may have the capacity to fill in the gaps of the ‘classic’ explanatory models that considers only spatial attributes.

The dependent relation between hard and soft components was clearly noted by Pelzer (2010, p.4): “Space does not lead to a universal and monocausal effects, but functions more complexly”. One cannot expect to observe the same travel behavior patterns only by the fact that a group of individuals share the same spatial or ‘hard’ environment conditions, other factors should be considered to understand the outcomes. These other factors, or ‘complexities’ are understood by Van Acker et al. (2010) as follows: the spatial, demographic, and ‘personality’, this last based on individual preferences and physiological attributes.

## *Conclusion*



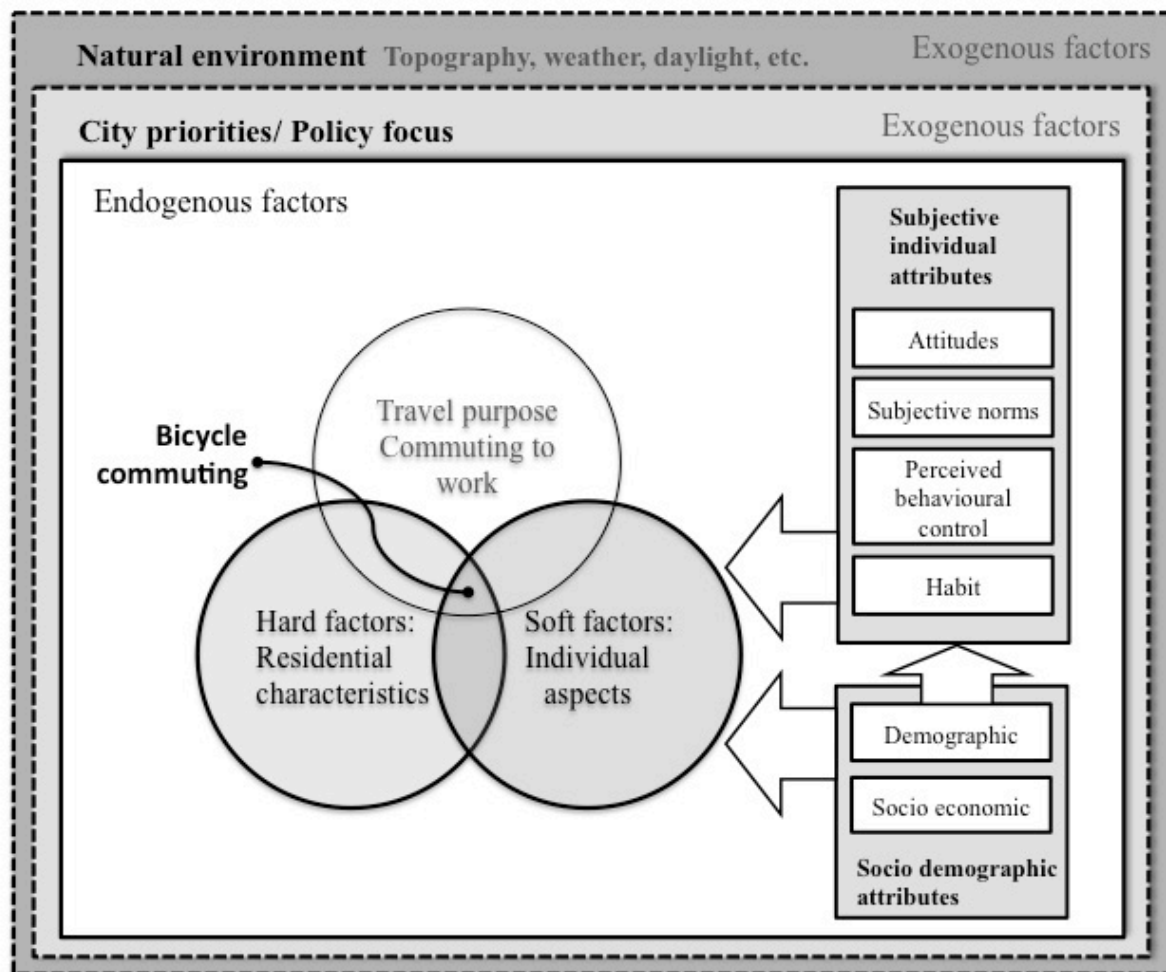
There is still lack of understanding the extent that soft factors shape travel behavior (Cervero & Ewing 2010; Dieleman et al. 1999; Dieleman et al. 2002; Cervero & Kockelman 1997). Nonetheless, literature studying the travel behavior from a broader perspective has been a growing in recent years. These later perspectives are turning into more suitable approaches that understand the social dimension too. What authors do coincide is that a multi-sectorial approach to overcome mobility challenges is needed; neither cultural nor hard components can overcome them alone. They advocate for substantial changes among land use, built environment, public policy, public acceptance, social awareness, technology and infrastructure sectors (Banister 2008; Vergragt & Brown 2007; Fotel 2006; Cervero 2002).

## **2.6 Conceptual framework**

Overall, different dimensions that contribute to determine the use of bicycle for commuting to work were identified in the literature. As shown in Figure 1, two large groups of factors were distinguished to influence the day-to-day decision for bicycle commuting: endogenous and exogenous factors. Within the exogenous factors, it was recognized the broad environment in which the city or the case develops, namely natural environment, and city priorities or policies. Within the endogenous factors, it was identified that travel purpose, built environment, and soft factors directly influenced the decision to use bicycle for commuting.

The focus of this work relies on the endogenous factors and the extent that these influence the decision to commute by bicycle. The hard or spatial factors are studied from the residential environment characteristics that might directly affect the decision to use bicycle. The soft factors are composed by two groups, namely subjective individual attributes and socio-demographic attributes. The subjective individual attributes were taken from the social-cognitive studies, more particular The Theory of Planned Behavior, viz. attitudes, subjective norms, perceived behavioral, plus habit (Ajzen 1991; Triandis 1980). The other group of attributes that compose the soft factors are the socio-demographic attributes. For this last subgroup, demographic aspects and socio-economic conditions were considered. More specific, education level, gender, age, income, ethnic background, and year immigration were included, since those resulted to be influential in the literature review. Additionally, the specific relation between some demographic attributes, (ethnic background and immigration year), and subjective individual attributes was analyzed. Regarding travel purpose, the scope of this work is limited on commuting to work, due to the relevance in the mobility systems discussed above.

**Figure 1** Conceptual framework



## Chapter 3: Research design and methods

In Chapter 2, some of the literature studying travel behavior and the factors that influence it were revised. The outcomes of these studies are variable, and still under research process. A re-direction in the focus to study travel behavior was noticeable. The observed shift in literature was from the study of the relation between built environment and motorized transport, to the inclusion of social dimension and the influence of exogenous factors (natural environment, and policy effects) over bicycle use. Additionally, it was observed the emergence of several urban cycling studies and policies in recent years (i.e. Heinen et al. 2012; Aldred & Jungnickel 2014; Steinbach et al. 2011; Bere et al. 2008; Passafaro et al. 2014). In Chapter 3, the selection of the case, the conceptual definitions, variables, and the specific methods to collect the data and analyze it are addressed. Reliability and validity are also discussed at the end of this chapter.

### 3.1 Selection of the case

At the international level, The Netherlands was selected due to its high degree of cycling infrastructure and urban spatial characteristics that appears to be appropriated for cycling (Bere et al. 2008; Pucher & Buehler 2008; Heinen et al. 2011). These contextual conditions allow us to locate factors of the general built environment (i.e. bicycle paths) on a secondary level to determine bicycle use (Heinen 2011).

The Netherlands is considered among one of the most successful countries in implementing the use of bicycle for daily travel. In spite of this fact, the use of bicycle has not been always thriving (Pucher & Buehler 2008; Pelzer 2010). Since the 70's The Netherlands has been implementing different policies to increase the use of bicycle. Furthermore, the Dutch Central Government has actively participated in the allocation of resources to support cycling. From 1990 to 2006 only the central Dutch government invested around €60 million in average to various cycling projects. In addition, the Central Government provided €1.8 to the provinces to spend in transport, including cycling infrastructure (Pucher & Buehler 2008).

Nevertheless, recent trends have showed some drawbacks in general terms. It has been observed that during the last decade that the average distance for commuting to work has considerably increased. In practically one decade, from 1993 to 2005, the average distance for commuting to work increased by 23%. In the same period, the commuting time also increased by 17% (Susilo & Maat 2007). On the other hand, the use of private cars has remained relatively stable during the same period. Nevertheless, it was noticed that the use of non-motorized modes have decreased, especially in high-urbanized areas where public transport has more presence (Susilo & Maat 2007).

The results of Dutch Census travel report are observed in Table 2. Bicycle is the second most important mode of transport (27%). However, car has more than the double of presence in the modal split. It is important to remark that the method used for the collection of national data is different from the one used in our own research, as it will be discussed in *Operationalization* subsection, in Chapter 3. The main difference relies in the fact that this type of data (in table 3) is not making difference in the frequency and variance of commuters' mode.

**Table 2** Main mode of transport according to the Dutch Census travel data (Ministry of Transport Public Works and Water Management 2010)

Dutch national data (2007)	
All trips	(%)
Main mode of transport	
Car	57
Bicycle	27
Public transport	6
Foot	10
Combination of public transport and bicycle	
Combination of public transport and foot	
Combination of car and bicycle	
Combination of car and public transport	
Other	2
Total	100

In particular, Rotterdam was selected since the economy of the city is highly active in the service and industrial sector. Thus, commuting to work is an important activity in the city. Another reason for the selection was the ethnic background diversity. More than 20% of the Rotterdam population is non-Western background, which is higher when compared to medium and small cities in the country, i.e. Delft 12-20%, Zwolle 8-12%, Groningen 8-12% (Statistics Netherlands). This last comparison should not be taken as a baseline for our specific population of study, but only as a reference of the general context in which our research is situated. Lastly, in large urban centers in The Netherlands it is observed a wide non-car trips portion compared to the suburbs and 'new towns' (Dieleman et al. 2002; Susilo & Maat 2007).

In contrast to the favorable performance regarding bicycle use in the Netherlands, Rotterdam has been classified among the lowest levels of bicycle use performance compared to other cities in the same country. As an illustration, the rate of bicycle use in some cities in the Netherlands was 38% in Groningen, 37% in Zwolle, or 27% in Amsterdam (Rietveld & Daniel 2004). Whereas in Rotterdam the rate of trips by bicycle was 16% (Pucher & Buehler 2008). The 'low' performance has been attributed mainly to the large population and long delays. Although it is believed that the 'inappropriate' urban design in addition to the high presence of public transport is contributing to a low share of bicycle use compared to the national average (27%) (Rietveld & Daniel 2004). Regardless of the 'low' performance, it is remarkable to say that this proportion of trips by bicycle in Rotterdam is far higher compared to many American or European cities, which in many cases range from 0.5% to 3.5% (Pucher

et al. 2012). Thus, the combination of existing demographic factors, and cycling levels, make the city appropriate for our research objectives.

**Figure 2** Research area



Source: Own elaboration based on Apple Maps V1.0

Our study was focused on two important institutions based on Rotterdam, The Netherlands. One of them is the Erasmus University of Rotterdam (EUR), a public university that attracts students and labor from all over the world. The EUR has a total population of 19,000 students. The second institution included in this research is the Erasmus Medical Center (Erasmus MC). The Erasmus MC offers academic services as well as medical public services. Both institutions develop scientific research in different fields, mainly financial, social, economic, and medical. In relation to the spatial place of work, both institutions have buildings in different locations of the city. However, for this research were considered only employees based within the city of Rotterdam. These two institutions were selected due to their importance at the city and regional level, the diversity of employees it attracts, and the access to the information that enabled the development of this research.

As shown in figure 2, The Erasmus MC locations are referring to the complex located in a central area of the city. In this complex is located the Erasmus MC Hospital and the Erasmus MC-Sophia. In a different area, in the south, there is the Daniel den Hoed building. On the other hand, the main campus of the EUR is located in the west part of the city, known as Kralingen-Oost.

### **3.2 Operationalization: Variables, Indicators**

As shown in the conceptual framework (Figure 1), within the endogenous factors there are two broad dimensions in which our study is focused, the soft and hard factors. The former refers to the fix characteristics of the residential built environment of commuters. The other dimension was broken down into objective demographic aspects and subjective individual attributes. From the conceptual framework it can be said that these two broad dimensions influence the use of bicycle for commuting to work.

Furthermore, the effects of the exogenous dimension may, to some extent, be reflected on the subjective individual attributes. This is deducted from The Theory of Planned behavior, which states that the actual behavior will depend on intentions and perceived behavioral control of an individual (Ajzen 1991). As an illustration, perception of behavioral control might be affected by the conditions of the built or/and natural environment, but also by the mode transport options available, this last resultant from the city priorities and policy focus. Said this, the present research mainly considered the study of endogenous factors. This is due to the reflection that these attributes might have from the exogenous factors. In the following subsection the independent, and explanatory variables are defined, as shown in Table 3. Following, the measurements and variables that were taken into account for this research are presented. Finally, in this research travel purpose is limited only to commuting to work, due to the relevance discussed in Chapter 2.

Before stating our own concepts, it is mandatory to revise some of the previous work done by other authors in order to contextualize our measurements and definitions. In this sense, the contemporary literature of travel behavior has been enriched from different fields, exploring the social and individual physiological influence over it.

#### ***3.2.1 Bicycle commuting***

In most of the studies and travel surveys transport mode is defined by the primary form to commute or based on the longer distance travelled in a mix journey (see Kroesen & Handy 2013). For example, Bere et al. (2008) define bicycle commuters as those who commute at least 3 time a week. Yet, all those assume that the commuters always use the same option. Hence, most of these definitions ignore the fluctuation in the day-to-day mode, which is even more sensible for bicycle commuters (Heinen et al. 2012). In others studies “bicycle

commuters are defined as those who used a bicycle to commute at least three times in a year” (e.g. Stinson & Bhat 2004, p.3), and the examples go on.

For this work, cyclists are defined as follow: first, as dichotomy of being cyclist commuter or non-cyclist (Heinen et al. 2012; Heinen et al. 2011; Stinson & Bhat 2004). Considering cyclists those who have completed a full journey to commute from home to work more than twice a year by bicycle. Then, cyclists were split by frequency, viz. full time cyclist or part time cyclist. The former is distinguished for commuting by bicycle every time is needed to travel to work. Part time cyclists are all remaining cyclists, as previously defined, excluding full time cyclists. Since the focus of this study is on urban cycling behavior and factors shaping it, particular differences and characteristics among other modes of transport, specially motorized transport (being public or private) are not addressed. For this work, commuters who cycle to public transport stations by bicycle are not included in the cyclists classification, yet we do recognize the important role this play for transport systems.

### *3.2.3 Residential environment*

For this study the ‘3D variables’, namely density, diversity, and design of the commuters’ residential environment were included as follows. First, the ‘type of residential area’, being urban/downtown, suburban, or rural was included as a general variable. The inclusion of the type of residential area is used as a proxy since this characterization may be reflecting the density and design. Diversity was considered by the presence of shopping facilities and public transport. Shopping facilities refers to the presence of supermarkets within 500 m and presence of shops within 1000 m. Public transport is measured with the presence of bus/tram stops within 500 m, and the presence of train station within 1000 m, according to the former studies of built environment and travel behavior (see Cervero & Kockelman 1997; Cervero & Radisch 1996; Heinen et al. 2012). Additionally, the existence of car and bicycle parking was included. The distance from home to work was included as part of the residential environment.

Detailed information regarding the ‘3Ds’ characteristic of the residential environment and other type of urban transport infrastructure is limited to what described above for three main reasons. First, because it may be deducted that the subjective individual attributes are partially derived from the fix characteristics of built environment, in particular perceived behavioral control, according to what stated by Ajzen (1991). Second, in relation to bicycle infrastructure, The Netherlands already has conditions to use bicycle as a regular mode of transport (Heinen et al. 2012). Thus, there would not be greater difference in the influence of the dependent variables. And lastly, because of limitation in time and resources to collect such detailed information.

### 3.2.4 Soft factors: Demographic and individual subjective attributes

The soft factors have been characterized differently in travel behavior studies. From the literature two main sub-groups were identified: the socio-demographic and the subjective individual factors. In the former there are mainly socio-demographic factors. The subjective variables were taken from the social-cognitive studies, more specifically The Theory of Planned Behavior (Ajzen 1991; Ajzen 2005). This approach contemplates attitudes, perceived behavioral control, and subjective norms. Habit was also included in this dimension due to the importance of past experiences influencing actual behavior (Triandis 1980).

Within the subjective attributes, perceived behavioral control was considered as “people’s perception of the ease or difficulty of performing the behavior of interest” (Ajzen 1991, p. 183). This was measured directly by asking commuters “To what extent do you consider it possible to travel your entire journey by bicycle?”, based on Heinen (2011). Subjective norm was studied by the expectation of people around one to perform certain behavior. Expectations of people at home and colleagues at work were measured. It was directly asked to commuters “With which transport mode do you think your colleagues expect you to travel to work?”. Subjective norm at home was obtained in the same way, by asking the expectations of “people at home”. Three different options of transport mode plus the “Does not matter” option were given. The outcome measure for subjective norms was in a score from 0 to 1 for each item (home and work). The total score was the cumulative score of both questions. When a respondent chose that was expected to commute to work by bicycle in any of those two environments it summed 1 point. Thus, the total scale for subjective norms was from 0 to 2 (see *Validity and Reliability* subsection for the tests used to measure reliability of the constructs).

Regarding attitudes, there are different techniques typically used to measure them, such as numerical, verbal, or mix scales. Attitudes are a polemic topic and there is disagreement in the validity of instruments measuring them, since the concept is frequently misunderstood as unidirectional (i.e. from 0 to 7) or because is biased into positive responses (Lubian, 2010). For this work, attitudes are considered as a bipolar construct (from -3 to 3). In this regard, attitudes were understood as “*the affect for or against a psychological object*” (Thurstone 1931). Thus, unipolar scales, being numerical or verbal, does not fit nor measure what is needed for our research. Hence, using a branching and numerical scale is more appropriated for the definition used in this work.

Thus, the branching technique breaks down questions in two steps. In the first step, it is simply identified the polarity or direction in our case “Agree” or “Disagree” (negative or positive). In the questionnaire was asked as follows: “For me, bicycling the whole journey to work is environmental friendly”, based on Heinen et al. (2011). Then, the intensity was graduated in numerical scale from 1 to 3. This technique allows to simplify the process of the surveyed, and furthermore avoids some problems of other techniques (Lubian 2010). The technique used combine the first part (polarity) with the second (the intensity) in a multiplicative fashion. Thus, a 7-point scale from -3 to 3 for each attitude was obtained. 10



questions (2 for each attitude) to measure attitudes toward bicycle were included in relation to: environmental friendly, healthy, safe in traffic, convenient, and time saving. Later on, these five items to measure the construct of attitudes were combined by summing the individual scores, obtaining a total scale for attitudes from -15 to 15 (see *Validity and Reliability* sub-section for the tests used to measure reliability of the constructs).

Habit is the influence that the repetition of an action in previous experiences may have over actual behavior, based on Triandis 1980 (p.204) “situation-specific sequences that are or have become automatic, so that they occur without self-instruction”. It was asked about the most likely mode to be used by the commuter for different purposes, based on Heinen (2011). For the total score, every time bicycle was mentioned one additional point was considered. Thus, the total score for bicycle habit was from 0 to 4.

On the other hand, the socio demographic attributes for this research include: education level, income, age, gender, car and bicycle ownership, ethnic background, and length of residence in The Netherlands. We collected this information from the questionnaire. Ethnic background was collected based on the definition of Statistics Netherlands (Statistics Netherlands 2000). Respondents were considered to be native-Dutch when both parents were born in The Netherlands. Someone was considered to be from Western ethnic background if one or both parents were born in another European country (except Turkey), North America, Oceania, Indonesia or Japan. Employees were considered to be from non-Western background if one or both parents were born in a non-Western country. The length of residence was self-reported in the questionnaire, according to the year of immigration in The Netherlands (when applicable).

**Table 3** Operationalization matrix

Variable		Indicator	Description	Source
Bicycle commuting	Cyclist type	Full time cyclists	Someone who commutes by bicycle every time he/she needs to travel to the place of work (cycling commute refers to the full trip completed by bicycle).	(Heinen et al. 2012)
		Part-time cyclist	Someone who commutes by bicycle at least 3 times a year, (Excluding FTC. Cycling commute refers to the full trip completed by bicycle).	(Heinen et al. 2012; Stinson & Bhat 2004)
	Commuter type	Cyclist	Someone who commutes to work by bicycle 3 times a year or more (cycling commute refers to the full trip made by bicycle)	(Heinen et al. 2012; Stinson & Bhat 2004)
		Non-cyclist	A commuter whose choose of transport is any other but bicycle or bicycle mixed with other mode	(Heinen et al. 2012)
Residential environment	Commuting distance (one way)	Km traveled per trip	Shortest route by bicycle from the place of residence of the commuter to the working place in kilometers in one way	N/A
	Diversity	Presence of bus/tram	Availability of bus/tram stop within 500m	(Heinen et al. 2012)
		Presence of train service	Availability of train stop within 1000 m	(Heinen et al. 2012)
		Supermarket	Presence of supermarket within 500m	(Heinen et al. 2012)
		Shops	Presence of supermarket within 500m	(Heinen et al. 2012)
	Bicycle infrastructure	Bicycle garage inside building	Provision of bicycle garage inside the building	N/A
	Car infrastructure	Free car parking	Provision of free parking space from the place of work	N/A
Social	Subjective norm	How people at work expect one to commute	The transport mode in which the colleagues at work would expect a commuter to travel to work	(Heinen 2011; Ajzen 1991; de Bruijn et al. 2005)
		How people at home expect one to commute	The transport mode in which the people at home would expect a commuter to travel to work	(Heinen 2011; Ajzen 1991; de Bruijn et al. 2005)

**Table 3** continued

	Variable	Indicator	Description	Source
Social	Subjective	Environmental friendly	Degree of attitude towards bicycling with respect to the environment	(Lubian 2010; Thurstone 1931)
		Traffic safety	Degree of attitude towards bicycling with respect to traffic safety	(Lubian 2010; Thurstone 1931)
		Attitudes	Convenient	Degree of attitude towards bicycling with respect to convenience (Lubian 2010; Thurstone 1931)
			Healthy	Degree of attitude towards bicycling with respect to personal health and fitness (Lubian 2010; Thurstone 1931)
			Time-saving	Degree of attitude towards bicycling with respect to time-saving (Lubian 2010; Thurstone 1931)
		Perceived behavioral control	Possible to commute by bicycle Which	The own perception of the commuter to complete the whole journey by bicycle from home to work (Lubian 2010; Thurstone 1931)
		Habit	transport mode would be more likely to be used	The mode of transport that would be more likely to be used for different purposes (shopping, leisure, social, etc.) (Triandis 1980; Heinen 2011)
		Length of residence	Year of immigration	If an employee was born in a different country, this refers to the year in which he/she immigrated to the Netherlands. N/A
		Socio-economic	Education level	The level of education that the commuter completed. N/A
			Income level	The level of income after taxes of the commuter. N/A
	Objective	Demography	Age	Age in years of the commuter N/A
			Gender	Gender of the commuter N/A
		Ethnic background	Mother place of birth	Place of birth of the commuter's Mother (Statistics Netherlands 2000)
			Father place of birth	Place of birth of the commuter's Father (Statistics Netherlands 2000)
		Bicycle ownership	How many cars at home	Total of cars that exist at the commuter's home. N/A
		Car ownership	How many cars at home	Total of cars that exist at the commuter's home N/A

Source: Own construct based in different authors (see last column for references)

### 3.3 Data Collection Methods

The group of variables needed to study the influence over the decision to use bicycle for commuting were reviewed during the process of operationalization. The specific data needed included subjective and objective information of the different dimensions mentioned above. The information required was considering specific information from the residential area of the commuters. Lastly, as reviewed during the operationalization, the subjective components need to be carefully selected and collected.

#### 3.3.1 Quantitative data

Most appropriated for this work was to conduct a survey that responds to the collection of objective and subjective requirements too. Hence, a survey was conducted online because of pragmatic reasons, namely limitation in time and budget. Thus, an online survey represented an efficient tool. In terms of segregation, it was consider that this instrument did not represent a limitation. This is because in the Netherlands the access to Internet is about 94% of Dutch households (Statistics Netherlands) .

To administer and collect the information of the survey it was used an online platform. The method to distribute the survey was via e-mail, according to email lists generated from the information available in the virtual platform of the EUR. In order to do not biased the survey of respondents that are more positive towards bicycle, the invitation to access the questionnaire was sent under the *Commuting to Work Research* subject. The survey was active during 3 working weeks, from June 24<sup>th</sup> until July 11<sup>th</sup> 2014.

The survey was available in English and Dutch, and it was structured in six sections. The first part of the survey considered general information with regards of the work place, such as location, material factors, private policies, and subjective attributes too. The second and third section was aimed to describe the commuting to work movements of the surveyed. The fourth part contained subjective perceptions of the surveyed, such as the subjective norm, habits, and opinions. The fifth part contained questions related to attitudes from the surveyed exclusively. Finally, the last section required objective personal data, such as socio-demographic and socioeconomic information.

On June 24<sup>th</sup> 2014, 4,025 invitations for the online survey via email were sent to employees of the main faculties and institutions of the EUR. The reaction within the first hour after the invitation was 189 “automatic replays” to our email inbox. From those automatic replays via email, most of them (58%) were to inform they were off the office. In those particular cases, the message explicitly informed that they would be back before the expiration of our survey (July 11<sup>th</sup>). An additional 10.6% of the automatic replays were to indicate that they were off too, although they did not specify when they would be back or would be back after the closure of our survey. 11.6% of the automatic replays were to inform that they were not

employees of the EUR anymore. And finally, 19% were to inform that they could not reply emails for various reasons such as illness, pregnancy, or did not specify.

On June 25th, 4,197 invitations more were sent to employees of different institutions of the Erasmus MC. Within the first hour after the invitations were sent, 179 'automatic replays' were received to our email inbox. From the total amount of automatic replays received from employees of the Erasmus MC, most of them were with the purpose to report that they were not in the office, 45% reported they would be back before the closure of our online survey (July 11<sup>th</sup>). 27% were to inform that they would be back after the expiration or did not specify the date. 13% of the automatic response reported that they did not longer were employees of Erasmus MC. Finally, the 15% informed that they could not reply emails for various reasons such as illness, pregnancy, or did not specify.

Apart from the original invitation, two reminders were sent via email during the active period of the survey. The reminders were sent only to those who had not completed the questionnaire by the date the reminders were sent. The first reminder was sent from July 2nd to July 3<sup>rd</sup>, 2014. The second reminder was sent from July 8<sup>th</sup> to July 9<sup>th</sup>. The reminders had to be sent in two groups (first the EUR employees and then the Erasmus MC employees) due to technical limitations of the survey platform.

In total, 7,879 invitations were delivered from the total of 8,228 invitations sent to employees in the EUR and Erasmus MC (some were bounced or had an error probably because the email address did not exist anymore or our invitation was detected as 'spam'). Note that for EUR, the amount of invitations sent was larger than the number of current employees. This was because some people's emails in the lists were not employees at the institution, were retired, or changed their e-mail address, among other reasons. Consequently, filter questions were included in the questionnaire with the purpose to select only the cases that were proper for this research.

It is also important to mention that other techniques and instruments were necessary to complement the information required for this research. The survey did not ask direct information in relation to commuting distance due to misperceptions or lack of accuracy from the respondent. Thus, the estimation of the distance travelled by commuters was generated from the postal code information collected in the questionnaire using API information from Google Maps. Microsoft Excel software was used to automatize the process and generate information to estimate the distance traveled in one way from home to the place of work, according to the shortest route by bicycle.

### *3.3.2 Qualitative data*

To complement and confirm the information collected from the online survey, face-to-face interviews were collected among employees and internal mobility policy managers. The

personal interviews were conducted in July 2014 in the city of Rotterdam. From the total of 8 interviews, 6 were employees of different departments and 2 policy managers. One of the mobility policy managers interviewed was Rachel Brussen from the department of Human Resources & Finance at the EUR. She administers the mobility policy and is the first contact to employees with regards of the intern policies to promote sustainable mobility. The second policy manager interviewed at the EUR was Giuliano Mingardo, a Senior Researcher Transport Economics, in Department of Regional, Port and Transport Economics (RHV) Erasmus University Rotterdam. He coordinated the official mobility survey in the EUR in 2010, and currently advises the mobility policies for the EUR. Regarding the interviews to employees, the real names were changed in order to protect their identities (see sample and size selection for the method used).

### 3.4 Sample Size and Selection

The population of the present study includes employees of two institutions in Rotterdam, The Netherlands, namely The Erasmus University of Rotterdam (EUR) and the Erasmus Medical Center (Erasmus MC). Within The Erasmus University of Rotterdam (EUR) the following institutions were considered: Erasmus School of Economics (ESE), Erasmus School of Law (ESL), Faculty of Social Sciences (FSW), Erasmus School of History, Culture, and Communication (ESHCC), Rotterdam School of Management (RSM), Institute of Health Policy & Management, International Institute of Social Studies (iBMG), and other administrative departments of the EUR. In the case of the Erasmus MC, this study did not make distinction of the internal institutions and departments of the Erasmus MC, even though it did include employees of the three main locations in Rotterdam. It is remarkable to mention that this study considered only employees whose main work location is within the administrative area of Rotterdam (the description of the case will be further discussed in Chapter 4).

The population of this study is composed as follows: 10,225 employees of the Erasmus MC, and 2,817 employees of the EUR. According to this, it was calculated the minimum sample required for the survey to be reliable. The sample size was calculated with a marginal error of  $\pm 5\%$ , and a confidence interval of 95% for both cases. The minimum number of observations required for the Erasmus MC was **370**, whereas the minimum number of observations for the EUR was **338**. (In both cases we collected a larger number of questionnaires, see *Description of the Case* for more details).

The personal interviews were conducted among employees and managers of different institutions within this study. In order to select the policy managers, purposive sampling was used. Two internal mobility policy managers of the EUR were contacted via email. The interviews were conducted face-to-face in their actual place of work. In total 8 interviews were conducted, 6 of employees and 2 policy managers. In the case of the process to select the sample of employees for the interviews, a mix method was used. This process combined purposive and random methods. First, the questionnaire was used to invite participants into a follow up interview. From those who accepted the invitation in the survey, three different

lists of emails according to the independent variable were created, namely full-time cyclists, part-time cyclists, and non-cyclists. From these lists, 2 cases were randomly chosen from each list. Then, they were contacted via email to concrete the appointment for the interview.

### 3.5 Validity and Reliability

Validity for this study was addressed in two main parts, namely process and results. Regarding the process, measuring attitudes was an important component of the subjective part at individual level, due to its nature of subjective component and the acknowledged difficulty to achieve valid results. Thus, to measure attitudes we used the branching technique, which have recently shown to be more valid compared to the 'classic' measurement methods (Lubian 2010) (see *Operationalization* subsection for detailed information regarding branching technique).

Another validation concern of the process was to adequately administer the survey. The respondents were invited to a *Commuting to work survey*, with the aim to reduce biased respondents that might be more identified or interested in cycling. Additionally, the methodology for administering the online survey provided advantages of reliability because the administrator does not influence responses at any moment, as could be the case in the face-to-face administered questionnaires.

With regard to validation of results, these were confirmed from two additional sources. A second source of information was the qualitative process, more specifically; the face-to-face interviews to employees (as described in Sample size and selection), and 2 EUR mobility policy managers of the EUR. A third source of information was the existing studies conducted in The Netherlands.

The validity construct of the survey was acquired by testing it in a pilot survey among employees of the Institute of Housing and Urban Development Studies of the Erasmus University of Rotterdam. The institute was selected because the participants had different cultural and ethnic backgrounds, such as native Dutch, Western, and non-Western. The participants were all based in The Netherlands, and had different length of residence in the country. Thus, it was aimed to identify inconsistencies of the construct in the pilot survey before the official launching.

Reliability was also important in our data, this was tested in different ways. *Internal consistency* was tested in SPSS statistical software using Cronbach's Alpha test (see Chapter 5 for the results of the reliability analysis). Additionally, when built the statistical models in the same software, the explanatory variables were introduced one by one to check the correlation among them and with the dependent variable and the other way rounded.

### 3.6 Data Analysis Methods

The total number of completed questionnaires received within 3 working weeks, from June 24<sup>th</sup> until July 11<sup>th</sup> 2014, was 934. From the observations collected, the information regarding the postal code of the place of work was corrected in some cases under the following assumptions:

1) When the postal code of the work place and the residential postal code were equal and the indicated number of days traveled to their place of work was 2 or more, the postal code of the place of work was corrected according to the official address of the institution in which the respondent expressed to be employed. This procedure could not be used for Erasmus MC employees. This was because the information collected in the survey at the Erasmus MC did not differentiate between the different locations of the organization. Thus, the specific location in which respondents work could not be deducted. When the postal code of the place of work and the postal code of the respondent's home address was the same, and they indicated to attend their place of work "1 or less" a week, we assumed that the employee did not require to commute to a specific location, therefore those cases were omitted.

2) The second type of correction was in those cases when respondents introduced the postal code of the 'mail address' of their institutions instead of the 'visiting address'. It was believed that in those cases, some respondents were not familiar with the actual postal code of their place of work. Thus, they possibly had to consult the information from the 'contact' information in the official webpage of their institution, which shows the 'visiting address' and the 'mailbox'. Hence, the 'mail address' postal codes were corrected as follows: 3000 CB, from MC-Sophia to 3015CN; 3000CA, from Erasmus MC (hospital) to 3015 CE; 3008 AE, from the Daniel den Hoed for 3075EA; 3000 DR, from the central campus of EUR, to the postal code of the main location of the EUR institute in which they were employed. Again, respondents from the Erasmus MC that wrote the P.O. Box instead of the actual postal code could not be corrected, because the specific location where they work could not be identified from the information collected in the survey.

From the questionnaires completed, 52 cases were eliminated from our data set because the postal code was not introduced correctly and was not possible to be corrected with a systematic method. In addition from the errors described above, some postal codes did not exist or could not be identified. Two more cases were discarded because the respondent expressed not to be employed at the moment when they took the survey. 7 more cases were deleted because the distance traveled in one way (deducted from the information the respondent provided) was longer than 120 kilometers and did not match with the frequency and duration they reported to travel, assuming that the information introduced as reference for the location of their place of work or home address was incorrect. Furthermore, those last were atypical cases of distance traveled from the rest of our data set, and were not representative of the total population. 31 additional cases were deleted because their main work location was not within the city of Rotterdam, thus were out of the scope of this research. Finally, the depuration of the data set resulted in **N=842**.



The analysis of the information was organized as follows: first according to each sub-research question. Then, a descriptive analysis including the correspondent variables for each sub research question was given. Later, the data was split in three different groups according to similar distances traveled by commuters as follows: less than 5 kilometers, between 5 to 10 kilometers, and more than 10 kilometers (In some cases was not possible to split the analysis by distance, the specific reasons are discussed during the presentation of the results). For all the analysis, the information was also spit by the depended variables. First, comparing cyclists and non-cyclists (including all the observations N=842), and then comparing only cyclists (N=223), full time cyclists (FTC) and part time cyclists (PTC).

In the study of commuters type (cyclists and non-cyclists), and cyclists type (FTC and PTC) different type of analysis were conducted. First, a descriptive analysis in order to contrast the differences of the each commuters' subgroup and to identify the general tendencies was done. Then, statistical tests to discard the differences in the results by coincidence were conducted. Two statistical binary logistic models were built in order to combine the subjective attributes and the effect of background.

## Chapter 4: Research Findings

### 4.1 Description of the case

In the survey, most of the departments and institutions of the EUR and Erasmus MC were included. In table 4 the total population of the study is presented. The EUR employees in total sum 2,817. The largest number of employees is in the RMS (N=533), followed by the ESE (N=484). In total, the EUR is even in respect to gender (49% males). The Erasmus MC has more than three times number of employees compared to the EUR, which sum in total 10,225. In contrast, there is a larger population of women in the Erasmus MC (70%). Considering both institutions, the total population of the study is 13,042. From this, more than the half is female (66%), the imbalance is due to the difference mentioned for the Erasmus MC.

**Table 4** Population of the study

	Males		Females		Total	
	<i>n</i>	(%)	<i>n</i>	(%)	<i>n</i>	(%)
Erasmus University of Rotterdam	1,372	48.70	1,445	51.30	2,817	21.60
ESE	302	62.40	182	37.60	484	3.71
ESL	169	46.69	193	53.31	362	2.78
FSW	159	42.97	211	57.03	370	2.84
ESHCC	62	40.00	93	60.00	155	1.19
RSM	275	51.59	258	48.41	533	4.09
iBMG	62	31.96	132	68.04	194	1.49
Other	343	47.71	376	52.29	719	5.51
Erasmus MC	3,111	30.43	7,114	69.57	10,225	78.40
Total	4,483	34.37	8,559	65.63	13,042	100.00

Source: Own elaboration based on EUR annual report 2013 and Erasmus MC Business Intelligence Center.

It is important to mention some general physical and policy conditions to better comprehend the context in which mobility develops in these two institutions. Regarding the main campus of the EUR, there is a metro stop within 900 m, four tram stops within 500 m, and 2 bus stops within 500. There is high frequency of the public transport service in working days. With respect to parking infrastructure, there is a paid car parking inside the main building. For employees the fare is relatively low (approx. 1 euro a day). There are free bicycle garages exclusive for employees. Additionally, there are free bicycle garages for the general public within the campus and a high coverage of bicycle racks around the campus.

It is particularly remarkable that in 2011 a specific mobility policy was introduced in the EUR. In 2010 there was an official mobility survey. After that, in 2011, a group of measures

was implemented, mainly aimed to discourage the use of private vehicles. Among the most important measures of the mobility policy was the introduction of the paid car parking, reimbursement of public transport expenditure up until 3,000 euros a year, and tax reimbursement in the purchase of a new bicycle, among others (Erasmus University of Rotterdam 2014). Information regarding internal policies was also collected from the interviews to the mobility policy managers of the EUR and directly from employees.

For the Erasmus MC, there is not public information available on internal mobility policies to the date. We tried to contact the coordinator for the Erasmus MC mobility policies via email. However, it was not possible to interview them because the main policy manager was out of office during our data collection period. Nonetheless, during the interviews with employees of the Erasmus MC the subject of policies and available transport infrastructure often emerged. It was also found that the policies are similar to the EUR, such as public transport reimbursement, free tax in the purchase of new bicycle. During the interviews to Erasmus MC employees it was frequently mentioned the ‘high’ price of the car parking (not detailed). It was also said that the public transport was highly accessible. In addition, during the fieldwork in the place of work at Erasmus MC, the presence of a metro station right next to the main complex and various tram and bus stop around the complex were observed.

## **4.2 Description of the sample**

During the following subsection specific and general results are presented. It is remarkable to mention that some studies conducted in The Netherlands regarding bicycle were presented to contextualize different cases. Since our study is not a replica and it was conducted in a very specific context, there is no an identical study that might be fully comparable to our own research. However, as mentioned here, results of other studies conducted in the Netherlands are presented as a general reference in order to contextualize our won results. Comparisons should be taken with caution and merely as complementary information.

A general overview of the quantitative results can be observed in Table 5. In the sample, most of the respondents were academic staff (63%), the rest were integrated by Management staff (15%), and other type of employment (22%). The institutions and departments where the respondents work were diverse. From our total sample, almost half were employees of the Erasmus MC (46%). Within the EUR, the largest proportion of respondents was from the Erasmus School of Management (RMS) (14%). In despite of the variance of the institutions of the sample, employees attended their place of work regularly. Close than three quarters of the sample commuted 4 or more days a week (74%). This information was confirmed in the interviews; since most of interviewees added that they regularly work from home one or two days a week.

Regarding the demographic characteristics the following information was collected: the average age of the respondents was 40 years old ( $SD=11,91$ ). Most of the respondents in the sample are female (61%). Even though the population of employees at the EUR was equilibrated regarding gender, our sample was in line with the general demography of the

total population (61% females) (see *Description of the case*). About one quarter of the participants were native Dutch (77%), the rest had Western background (15%), and a minority had non-Western background (8%) (see *Operationalization* for the classification of ethnic background).

From our data, there is greater degree of certainty regarding the respondents who immigrate than the certainty over the ones who were born in The Netherlands. This variance is because the information regarding immigration was deducted from the following question in the survey: "If you were not born in The Netherlands, please indicate the year in which you move here:". From this question, 18% of the participants stated the year in which they moved to the Netherlands, and the rest (82%) did not introduce any information. For this study it was assumed that respondents who did not answer this question were born in the Netherlands. To finalize these demographic attributes, it seems that it is more common to find foreign employees in the EUR than in the Erasmus MC. This information was perceived during the face-to-face interviews in the different locations.

*"[The work team] It's very homogenous group. Most of them are Dutch. It's maybe different the other part of the university where many people from abroad are working."*

-Franz, Erasmus MC Professor.

Thus, due to the large number of participants from the Erasmus MC, the average of native Dutch was equilibrated in comparison to other studies.

In relation to the socio-economic attributes, it was found that more than three quarters of the sample has a high degree of education (77%). This was something expected, since the survey was conducted in an academic institution overall. Thus, many of the activities require high skill-labor employees. Regarding income, more than the half (60%) had an income after taxes of 2.000 euros a month or more. Practically all respondents in the sample (98%) have at least one bicycle at home, as also noted in the interviews. On the other hand, 23% of the sample reported not to have any car at home, about half of the sample reported to have one car at home (51%), and the rest had 2 or more. It was found that the bicycle ownership in our own results was practically the same when referenced with a survey for commuting to work conducted in medium size cities in The Netherlands (Delft, Zwolle, Pijnacker among others) (Heinen et al. 2012). Only 2% of employees reported not to possess a bicycle at home. Regarding car ownership, there were some differences with our own results, since they reported that only 9.6% did not own a motor vehicle at home.

**Table 5** Overall view

Statistics	(%)	<i>n</i>	Mean	St. Deviation
Type of work				
Academic staff	63.3	533		
Management staff	15.08	127		
Other	21.62	182		
Faculty or institute				
Erasmus School of Economics	9.14	77		
Erasmus School of Law	7.48	63		
Faculty of Social Sciences	9.98	84		
Erasmus MC	46.44	391		
Erasmus School of History, Culture, and Communication	3.92	33		
Rotterdam School of Management	13.54	114		
Institute of Health Policy & Management	5.7	48		
Other	3.88	32		
Subsidy for public transport				
Yes	56.29	474		
No	43.71	368		
Frequency travel (a week)				
1 or less	2.97	25		
2	5.82	49		
3	17.22	145		
4	34.09	287		
5 or more	39.9	336		
Alternate mode				
No	60.93	513		
Yes	39.07	329		
Subjective norm (0-2)			0.57	0.84
Perceived behavioral control (1-5)			3.12	1.77
Habit (0-4)			1.93	1.35
Attitudes (-15 to 15)			4.5	6.53
Type of residential area				
Suburban/Rural	49.41	416		
City/Downtown	50.59	426		
Bicycle garage inside the building				
Yes	45.72	385		
No	54.28	457		

**Table 5** continued

Statistics	(%)	<i>n</i>	Mean	St. Deviation
Free car parking in the residential area				
Yes	57.01	480		
No	42.99	362		
Diversity of the residential area (0-4)			2.64	1.25
Age (20-80)			39.74	11.91
Ethnicity				
Native Dutch	76.9	626		
Western	15.36	125		
Non-western	7.74	63		
Gender				
Male	39.43	332		
Female	60.57	510		
Year of immigration				
2014-2010	9.98	84		
2009-2000	2.97	25		
Pre 2000	4.87	41		
NL born	82.19	692		
Education				
Low	9.38	79		
Medium	14.01	118		
High	76.6	645		
Income				
<1000	3.01	22		
1000-1.500	7.67	56		
1.500-2.000	29.73	217		
2.000-2.500	23.84	174		
2.500-3.000	12.6	92		
>3.000	23.15	169		
Bicycle ownership				
None	2.26	19		
1	12.35	104		
2 or more	85.39	719		
Car ownership				
None	23.16	195		
1	50.71	427		
2 or more	26.13	220		
Distance (kilometers) (0.2-120)			23.24	25.22

In the following paragraphs the general results regarding the routinely journeys of employees are presented. Before continuing, it is noteworthy to mention that specific information regarding the frequency and variance in modes was captured in our won data. This type of information is not usually collected by travel surveys, including the Dutch Census travel data. Yet, this type of information is important to understand the factors that determine the day-to-day decision to chose a mode of transport, specially for bicycle commuters (Heinen & Maat 2012). This, as previously discussed in the literature review and operationalization. In general, little amount of information is available to the date that has made distinction in mode variance. For this reason, the specific results in variance were taken with caution and often referenced to a similar study conducted in The Netherlands, which did collected this type of information.

Regarding the routinely journey, respondents commuted long distances for they daily journeys on average ( $M=23.24$ ,  $SD=25.22$ ). According to other studies in The Netherlands, employees traveled shorter distances, being 17.0 kilometers on average (Heinen et al. 2012). This difference is possibly because our case was focused on academic institutions. The fact of traveling long distances could also be perceived during the interviews. It was mentioned by interviewees that they had colleagues commuting from Utrecht, Amsterdam, or in some cases Belgium.

*“I know RSM has a couple of employees commuting from Belgium. Some in the Gent area, others Antwerp. We often try to do carpooling to limit our carbon footprint and feelings of guilt for polluting that much!”*

-Dr. Janis, RMS researcher at EUR (Non-cyclist).

From our total sample ( $n=842$ ) it was observed that more than the half (61%) did not alternate the mode of transport (or combination of modes) to commute to work. This specific variance of mode was practically the same to the one reported in another survey which studied commuting to work in The Netherlands (Heinen et al. 2012). In Table 6, the split by mode of alternators and nonalternators is shown in more detail. Bicycle was the most important mode for the employees who always commuted with the same mode (26%), followed by employees who combined bicycle with public transport (25%). The use of car is close to the other two modes already mentioned, with a presence of 24%.

The results for nonalternators differ considerable in the use of car and the combination of bicycle and public transport when compared to another study in The Netherlands (Heinen et al. 2012). The use of car in the other study was the double as it was for our sample (27%). More contrasting was the use of the combination of public transport and bicycle, which in our study was four times higher (25%) than in the results reported by Heinen et al. (2012), only 6%. Nevertheless, the results are practically the same in the case of bicycle use. The difference observed in other modes might be result of the internal policies to encourage the use of public transport, since more than the half of employees in our sample reported to receive a “subsidy for public transport” (56%).

For employees who alternated mode, 41% of them used the combination of public transport and bicycle occasionally. This combination was followed by bicycle, 28% of employees who alternated mode reported to use it for commuting to work. This again was close to private car use, one quarter of the employees who alternate mode used car for commuting occasionally (25%). The split by mode for alternators also differed from the results by Heinen et al. (2012). They observed higher use of car and bicycle, 62 and 59%, respectively. In that study, it was reported a lower use of the combination of bicycle and public transport than the observed in our own data, 13% compared to 41%. This again may be related to the internal mobility policies applicable for EUR and Erasmus MC employees. In a bivariate correlation analysis it was found to be significant being non-cyclist with using a subsidy for public transport  $r(842) = .22, p < .01$ .

**Table 6** Total split by mode own data

	Nonalternators		Alternators	
	<i>n</i>	(%)	<i>n</i>	(%)
Car	124	24.17	81	24.62
Bicycle	131	25.54	92	27.96
Public transport	42	8.19	68	20.67
Foot	8	1.56	12	3.65
Combination of public transport and bicycle	127	24.76	134	40.73
Combination of public transport and foot	38	7.41	61	18.54
Combination of car and bicycle	10	1.95	51	15.50
Combination of car and public transport	16	3.12	52	15.81
Other	17	3.31	0	0.00
Total	513	100	329	
Missing	329		513	

Note that the alternators could choose multiple modes (or mode combinations) of transport; Therefore the sum of all modes used is higher than the number of people.

To analyze our data, the sample was grouped in two ways. First, according to the distance traveled, namely less than 5 km, 5 to 10 kilometers, and more than 10 kilometers in order to make the cases comparable each other within similar distances. Then, the sample was split according the dependent variable. We identified between cyclist and non-cyclists. In total, 26% of respondents of the total sample are at least occasional cyclists, as shown in Table 7 (considering all distances in the sample).

The proportion of cyclists in own data was lower than the findings by Heinen & Maat (2012), being 26% of our total sample, compared to 39% of their total sample. This difference is possibly explained by three reasons. First, Rotterdam has lower use of bicycle (16%) than the national average (27%) (Ministry of Transport Public Works and Water Management 2010). The second reason may be that the distances traveled by employees of the EUR and the Erasmus MC were, on average, longer than other employees compared to another study (Heinen et al. 2012). Thus, as the literature suggest, the decision to use bicycle is negatively



affected by distance (Heinen et al. 2012; Cervero & Duncan 2003; Rodríguez & Joo 2004). Lastly, a similar study in this respect (Heinen et al. 2011), considered occasional bicycle users based on a different definition. Whereas our own study considered cyclists those commuters who traveled to work at least 3 times a year the other study included as cyclists those who commuted from one time traveled to work a year and on.

In despite of what noted above, the odd of cyclists in short distances is much higher than in long distances. Within commuters traveling 5 or less kilometers to work almost the half (49%) are at least occasional cyclists. For distances from 5 to 10 kilometers, it is observed a slight reduction (46%). Nonetheless, for long distances (more than 10 kilometers) cycling to work is largely affected, 9% of commuters cycled to work. These observations are confirmed by the findings of other studies, and it also elaborates more in the differences discussed above regarding the proportion of cyclists compared to other studies.

**Table 7** Commuter type over various distances

	Distance kilometers							
	<5		05 to 10		>10		Total	
	(%)	<i>n</i>	(%)	<i>n</i>	(%)	<i>n</i>	(%)	<i>n</i>
Cyclist	48.79	101	46.29	81	8.91	41	26.48	223
Non-cyclist	51.21	106	53.71	94	91.09	419	73.52	619
Total	100	207	100	175	100	460	100	842

From the total number of cyclists in our sample (n=223), more than the half (59%) are FTC, as noted in Table 8. As expected, the proportion of FTC is larger in short and middle distances, 65% and 63% respectively, than in long distances (34%). This is comprehensible because one might occasionally cycle to work in long distances, but it is harder to complete it as an every-day activity. This can be expected specially for bicycle commuters, that have shown to be more sensible to external conditions than other mode users according to the interviews and literature (Heinen et al. 2010; Cervero & Duncan 2003).

**Table 8** Cyclists over various distances

	Distance kilometers							
	<5		05 to 10		>10		Total	
	(%)	<i>n</i>	(%)	<i>n</i>	(%)	<i>n</i>	(%)	<i>n</i>
FTC	65.35	66	62.96	51	34.15	14	58.74	131
PTC	34.65	35	37.04	30	65.85	27	41.26	92
Total	100	101	100	81	100	41	100	223

## 4.3 Analysis

### 4.3.1 Demographic attributes and commuting by bicycle to work

This first part of the analysis consisted on the possible relation of the socio-demographic individual attributes with the fact of being cyclists over various distances. Then, it was analyzed the possible relation of the socio-demographic attributes and being FTC or PTC. For this last analysis, the results were not differentiated by distance. The main reason for this is that there were not enough cases to split the specific variables of the attributes over various distances. The results are presented in descriptive statistics, and then Chi-square test was used for all demographic variables.

As shown in Figure 3, it was found statistical significance between ethnic background and being cyclist in short and medium distances  $\chi^2(2, N = 103) = 9.72, p < .05$ ,  $\chi^2(2, N = 81) = 8.46, p < .05$  respectively. It was observed that non-Western background respondents had less proportion of cyclists than native Dutch and Western background had. This was uniformly observed for all distances. Whereas native Dutch and Western decreased similarly with distance, non-Western seemed to be more affected by this fact. This difference could also be perceived during the interviews.

*“In my group there's eight people and two of them are Dutch, one has lived here for a long time, German. And then... There's one from Macedonia, and one from India, and another one from maybe Pakistan, and those three don't cycle. So, it's a very distinct three people in the group that don't cycle, and then the people that live here long or Dutch...So if I think of as a representative sample, yeah...And then it's me. So, I'm the...I go with the Dutch hahaha!”*

-Johanna, Researcher at Erasmus MC (PTC from Oceania).

From the last quotation, the nationalities mentioned fitted to the findings of the survey. The sample described above contained the different backgrounds in this research. As described, native Dutch, and Western background employees seemed to regularly cycle to work, in contrast to non-Westerns background employees. Finally, it was mentioned by native Dutch interviewees that background was playing an important role in their own decision to commute by bicycle to work. It was frequently mentioned the use of bicycle as ‘part of their culture’. They often expressed that from young ages they were taught to use bicycle, and in some cases they also mentioned that taught their own children to cycle for routinely activities.

*“I think Dutch people use the bike whenever they can and non-Dutch use the bike when they must. It is a generalization of course. I think people for instance living here in Rotterdam and that work here...most of my Dutch colleagues if it's not storming or something or they don't need the car for something else they always come by bike and then my non-Dutch colleagues always find reasons why is better to come by tram or to come by car or...whatever.”*

-Dave, EUR researcher at EUR (Non-cyclist).

The length of residence was studied in this subsection as part of the demographic conditions. In the statistical tests, significant difference between cyclists and non-cyclists was found in relation to the length of residence in The Netherlands only for short distances  $\chi^2(3, N=106)=9.23, p < .05$ . Immigrants were also compared to the cycling proportions of those who were born in The Netherlands. Despite the fact that there was not a linear relation between the length of residence and proportion of cyclists, it was observed that respondents who had lived in The Netherlands for five years or less cycled less than the ones who moved 15 or more years ago and the ones who born in The Netherlands in all distances. These findings are also in line with the general perception of people during the interviews. Furthermore, during the interviews the fact of previous cycling experiences in the immigrants' countries emerged, and it was related to the use of bicycle in the Netherlands.

Regarding age and gender some notable results were found. Whereas for short and middle distance gender did not appear to be relevant, our findings suggest that males seemed to be less affected by distance than females  $X^2(1, N=44)=6.45, p<0.05$ . Age did not appear to play a role, as suggested in literature. In general, high use of bicycle for older ages was observed as well. The only exception in which statistical difference was found was for middle distance commuters  $X^2(3, N=82)=8.48, p<0.05$ , commuters cycled less with more age.

In our findings there was no direct relation between income and use of bicycle. This was confirmed during the interviews. In general, it was mentioned that income did not affect the mode of transport. In some cases it turn to be important for users and policy managers in an indirect way trough the paid parking. The persistence in the use of the same mode was observed when different type of commuters were ask if they would shift their regular mode in the hypothetical case they earned more.

*“I think...well, if I earned more I would buy a better car! hahaha...But no between modes.”*

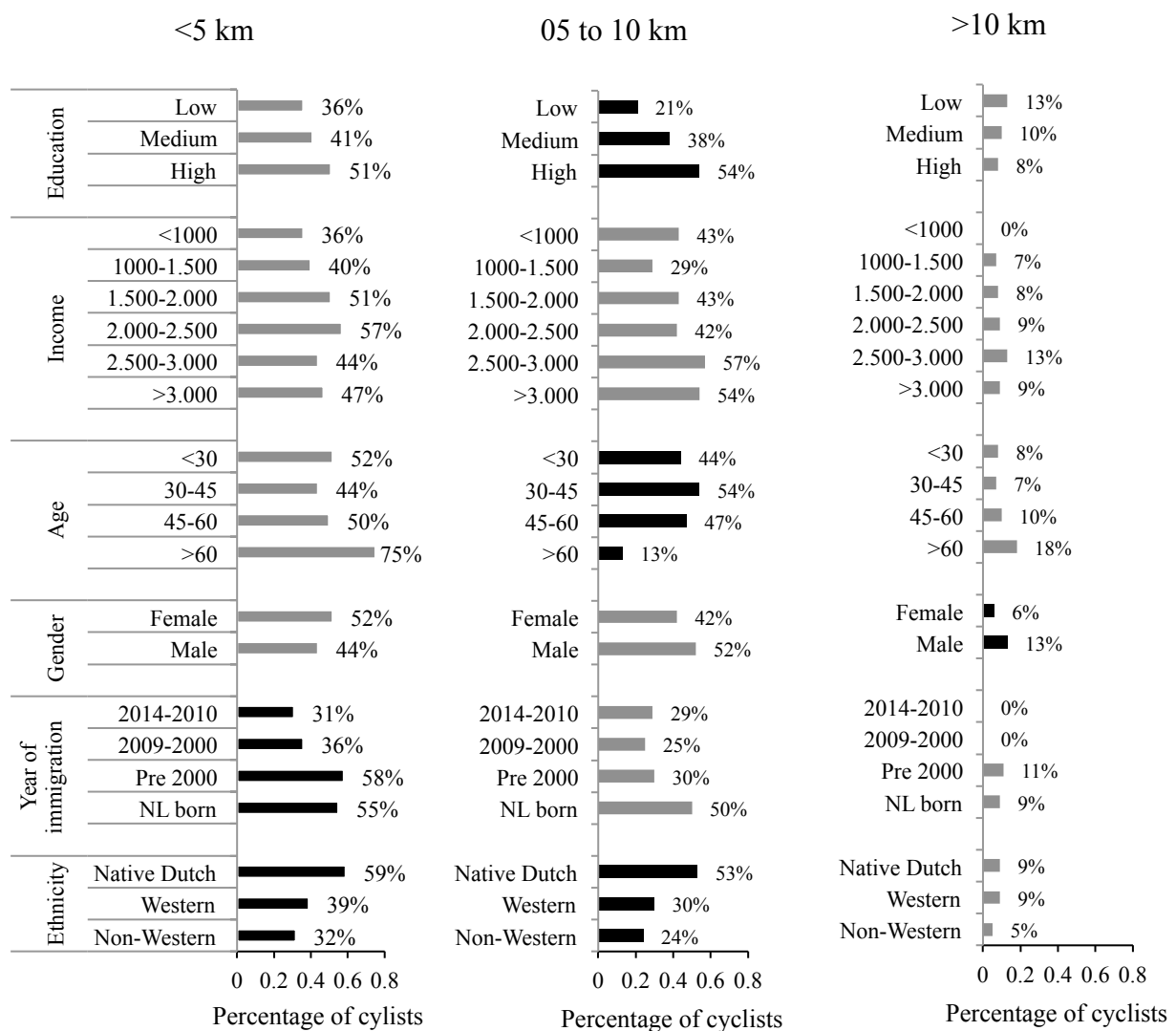
-Dave, EUR researcher at EUR (Non-cyclist)

*“No I wouldn't. Maybe a better bike but...hahaha”*

-Kurt, Laboratory researcher at Erasmus MC (FT cyclist)

The level of education in the descriptive statistics had a relation with the use of bicycle in short and middle distances. As the level of education increased the odd of cyclists did it too. This was significant only for middle distances  $X^2(2, N=82)=10.39$ ,  $p<0.05$ . Additionally, respondents with high and medium education were barely affected by the middle distance in contrast to low education respondents.

**Figure 3** Cyclists and demographic attributes over various distances



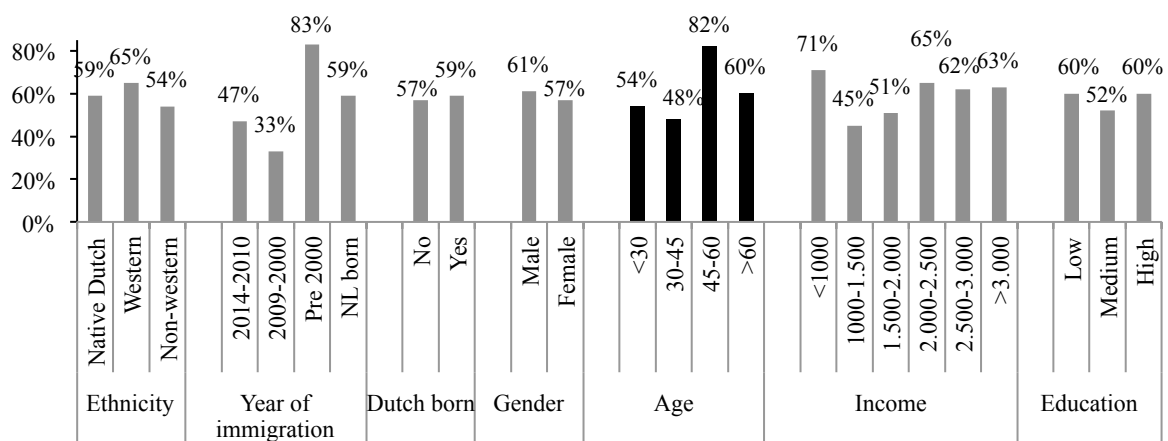
1) Bars in black showing Chi-square test significant differences at  $p < 0.05$  between cyclists and non-cyclists in similar distances. 2) The proportion not showed in bars corresponds to non-cyclists.

As shown in Figure 4, the demographic attributes were analyzed in relation with full time cyclists (FTC) and part time cyclists (PTC). This part of the analysis only considered cyclists (N=223), which were sub-divided in FTC and PTC (see *Operationalization* for the methodology used). In this case, it was not possible to analyze the differences according to

distance as it has been done with cyclists and non-cyclists. This was not possible because of the number of the sample was not enough to split the specific variables of the attributes over various distances. To analyze the data, descriptive analysis and Chi Square Tests were used in relation to FTC and PTC, in order to determine which demographic factors were significant to determine the frequency of bicycle use.

When comparing FTC and PTC, it was observed that differences were not as consistent and constant as they were in the case of cyclists and non-cyclists. Even though it was observed variance for FTC according to the ethnic background, which usually is higher for native Dutch, this attribute did not turn out to be significant in the statistical test. In the case of length of residence, the odd of FTC was higher for employees living in The Netherlands for 15 years or more compared to the ones residing less than 15 years in the country. However, this difference was not statistically significant. Age was the only variable that was significant  $X^2(3, N=223)=16.83, p>0.05$ . Finally, the odd of FTC of employees between 45 to 60 years old was much higher compared to any other group of age.

**Figure 4** Full time cyclist by demographic attributes



1) Bars in black showing Chi-square test significant differences at  $p < 0.05$  between full time cyclists and part time cyclists. 2) The proportion not showed in bars corresponds to part time cyclists.

#### 4.3.2 Subjective individual attributes and commuting by bicycle over various distances

In order to analyze the subjective individual attributes this subsection is organized as follows. First it was presented a general overview of the subjective norms, since it turned to be an important subjective attribute for the general analysis. Secondly, the average score for subjective individual attributes in relation to cyclists and non-cyclists was presented in a descriptive analysis together with the Independent T-Test results. Later, the same two analyses for FTC and PTC are presented.

#### 4.3.2.1 Descriptive analysis

In Table 9, the data was split according to the distance traveled by commuters from home to their place of work in order to make the cases comparable. At first instance, when comparing subjective norm at work with subjective norm at home there were more respondents expressing “doesn’t matter”. This could mean that the opinion of the people at home was more important than commuters’ colleagues at work, as also expressed in the interviews.

For short distances bicycle was the most expected mode of transport at work and home by far compared to other modes, 61% and 64% respectively. As a remark, in short distances car had a very low presence in both environments, and it considerably increased for distances larger than 5 kilometers. For middle distances bicycle seemed to be reduced, nonetheless it was still the most expected mode for both cases. Lastly, in long distances, expectations to travel by bicycle to work decreased considerably compared to short and middle distances.

**Table 9** Subjective norm at home and work by mode of transport

		Distance in kilometers			
		<5	05 to 10	>10	Total
		(%)	(%)	(%)	<i>n</i> (%)
Subjective norm at work					
	Car	1.93	13.71	25.65	146 17.34
	Public transport	6.28	13.14	42.39	231 27.43
	Bicycle	64.25	41.71	7.17	239 28.38
	Foot	1.93	0.00	0.00	4 0.48
	Doesn't matter	25.6	31.43	24.78	222 26.37
Subjective norm at home					
	Car	3.86	16	30	174 20.67
	Public transport	6.76	11.43	39.13	214 25.42
	Bicycle	61.35	44	8.48	243 28.86
	Foot	3.38	0.57	0.00	8 0.95
	Doesn't matter	24.64	28	22.39	203 24.11

The total scores for the subjective individual attributes are presented in Table 10. It can be observed that the subjective norm scores for cyclists were higher than non-cyclists’ scores in short, middle, and long distances. Independent T-Test indicated that there was significant difference between cyclists and non-cyclists’ subjective norm scores for all distances. There was also a significant difference for all distances in subjective norm at work and home between cyclists and non-cyclists. Subjective norm at home for cyclists had higher scores when compared to subjective norm at work. Subjective norm seemed to be more influential for cyclists at home in all distances. Nonetheless, for non-cyclists it occurred the opposite,

subjective norm at work was more influential for not being cyclists than subjective norm at home.

The difference observed in subjective norms at home and at work for non-cyclists might be because people at the commuters' home might suggest not to commute by bicycle when the weather conditions are adverse, as frequently mentioned during the interviews. However, since non-cyclists are generally less affected by weather, the expectations at home for not to commute by other mode did not happen as frequently as it did with cyclists.

Furthermore, it was constantly expressed by interviewees that expectations of colleagues at work did not have an influence over their own decision to choose a certain mode of transport. In contrast to what they generally mentioned about the influence over themselves, interviewees did mention that probably they had an influence over their colleagues, or they have had the conversation to suggest other modes.

*“No, they don't have any influence on my decision, not at all. Instead I am experimenting with things. I am considering lending my scooter to a colleague over here to give it a try... Everyone has a bicycle. We try to convenience more people to come here by e-bike. The talks I had here with colleagues, is that they are considering buying e-bikes but it is still quite expensive buying a new, even with the subsidy.”*

-Roger, Researcher at RSM at EUR, (Part time cyclist).

Sometimes it was mentioned the fact to suggest to travel by bicycle to colleagues at work with a humoristic connotation. This connotation might be due to the overall perception that among employees was not socially acceptable to be influenced by colleagues. Overall, colleagues seemed to have an effect even in non-verbal and in direct verbal expressions.

*“For me not [Being influenced], but in general I remember, that two years ago my former department that there was one colleague who really lived nearby Erasmus MC, and she always came by car, and it was...I think one or two kilometers haha. So we bullied her a lot with that hahaha...And after some time she saw the light and she always came by bike, and later on she cycle much further distances.”*

-Kurt, Laboratory researcher at Erasmus MC (FT cyclist).

From the last quotation, it was observed distance as an important factor, which appeared to be relevant in the past quantitative analysis as well. From this, it might be confirmed that for short distances the subjective norm is to commute to work by bicycle, contrary that by doing it by car.

Similarly, commuters were influenced by habit but also by distance. The findings are coincident to those reported by Heinen et al. (2011), apparently commuters that cycle for other purposes had higher likelihood to cycle to work too. There was a significant difference between cyclists and non-cyclists for all distances.

Employees that used bicycle to commute to work, perceived more behavioral control and had more positive attitudes towards bicycle, differing significantly from non-cyclists. Furthermore, distance barely affected the perception of cyclists' behavioral control (PBC), whereas employees with low perception of behavioral control seemed to greatly affect the probability of being non-cyclist, especially in middle and long distances. Attitudes towards bicycle were more positive from cyclists than non-cyclist. Attitudes were significant for all distances. Attitudes had similar effects with distance as the PBC. Cyclists' attitudes were slightly affected by middle distance, whereas for non-cyclists attitudes towards bicycle were considerably affected by medium distances and greatly affected in long distances.

**Table 10** Subjective individual attributes for cyclists and non-cyclists

	Commuter type					
	Cyclist			Non-cyclist		
	Distance kilometers			Distance kilometers		
	<5	05 to 10	>10	<5	05 to 10	>10
Subjective norm	1.59**	1.1**	0.98**	0.93	0.65	0.08
Subjective norm at work	0.76**	0.51**	0.44**	0.53	0.34	0.04
Subjective norm at home	0.83**	0.59**	0.54**	0.41	0.31	0.04
Habit	3.06**	2.78**	2.22**	1.98	1.38	1.57
Perceived behavioral control	4.95**	4.81**	4.44**	4.61	3.76	1.69
Attitudes	10.53**	9.65**	6.07**	8.05	4.23	1.07

Independent t-test showing significant differences at \*\*( $p < 0.05$ ), \*( $p < 0.1$ ) between cyclists and non-cyclists at similar distances. Significant paired relationships shown in the cyclists' columns.

In a general overview of the subjective attributes affecting frequency of bicycle use, it was noticed that these did not appear to be significant in short distances mostly, as shown in Table 11. The subjective norm and habit levels in short distances are similar between FTC and PTC. Only perceived behavioral control and attitudes have a significant difference in short distances  $t(101)=.60, p<.05$ . Commuters who were expected to travel by bicycle to work from middle and long distances appeared to have more probabilities to be FTC. For subjective



norms, it was found a similar effect discussed above. In the case of FTC and PTC, the expectations at home to commute by bicycle were higher than at work. It appeared that distance affected PTC more than FTC. It is remarkable that FTC's subjective norm is barely affected over distance.

The use of the bicycle for other purposes, understood as habit, did not change for FTC who commuted over various distances, those appear to be 'everywhere cyclists', whereas cyclists who think about different modes for different activities apart from work are more likely to be PTC. Attitudes appeared to have strong influence for being FTC, this can be observed because PTC expressed themselves less positive towards bicycle in middle and long distances, while FTC are not affected in short distances, and slightly affected for long distances.

**Table 11** Subjective individual attributes for FTC and PTC

	Cyclist type					
	Full time cyclist			Part time cyclist		
	Distance kilometers			Distance kilometers		
	<5	05 to 10	>10	<5	05 to 10	>10
Subjective norm	1.62	1.33**	1.64**	1.54	0.7	0.63
Subjective norm at work	0.79	0.63**	0.71**	0.71	0.3	0.3
Subjective norm at home	0.83	0.71**	0.93**	0.83	0.4	0.33
Habit	3.14	3.02**	3**	2.91	2.37	1.81
Perceived behavioral control	4.98*	-	-	4.89	4.5	4.15
Attitudes	11.41**	10.53**	8.93**	8.89	8.17	4.59

1) Independent t-test showing significant differences at \*\*( $p < 0.05$ ), \*( $p < 0.10$ ) between full time cyclists and part time cyclists at similar distances. Significant paired relationships shown in the FTC columns. 2) Perceived behavioral control for middle and long distances were not considered for analysis due to the small number of cases.

#### 4.3.2.2 Statistical model analysis

Continuing with the analysis, there were built two binary logistic regression models. The method used was to enter variables in two steps for each analysis. The first step included subjective norms and attitudes. In addition, the second step included perceived behavioral control, and habit. In both cases, the subjective norm was split into working and home environment. It is also shown the effect of each mode expectation over cyclists' behavior.

The first model analyzed cyclists and non-cyclists, with an accuracy of 83.7% based on 842 observations. The second model analyzed full time cyclists and part time cyclists; it was based on 218 observations and was able to predict 74.4%.

In table 12, the results for the first two-step model analyzing commuter type, cyclists and non-cyclists are shown. In the first step attitudes and subjective norm explain 9% of the total variance. In this first step, expectations to travel by car, 'other, or 'Does not matter' at home negatively affected being cyclist. In the same way, expectations at work to travel by car, negatively affected the likelihood to commute by bicycle. In this same step, more positive attitudes were positively related with being cyclist.

In the step two, the inclusion of habit and behavioral control explained an additional 2% of variance in the model. Commuters expected to travel by car at work were less likely to commute by bicycle in step 1 and 2. Similarly, expectations at home seem to be influencing the decision to use bicycle to work since it was significant for both steps. A negative effect was noted on the use of bicycle when respondents indicated 'Does not matter' for expectations at home. This did not have a plausible explanation related from our other sources of information yet, and has not been discussed in other papers (to the extent of our knowledge). Perceived behavioral control positively influences the chances to be cyclist. If commuters believe it is possible to travel by bicycle the whole journey from home to work, the likelihood to actually do it increases.

**Table 12** Being cyclist, subjective attributes as explanatory variables: binary logistic model results.

<i>Variables in the equation</i>	<i>Step 1</i>			<i>Step 2</i>		
	B	S.E.	Sig.	B	S.E.	Sig.
Attitudes (-15 to 15)	0.123	0.021	0.000**	0.022	0.026	0.400
Subjective norm at home (Bicycle)			0.000**			0.040**
Car	-2.112	0.555	0.000**	-0.806	0.612	0.187
Other	-1.744	0.385	0.000**	-0.594	0.424	0.161
Does not matter	-1.519	0.330	0.000**	-0.999	0.361	0.006**
Subjective norm at work (Bicycle)			0.002**			0.023**
Car	-1.904	0.605	0.002**	-1.490	0.622	0.017**
Other	-0.553	0.375	0.140	-0.160	0.395	0.686
Does not matter	0.340	0.325	0.295	0.533	0.351	0.129
Perceived behavioral control (1-5)				0.929	0.133	0.000**
Habit (0-4)				0.317	0.091	0.001**
Constant	-0.604	0.260	0.020**	-5.093	0.675	0.000**

Category in brackets is reference. Significance: \* P<0.10; \*\* P<0.05

Habit, as shown in our own descriptive analysis, had a positive effect for being cyclist. In other words, people who have intentions to use bicycle to travel for other purposes, have

more chances to cycle to work. Attitudes did not show to be significant for this model. However, it is suggested to observe table 10, to see the effect over various distances.

Difference in commuting to work by bicycle was also perceived during the interviews. There was a general perception (in despite of their background) that native-Dutch were more likely to be cyclists. Additionally, it could be identified more positive attitudes from native-Dutch employees, since it was also mention the feeling of independence and freedom.

*“So I think cycling is very a part of our culture and also something you ... like a basic need, you need to cycle, you have to...You must cycle it gives you more freedom, you can go independently to places. And of course, it’s fun, it is good for health.”*

-Rachel Brussen, Mobility Policy Manager at EUR.

As shown before, full time cyclist and part time cyclists did not show differences as contrasting as cyclists and non-cyclists commuters did. In table 13, few attributes were observed to be significant in predicting the frequency for bicycle commuting. In step 1 subjective norms and attitudes explained 13% of the total variance in the model. The expectation at home to commute to work by ‘Other’ mode was positively related to be part time cyclist. These results are comprehensible, if a cyclist is expected to travel by other mode apart from bicycle, then this will be more likely to alternate mode. Thus, cyclists had less chances of not being full time cyclist according to other’s expectations.

**Table 13** Full time cyclist and part-time cyclist, subjective attributes as explanatory variables: binary logistic model results.

<i>Variables in the equation</i>		<i>Step 1</i>			<i>Step 2</i>		
		B	S.E.	Sig.	B	S.E.	Sig.
Attitudes (-15 to 15)		-0.188	0.043	0.00**	-0.160	0.046	0.001**
Subjective norm at home	(Bicycle)			0.373			0.464
	Car	0.42	1.307	0.748	-1.847	1.882	0.326
	Other	1.36	0.813	0.095*	0.647	0.928	0.486
	Does not matter	-,183	0.513	0.722	-0.629	0.559	0.261
Subjective norm at work	(Bicycle)			0.254			0.249
	Car	1.102	1.549	0.477	-0.768	2.982	0.797
	Other	0.939	0.687	0.172	0.937	0.726	0.197
	Does not matter	0.730	0.464	0.116	0.808	0.483	0.094*
Perceived behavioral control (1-5)					-3.101	1.146	0.007**
Habit (0-4)					-0.161	0.161	0.317
Constant		1.000	0.464	0.03	16.660	5.698	0.003

Category in brackets is reference. Significance: \*\* P<0.05; \* P<0.10

In the step 2, the inclusion of perceived behavioral control, habit, and attitudes increased the explanatory ability in the model by 3%. ‘Does not matter’ expectations at work resulted to be significant. This was related with being part time cyclist, as mentioned in the last analysis, there is no proper explanation and there are no coincidental findings in other studies. Cyclists who perceived a higher behavioral control increased their likelihood to be full time cyclists. In contrast to the previous model predicting cyclists and non-cyclists, it was found that cyclists with higher attitudes towards bicycle had more chances to be full time cyclists.

#### *4.3.3 Ethnic background and length of residence affecting subjective individual attributes for commuting to work by bicycle*

This subsection presents a descriptive analysis of ethnic background and length of residence in The Netherlands in relation to the subjective attributes over various distances. First, the subjective attributes are studied in combination with ethnic background over various distances. Then the subjective individual attributes were analyzed by length of residence and commuter type.

##### *4.3.3.1 Ethnic background and commuting to work by bicycle*

In table 14, the subjective scores were split by distance and ethnicity. This was with the aim to analyze the subjective attributes that in turn might be influencing the decision to commute by bicycle ‘behind’ the ethnic background. In a general overview, the subjective individual attributes were similar for cyclists disregarding the ethnic background. In contrast, there is a uniform decrease in the subjective scores for non-cyclists in most of the attributes depending on distance (as shown before), but also by background.

Subjective norm for cyclists did not differ considerably or uniformly among different ethnicities. In contrast, non-cyclists’ subjective norm was uniformly diminished by distance as well as by ethnicity. Native-Dutch non-cyclists showed themselves more expected to travel by bicycle for all distances than Western and non-Western commuters. Being the same case for Western over non-Westerns commuters. The perceived behavioral control for cyclists was barely diminished by distances and regardless of ethnic background. In contrast, the non-cyclists perception of behavioral control was largely affected by distance and ethnicity. Habit appears to be similar for all cyclists. Nonetheless, for non-cyclists is uniformly diminished in short and middle distances, whereas for long distances it appears to be the roughly the same for all ethnicities. Thus, there are more important factors determining to commute by bicycle in long distances than habit. Attitudes for cyclists did not differ considerably by ethnicity. Yet, it is noted that native-Dutch non-cyclists are less affected than Westerns and non-Westerns non-cyclists, especially for middle distances.

The findings of the last quantitative analysis comparing cyclist and non-cyclists by ethnic background were similarly perceived during the interviews, since native-Dutch commuters

expressed themselves more positive towards bicycle for subjective attributes in general. This was in spite of the fact that they were non-cyclists.

*“I grew up thinking that you would need to do everything by bike, if it's possible you only travel by bike. You only travel by car if it's really necessary...If I lived closer to work or my work were closer to home, I would definitely take the bike, because I like that, but it's too far. But my natural way would be to go to work by bike.”*

-Courtney, Manager staff at ESM, EUR (non-cyclist)

From the last quotation is noted that habit was expressed by the desire to travel for different purposes by bicycle. There, distance was mentioned as a deterministic factor to choose a different mode to commute to work. Furthermore, attitudes towards bicycle appear to be more positive for native Dutch employees than for the other ethnic background employees, even for non-cyclists.

**Table 14** Subjective individual attributes and ethnic background by commuter type

	Commuter type					
	Cyclist			Non-cyclist		
	Distance kilometers			Distance kilometers		
	<5	05 to 10	>10	<5	05 to 10	>10
	Mean	Mean	Mean	Mean	Mean	Mean
Subjective norm						
Native Dutch	1.65	1.12	0.97	1.06	0.72	0.08
Western	1.47	1.00	1.00	0.83	0.63	0.02
Non-western	1.5	1.25	- <sup>a</sup>	1.18	0.54	0.1
Perceived behavioral control						
Native Dutch	4.99	4.84	4.35	4.86	4	1.74
Western	4.89	5.00	4.8	4.57	3.5	1.44
Non-western	4.88	4.75	- <sup>a</sup>	4.18	3.31	1.5
Habit						
Native Dutch	3.24	2.71	2.29	2.16	1.62	1.57
Western	2.79	3.29	1.4	2.07	1.38	1.6
Non-western	2.00	3.00	- <sup>a</sup>	1.41	0.62	1.7
Attitudes						
Native Dutch	10.52	9.58	6.59	9.20	4.87	1.23
Western	10.89	10.57	2.8	8.13	4.25	1.1
Non-western	10.13	11.5	- <sup>a</sup>	5.76	2.69	-0.8

a. Means generated by 3 or less cases were not considered for analyzes.

Subjective norms seem to be influencing cyclists for being FTC or PTC as shown in table 15. In all distances, subjective norm was higher for FTC. Nonetheless, when subjective norm of FTC and PTC is compared among the different ethnicities, there is not a clear tendency. It is remarkable to mention that the perception of behavioral control of native-Dutch FTCs was not affected by distance at all. The results were similar to the case of native-Dutch PTC. For other ethnic background employees was difficult to determine a tendency. In any case, it could be deducted that PBC was high for all cyclists, but not as high as native-Dutch cyclists. The use of bicycle for other purposes seemed to have an effect to determine the likelihood of frequency to commute by bicycle. It is also noticeable that FTCs' attitudes were scarcely affected by distance, whereas distance affects more evidently PTCs' attitudes.

**Table 15** Subjective individual attributes and ethnic background by commuter type

		Cyclist type					
		Full time cyclist			Part time cyclist		
		Distance kilometers			Distance kilometers		
		<5	05 to 10	>10	<5	05 to 10	>10
		Mean	Mean	Mean	Mean	Mean	Mean
Subjective norm							
	Native Dutch	1.66	1.3	1.82	1.63	0.8	0.57
	Western	1.62	1.4	- <sup>a</sup>	1.17	- <sup>a</sup>	0.67
	Non-western	1.2	- <sup>a</sup>	- <sup>a</sup>	2	- <sup>a</sup>	- <sup>a</sup>
Perceived behavioral control							
	Native Dutch	5	5	5	4.96	4.56	4.04
	Western	4.92	5	- <sup>a</sup>	4.83	- <sup>a</sup>	4.67
	Non-western	5	- <sup>a</sup>	- <sup>a</sup>	4.67	- <sup>a</sup>	- <sup>a</sup>
Habit							
	Native Dutch	3.26	3	3	3.21	2.2	1.96
	Western	3.08	3.2	- <sup>a</sup>	2.17	- <sup>a</sup>	0.67
	Non-western	2	- <sup>a</sup>	- <sup>a</sup>	2	- <sup>a</sup>	- <sup>a</sup>
Attitudes							
	Native Dutch	11.06	10.52	10.27	9.46	7.92	4.83
	Western	12.54	9.8	- <sup>a</sup>	7.33	- <sup>a</sup>	2.33
	Non-western	11.2	- <sup>a</sup>	- <sup>a</sup>	8.33	- <sup>a</sup>	- <sup>a</sup>

a. Means generated by 3 or less cases were not considered for analyzes.

#### 4.3.3.2 Length of residence in the Netherlands and subjective individual attributes

Regarding the analysis of length of residence in The Netherlands, the scores were split by commuter type and year of immigration. In the analysis, Dutch born respondents were also

included as a reference. The aim of this particular analysis was to revise the differences of the subjective attributes in relation to length of residence in The Netherlands. In a previous subsection (Demographic attributes and cycling), it was observed that there was a significant difference on year of immigration and being cyclists or not. Thus, a deeper analysis may allow us to observe if there was a change on subjective individual attributes across the time when residing in The Netherlands.

In Table 16, descriptive statistics are shown by commuter type and cyclist type in combination to length of residence in The Netherlands. In the commuter type columns, there is a uniform change in the odd of cyclists according to the length of residence. In the case of the cyclist type, there was a change in the odd when employees who immigrate 5 years ago or less are compared with the ones who moved 15 years ago or more. However, there was not a significant difference in the statistical tests neither for commuter type nor cyclist type  $\chi^2(3, N = 842) = 0.94, p = .82$  and  $\chi^2(3, N = 223) = 5.62, p = .13$ , respectively.

**Table 16** Commuter type and year of immigration

		Commuter type (842)			Cyclists type (223)		
		C	NC	Total	FTC	PTC	Total
		(%)	(%)	n	(%)	(%)	n
Year of immigration	2014-2010	22.62	77.38	84	47.37	52.63	19
	2009-2000	24.00	76	25	33.33	66.67	6
	Pre 2000	29.27	70.73	41	83.33	16.67	12
	NL born	26.88	73.12	692	59.14	40.86	186

In the first two columns of Table 17 cyclists and non-cyclists (commuter type) can be found. In general, cyclists' scores for subjective attributes were higher in all cases compared to non-cyclists. In the next two columns, FTC and PTC were compared. It was found that in most of the cases the FTC scored higher than the PTC, but not as contrasting as in the commuters' comparison. These results were expected, as it was similarly shown in the previous subsection. Nevertheless, the aim of this particular analysis was to compare the subjective attributes by length of residence that may indirectly affect the decision to commute by bicycle.

When cyclists and non-cyclists were compared, the subjective norm for the respondents who immigrate 5 or less years ago was lower than those who immigrated 15 or more years ago, being statistically significant  $F(3, 219) = 2.20, p = .088$ . In all the following attributes there was a similar variance as the one described for subjective norm according to the length of residence, although there was no statistical significance.

It is remarkable to mention that an opposite effect for non-cyclists was found. When non-cyclists were analyzed, it was found that people who immigrated 5 or less years ago showed

higher scores compared to the people who moved to The Netherlands 15 or more years ago for all attributes. The mean of the attributes were tested using One-way Anova, finding that there was significant difference for all non-cyclists. Attitudes were especially remarkable, for cyclists there was practically no difference in the scores, yet for non-cyclists there was a very important decrease across the years  $F(3, 618) = 4.20, p = .006$ . In comparison with people born in the Netherlands, cyclists scored similarly (or in some cases higher). In contrast, non-cyclist scored much lower in all the cases than commuters that were born in The Netherlands.

**Table 17** Subjective attributes and year of immigration

	Commuter type (842)		Cyclist type (218)	
	Cyclist	Non-cyclist	Full time cyclist	Part time cyclist
	Mean	Mean	Mean	Mean
Subjective norm				
2014-2010	<b>1</b>	<b>0.6</b>	1.22	0.8
2009-2000	<b>1.17</b>	<b>0.53</b>	1	1.25
Pre 2000	<b>1.92</b>	<b>0.14</b>	1.9	2
NL born	<b>1.3</b>	<b>0.27</b>	1.51	0.99
Perceived behavioral control				
2014-2010	4.74	<b>3.48</b>	<b>4.89</b>	4.6
2009-2000	4.83	<b>3.11</b>	<b>5</b>	4.75
Pre 2000	5	<b>2.41</b>	<b>5</b>	5
NL born	4.8	<b>2.36</b>	<b>5</b>	4.51
Habit				
2014-2010	2.68	<b>1.88</b>	2.67	2.7
2009-2000	2.33	<b>1.32</b>	3.5	1.75
Pre 2000	2.83	<b>1.17</b>	2.8	3
NL born	2.83	<b>1.62</b>	3.13	2.39
Attitudes				
2014-2010	10	<b>5.03</b>	11.89	8.3
2009-2000	9.33	<b>3.26</b>	11	8.5
Pre 2000	9.83	<b>0.59</b>	10.1	8.5
NL born	9.31	<b>2.55</b>	10.77	7.18

1) One-way Anova showing significant differences at  $p < 0.05$  between year of immigration and subjective attributes scores in similar distances.

FTC and PTC differed less for subjective attributes than in the comparison between cyclists and non-cyclists. For almost all the cases there was an increase in the scores for subjective



attributes when respondents who immigrated 5 or less years ago were compared with employees who immigrated more than 15 years ago. This tendency could be observed even for the global cyclists in column 1 of Table 17. When FTC were compared each other, the scores were similar. However, the scores of PTC who immigrated 15 or more years ago were always higher when compared to PTCs that were born in The Netherlands. All attributes were tested to identify if there was statistical difference in the mean scores of cyclists according to their length of residence. Nonetheless, only the FTCs' perceived behavioral control was significant  $F(3, 130) = 4.93, p < .05$ .

From the interviews, differences in attitudes with respect to sense of safety could be identified. Furthermore, there was a general perception that foreign commuters changed their travel behavior across the time, although they rarely could remember specific cases of change in behavior.

*"The longer you live here, and the longer you see it's common everybody cycles...and then of course if you can if you are willing to learn, more and more foreigners will ride the bike...I think the longer you live the chance you cycle will be bigger as well. Some times I see that people from abroad and...not because they are like German, or American or whatever...They are more willing to wear a helmet. If I see people with helmets on the bike I think oh... Or they have had an accident before and bump their heads or they are maybe from abroad and a bit afraid because they were raised by all those cars passing by and just to feel safe, which is of course very good they wear helmet. I know like Germans, in Germany the cyclists are wearing more often the helmets than Dutch do."*

-Rachel Brussen, Mobility Policy Manager at EUR.

From the last comment, it can be said that Dutch born people have more positive attitudes with regard of bicycle traffic safety, but more positive attitudes could also be perceived in other aspects. A relation from previous experiences could also be noted as a factor to affect attitudes. In this case a traffic accident was mentioned as example to affect present attitudes, and possibly current behavior.

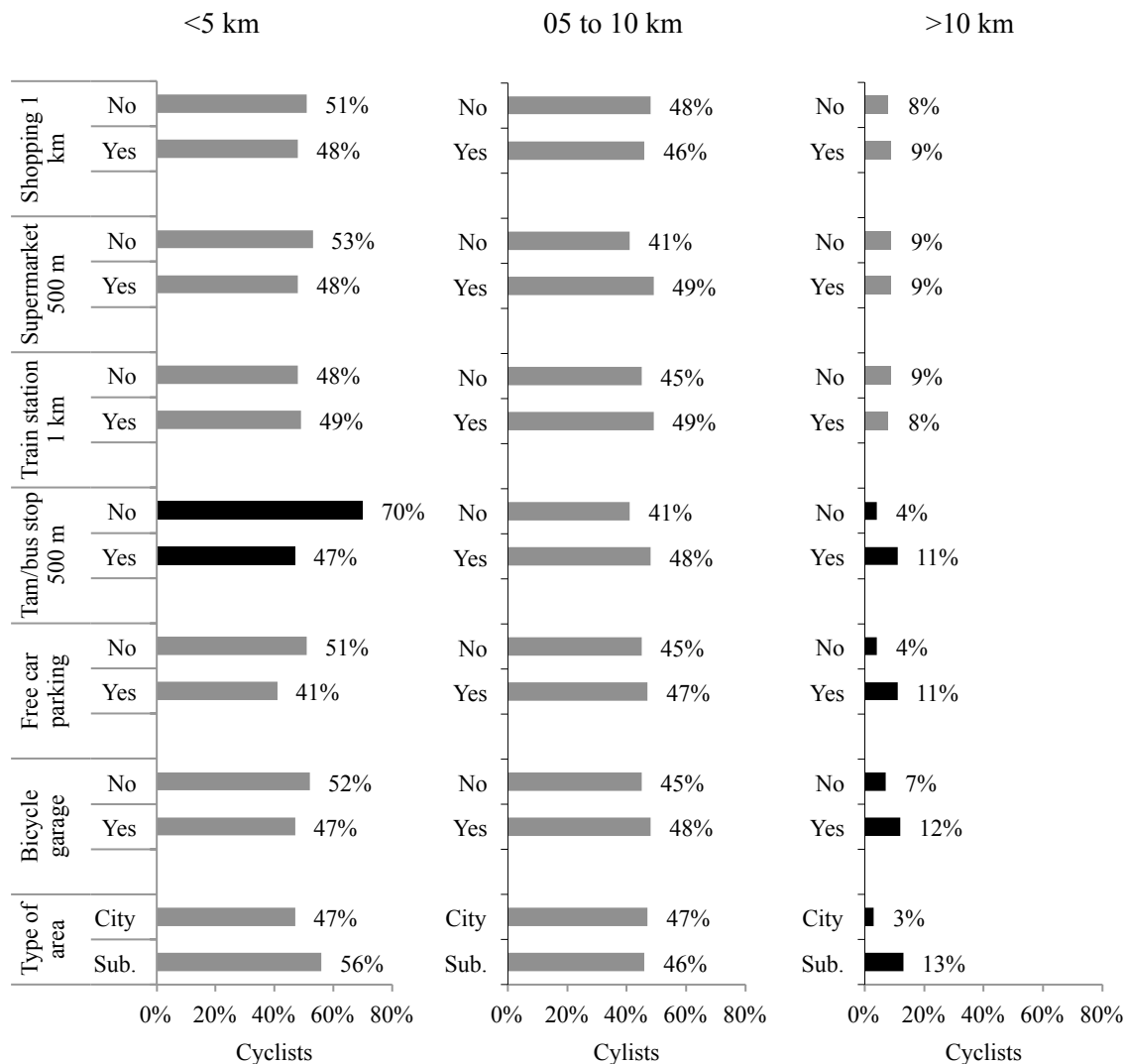
#### 4.3.4 Residential area and commuting by bicycle to work

In the following subsection spatial factors of commuters' residential area were analyzed with the aim to identify possible relations with bicycle use for commuting to work. First it is presented a descriptive analysis of the frequencies, comparing cyclists and non-cyclists with all the residential location attributes collected from the survey, as shown in Figure 5. In short distances there were two spatial attributes that made the proportion of non-cyclists differ. Free car parking appears to influence the odd of cyclists, although this was not statistically significant. The other spatial attribute that in the descriptive statistics apparently influences the odd of cyclists was the existence of bus/tram stop within 500m. This factor was the only one significant for short distances  $\chi^2(1, N = 207) = 3.99, p < .05$ . This finding has been

65

already noted in some studies in The Netherlands as influential for decreasing the use of bicycle (see Dieleman et al. 1999; Susilo & Maat 2007; Rietveld & Daniel 2004). For middle distances it is observed a uniform odd of cyclists for all attributes, actually any of the characteristics was significant in the Chi Square tests.

**Figure 5** Cyclists and residential characteristics over various commuting distances

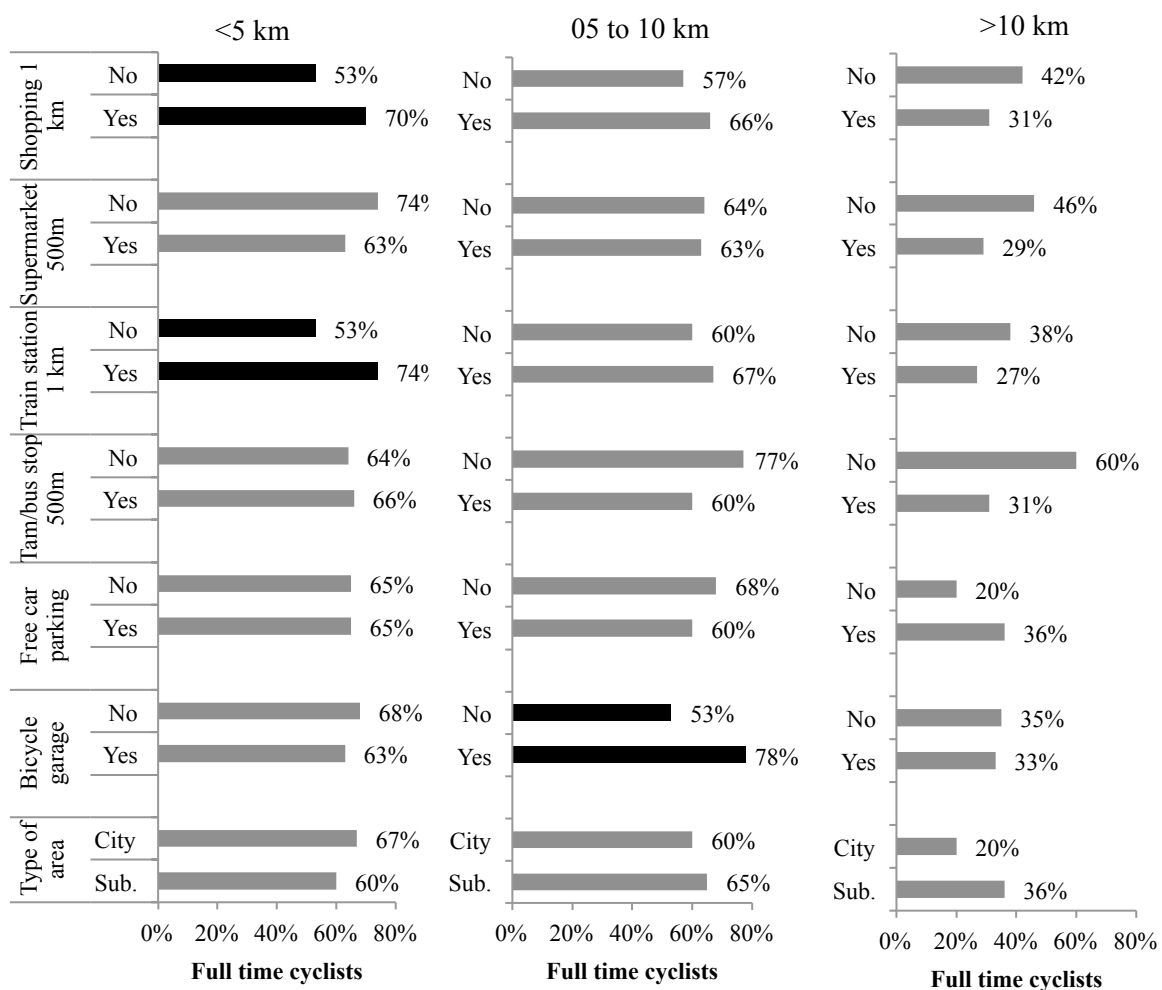


1) Bars in black showing Chi-square test significant differences at  $p < 0.05$  between full time cyclists and part time cyclists. 2) The proportion not showed in bars corresponds to non-cyclists.

In contrast to short and middle distances, in long distances there were various spatial attributes of the residential environment that appeared to be significant. In suburban and rural areas there were more cyclists than in the city or downtown areas, this difference was significant in the tests for long distances  $\chi^2(1, N = 460) = 13.71, p < .05$ . This might be

because in more urbanized areas the public transport not only has more presence but might also offer higher frequencies in the service. The presence of bicycle garage inside the building was also significant in the analysis for long distances  $\chi^2(1, N = 460) = 3.79, p = .052$ . This finding might be related to the fact that if commuters have strong preferences for bicycle, they might arrange or chose a place with bicycle storage. Free car parking was also significant for being cyclist  $\chi^2(1, N = 460) = 6.39, p = .01$ . Curiously, the ones who reported to have free car parking space showed more likely to be cyclists, there is not plausible explanation for this cases yet. Lastly, the presence of bus or tram stops showed to be positively related with cyclists,  $\chi^2(1, N = 460) = 4.74, p < .05$ , equally related to the type of residential area discussed above.

**Figure 6** Full time cyclists and residential characteristics over various commuting distances



1) Bars in black showing Chi-square test significant differences at  $p < 0.05$  between full time cyclists and part time cyclists. 2) The proportion not showed in bars corresponds to part time cyclists.

In the case of frequency of commuting by bicycle to work, there were found more differences in short and middle distances than in the previous analysis for cyclists and non-cyclists, as shown in Figure 6. For short distances, the presence of train station within 1 km of their residential area was significant for being FTC as well as the presence of shopping within 1 km  $\chi^2(1, N = 101) = 4.65, p < .05$  and  $\chi^2(1, N = 101) = 2.72, p < .10$ , respectively. The presence of train station within 1 km and being FTC in short distances could be related to the fact that cyclists that live in short distances from their work are located in more urbanized areas, and for short distances it is more probably to be FTC than PTC. For the case of shopping within 1km, could be reasoned a similar approach. Cyclists that live in urban areas (possibly related with more commerce) close to their work location have higher possibilities to be FTC. Lastly, for middle distance, the presence of bicycle garage inside the building is significant for being FTC,  $\chi^2(1, N = 101) = 5.22, p < .05$ . This, as discussed above, can be related to the fact that commuters that are more positive to bicycle might adapt or get a place with a bicycle garage inside the building.

## Chapter 5: Conclusions and recommendations

In the last two decades there has been a great focus on the efforts to decrease the motorization rates globally due to various environmental, economical, and social reasons at individual and social levels. In these efforts, commuting by bicycle has been recognized as an important component for improving mobility systems in research and policies. Travel behavior has been largely studied from different approaches. There is an important amount of literature studying the influence of objective factors, such as built environment and demographic attributes over travel behavior. In the same way, motorized modes are the ones that have received most of the attention in the process to better understand behavior. To the date, bicycle for commuting to work have received little attention in research in despite of the global efforts to encourage it as a regular mode of transport. In addition, ‘soft’ factors, such as demographic and physiological, have received little attention in the existent bicycle literature. Even though recent research have shown that those factors are playing an important role next to the ‘hard’ factors, as also shown in this research (Van Acker et al. 2010; Heinen et al. 2011; Pelzer 2010; Klinger et al. 2013).

In order to study the influence over bicycle commuting, two approaches that include objective and subjective factors were combined. Objective factors include demographic characteristics and residential characteristic of commuters. Subjective factors, on the other hand, are studied from a social-cognitive perspective. The Theory of Plan Behavior (Ajzen 1991; Triandis 1980) was reviewed to identify the extent of influence of attitudes, subjective norms, and perceived behavioral control, plus habit. In the analysis, the subjective factors were combined with ethnicity background and length residence in the Netherlands. This might help to better understand the influence of the contexts. For this research, an online survey and face-to-face interviews were conducted in main institutions of the Erasmus MC and the Erasmus University of Rotterdam, The Netherlands.

From of our own data it was noted that about half of the employees commuted by bicycle at least occasionally in short and middle distances (49% and 46% respectively. Few respondents commuted by bicycle to work for long distances (9%). The general results of our research regarding the subjective individual attributes viz. the significance in ethnic background, some characteristics of the residential environment (more in particular the relation with public transport), and the characteristics of the daily commute for employees were in line with the expectations and literature, as noted in particular when the results were presented in Chapter 4. The interviews also helped to confirm the quantitative information and to better interpret the results from the survey.

With respect to demographic characteristics, ethnicity background and year of immigration showed to be significant for being cyclist or not, as literature suggest (de Bruijn et al. 2005; Bere et al. 2008). Yet ethnicity background and length of residence did not appear significant to determine cycling frequency FTC or PTC. It was shown that females are more distance sensitive than males. This specific finding is coincident with Heinen et al., (2012).

From the quantitative data and interviews, it was confirmed that there is clearly defined the subjective norm for commuting to work. It was found that for short and middle distances, there is a high level of expectancy to travel by bicycle, at home and work environment. For all subjective attributes there were significant differences between cyclists and non-cyclists. Distance affected more non-cyclists than cyclists, as shown by the subjective attributes. Cyclists and non-cyclists had closer differences in shorter distances, but strongly differed in middle and long distances. The differences between full time cyclists and part time cyclists with respect to the subjective norms were not as contrasting as it was with cyclists and non-cyclists.

Regarding differences in length of residence, there was again a general difference in subjective scores between cyclist and non-cyclists. An increase in the odd of cyclists in relation with longer time of residence in The Netherlands was observed. In the same way, there was an increase of full-time cyclists when the length of residence was longer, although there was not statistical significance. Higher scores for subjective individual attributes were observed for cyclists with longer residence in The Netherlands. Those scores were similar to the score levels of Dutch born commuters. Nevertheless, something that was not expected and it has not been reported in the literature yet (to the extent of our knowledge) is that non-cyclists showed lower scores for subjective attributes with longer time of residence. Non-cyclists who immigrate to the Netherlands 5 or less years ago showed higher habit for bicycle, more positive attitudes, perceived higher behavioral control and were more expected to commute by bicycle than people who immigrate 15 or more years ago.

For the present research the following limitations were identified: First, the survey did not collected information about physical limitations or particular health conditions that might affect the mode of transport used by these users. In the same sense, the data that the survey collected with regard of the number of days a week that the respondent traveled to their place of work did not make distinction of “1 day or less”, it is aggregated in one response and cannot be differentiated. Being the same case for the option “5 or more”. Additionally, commuters traveling from other countries apart from The Netherlands could not be captured in the questionnaire. Nonetheless, some of those limitations were covered during the personal interviews.

During the interviews none of the participants was aware of commuters that traveled in a particular mode due to a physical limitation. Thus, this fact might be interpreted that this condition is not substantially influencing our results. Even though it is not discarded that such cases exist, and attention should be paid to support accessible transport. The frequency of commuting to their place of work was also discussed during the interviews. It was found that employees generally attend their place of work 4 or 5 days a week. Thus, the limitations discussed do not affect any of the results here presented. In this research, additional quantitative information regarding employees commuting from abroad is missing. It is suggested to include such travelers' information in further research. This suggestion applies

specially for high skilled labor clusters, which might attract commuters from longer distances, as shown in the results.

The main source of information was the self-reported by employees from the questionnaire and interviews. Therefore, the present results should be taken with caution. Even though reliability was tested with Chronbach's Alpha (reliability will be discussed later). In order to reduce possible errors, commuting distance was deducted from secondary data based on location of home and place of work reported in the questionnaire. This was because distance might be perceived differently from users, thus difficult to report it accurately. As part of these limitations, residential characteristics were considered from the self-reported information too. Due to the limitation in time and resources built environment proxies were used. Nonetheless, residential environment attributes used here are related to the specific built environment characteristic and generally did not show to be determinant.

Some issues that were not considered previous the fieldwork came out during the interviews as influential for determining cycling levels. First, residential self-selection emerged during the interviews. This is related to the fact that people may have chosen their residential location in function to the preferred mode of transport, which might decrease the strength of direct influence of residential built environment over choosing bicycle for commuting. Another issue that was important for employees and was not considered in the main source of information was the car parking at the place of work. Some contrasting comments were made in relation to the paid parking. Erasmus MC employees expressed that the prices of the car parking were directly influencing them to not choose car. Whereas in the EUR central campus, where the prices remain relatively low, car commuters interviewed expressed not to be affected by this fact. Thus, this issue should receive more attention in further research.

Regarding reliability, Chronbach's alpha was used in SPSS to determine the reliability of attitudes and Kuder-Richardson-20 (KR-20) for the subjective norm measurements. The subjective norms measurements were analyzed using the KR-20, since it was constructed by 2 dichotomous items. In the analysis, subjective norm measurements resulted high reliable ( $\alpha = .85$ ). For measuring attitudes were considered 5 items in a continuous scale. Thus, it was appropriate to use the Chronbach's alpha, that in the analysis was at an acceptable level ( $\alpha = .70$ ), according to DeVellis (2003).

As general conclusions, it was confirmed that not only distance is playing a role to determine the decision to commute by bicycle, but also other individual attributes (subjective and objective) are affecting the decision to choose bicycle to commute to work. Nevertheless, the fact of distance should be taken with caution, since in the interviews came out the fact of residential self-selection. Thus the relation can be result of people who is interested in using bicycle to live closer to their place of work in a 'cycling distance', as expressed by employees. Hence, further research is needed in this specific issue.

Regarding the general split of modes, it was observed that the cycling levels in comparison to the national average remain practically the same on average for the EUR and the Erasmus MC. What was noteworthy is the fact that the car use to commute to work is far lower compared to the national data. Additionally, commuting by the mix mode of public transport and bicycle was much higher on average for both institutions compared to the proportions of other employees reported by Heinen et al. (2012). The following interpretation emerged from these facts. On one hand, commuters that usually travel by car may indeed have switched to public transport. On the other hand, a significant correlation was found between the commuters that use public transport subsidy and not being cyclist. Thus, it is advisable to locate the subsidies for commuters where the subsidized public transport does not represent a competition for commuting by bicycle. Otherwise, incentives to discourage car use might be discouraging the use of bicycle at the same time.

Since spatial factors showed to be significant overall for long distances, this might mean that the possibilities or likelihood to cycle is reduced by distance, as shown here and other studies. Thus, the presence of public transport, or other spatial characteristics might be playing a major role for the decision to commute by bicycle than they do in short distances. As shown, demographic attributes are more significant for short and long distances, what can be understood as a counterpart of the factors that encourage the decision to commuter by bicycle.

Bicycle habit, as described in this research, can be understood with a bidirectional effect. Either other purposes influence more cycling to work or cycling to work influences intentions to use bicycle for other purposes, as shown in previous research in the Netherlands (Kroesen & Handy 2013). In that study, it was concluded that encouraging commuting to work by bicycle would simultaneously improved cycling levels for different purposes. Our research was partially confirmed by those findings. It was shown that habit, measured as the intention to use bicycle for different purposes positively influenced the likelihood to use bicycle for commuting, and furthermore to use it more frequent. More attention might be suggested in the direction of the influence in order to confirm the focus on commuting to work.

Commuters with more positive attitudes towards bicycle were more likely to be full time cyclists, as already observed in previous descriptive analysis. These findings are coincident with two different studies. One including young students for commuting to school in the Netherlands (de Bruijn et al. 2005), and other focused on employees for commuting to work (Heinen et al. 2011). What might indicate that demographic conditions or ‘distal’ factors are playing a secondary role, and point out attitudes to a stronger influence to use bicycle.

Complementary to the findings by other studies that have discussed the relation with ethnicity and cycling behavior, this research might add that demographic factors are influencing cycling behavior not merely by the fact of being non-native Dutch, for example. Attitudes, habit, perceived behavioral control, and subjective norms might be ‘behind’ certain demographic characteristics and are determining to an important extent the use bicycle to



commute. It was observed that once commuters are cyclists, they behave similarly to other cyclists regardless of the ethnic background or length of residence in The Netherlands. Thus, it might be suggested that beyond demographic characteristics subjective attributes are playing a major role in the decision to choose bicycle to work. This particular fact should be further researched to find more detailed information of cyclists.

In relation to the length of residence, the findings presented above might be also related to previous experiences of employees in their former country of residence, as hastily mentioned in the interviews. In other words, people who already used bicycle reinforced their individual subjective attributes towards bicycle, whereas with non-cyclists occurred the opposite. This also points out to further investigation since the data collected is not concrete enough to confirm what hypothesized here. Longitudinal data regarding length of residence might give more accurate information in the evolution of subjective attributes and actual behavior.

The findings of this research confirm that ‘soft’ attributes are playing an important role to determine commuting by bicycle. If policy managers and governments wish to improve cycling levels, they should put more attention into this dimension. It is also necessary that further research and policies differentiate commuters’ type and cyclists frequencies in order to more adequately propose measures that fit to specific requirements. Generic policies to attract more cyclists does not always encourage existing cyclist to increase their frequency, nor preserve full time cyclists into the same routine. This does not mean absence of infrastructure, but that both dimensions should be considered to increase cycling levels.

## Bibliography

- Van Acker, V., Van Wee, B. & Witlox, F., 2010. When Transport Geography Meets Social Psychology: Toward a Conceptual Model of Travel Behaviour. *Transport Reviews*, 30(2), pp.219–240. Available at: <http://www.tandfonline.com/doi/abs/10.1080/01441640902943453> [Accessed July 17, 2014].
- Ajzen, I., 2005. *Attitudes, personality and behavior* 2nd ed., Berkshire: McGraw-Hill International. Available at: <http://books.google.com/books?id=dmJ9EGEy0ZYC>.
- Ajzen, I., 1991. The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, 50, pp.179–211.
- Aldred, R. & Jungnickel, K., 2014. Why culture matters for transport policy: the case of cycling in the UK. *Journal of Transport Geography*, 34, pp.78–87. Available at: <http://linkinghub.elsevier.com/retrieve/pii/S0966692313002202> [Accessed May 1, 2014].
- Amiri, M. & Sadeghpour, F., 2013. Cycling characteristics in cities with cold weather. *Sustainable Cities and Society*. Available at: <http://linkinghub.elsevier.com/retrieve/pii/S2210670713000784> [Accessed May 6, 2014].
- Anderson, W.P., Kanaroglou, P.S. & Miller, E.J., 1996. Urban Form, Energy and the Environment: A Review of Issues, Evidence and Policy. *Urban Studies*, 33, pp.7–35. Available at: <http://usj.sagepub.com/content/33/1/7.abstract>.
- Angel, S. et al., 2011. *Making room for a planet of cities*, Lincoln Institute of Land Policy. Available at: [http://community-wealth.org/\\_pdfs/articles-publications/outside-us/report-angel-et-al.pdf](http://community-wealth.org/_pdfs/articles-publications/outside-us/report-angel-et-al.pdf) [Accessed March 25, 2014].
- Angel, S., 2012. The Sustainable Densities Proposition. , pp.71–79.
- Banister, D., 2008. The sustainable mobility paradigm. *Transport Policy*, 15(2), pp.73–80. Available at: <http://linkinghub.elsevier.com/retrieve/pii/S0967070X07000820> [Accessed March 25, 2014].
- Bere, E. et al., 2008. Socio-demographic factors as correlates of active commuting to school in Rotterdam, the Netherlands. *Preventive medicine*, 47(4), pp.412–6. Available at: <http://www.ncbi.nlm.nih.gov/pubmed/18657568> [Accessed May 7, 2014].
- Boarnet, M.G. et al., 2011. Land use and vehicle miles of travel in the climate change debate: Getting smarter than your average bear. In Y.-H. Hong & G. K. Ingram, eds. *Climate Change and Land Policies*. Bolton, MA: Puritan Press Inc., pp. 151–187. Available at: [https://www.lincolnst.edu/pubs/2038\\_Land-Use-and-Vehicle-Miles-of-Travel-in-the-Climate-Change-Debate](https://www.lincolnst.edu/pubs/2038_Land-Use-and-Vehicle-Miles-of-Travel-in-the-Climate-Change-Debate).

- Bonham, J. & Koth, B., 2010. Universities and the cycling culture. *Transportation Research Part D: Transport and Environment*, 15(2), pp.94–102. Available at: <http://linkinghub.elsevier.com/retrieve/pii/S136192090900114X> [Accessed May 7, 2014].
- De Bruijn, G.-J. et al., 2005. Determinants of adolescent bicycle use for transportation and snacking behavior. *Preventive medicine*, 40(6), pp.658–67. Available at: <http://www.ncbi.nlm.nih.gov/pubmed/15850862> [Accessed July 10, 2014].
- Buehler, R., 2011. Determinants of transport mode choice: a comparison of Germany and the USA. *Journal of Transport Geography*, 19(4), pp.644–657. Available at: <http://linkinghub.elsevier.com/retrieve/pii/S0966692310001171> [Accessed March 21, 2014].
- Buehler, R. & Pucher, J., 2012. Big city cycling in Europe, North America, and Australia. In *City cycling*. Cambridge, MA: MIT Press, pp. 287–318.
- Cervero, R., 2002. Built environments and mode choice: toward a normative framework. *Transportation Research Part D: Transport and Environment*, 7(4), pp.265–284. Available at: <http://linkinghub.elsevier.com/retrieve/pii/S1361920901000244>.
- Cervero, R. & Duncan, M., 2003. Walking, bicycling, and urban landscapes: evidence from the San Francisco Bay Area. *American journal of public health*, 93(9), pp.1478–1483. Available at: <http://ajph.aphapublications.org/doi/abs/10.2105/AJPH.93.9.1478> [Accessed April 23, 2014].
- Cervero, R. & Ewing, R., 2010. Travel and the Built Environment. A Meta-Analysis. *Journal of the American Planning Association*, 76(April 2014), pp.37–41. Available at: <http://www.tandfonline.com/doi/pdf/10.1080/01944367908977008> [Accessed April 17, 2014].
- Cervero, R. & Kockelman, K., 1997. Travel demand and the 3Ds: Density, diversity, and design. *Transportation Research Part D: Transport and Environment*, 2(3), pp.199–219.
- Cervero, R. & Radisch, C., 1996. Travel choices in pedestrian versus automobile oriented neighborhoods. *Transport Policy*, 3(3), pp.127–141. Available at: <http://linkinghub.elsevier.com/retrieve/pii/0967070X96000169>.
- Christensen, J., 2013. On Compact Cities. *Lincoln Planning Review*, 5(1), pp.37–42.
- DeVellis, R.F., 2003. *Scale Development: Theory and Applications* 2nd ed., London: Sage Publications.
- Dieleman, F.M., Dijst, M. & Burghouwt, G., 2002. Urban form and travel behaviour: micro-level household attributes and residential context. *Urban Studies Journal Foundation*, 39(3), pp.507–527. Available at: <http://usj.sagepub.com/content/39/3/507.short> [Accessed April 16, 2014].

- Dieleman, F.M., Dijst, M.J. & Spit, T., 1999. Planning the compact city: The randstad Holland experience. *European Planning Studies*, 7(5), pp.605–621. Available at: <http://www.tandfonline.com/doi/abs/10.1080/09654319908720541> [Accessed April 16, 2014].
- Duncan, D.T. et al., 2012. Validation of Walk Scores and Transit Scores for estimating neighborhood walkability and transit availability: a small-area analysis. *GeoJournal*, 78(2), pp.407–416. Available at: <http://link.springer.com/10.1007/s10708-011-9444-4> [Accessed April 9, 2014].
- Erasmus University of Rotterdam, 2014. Official webpage. Available at: <http://www.eur.nl/>.
- Ewing, R., Pendall, R. & Chen, D., 2003. Measuring sprawl and its transportation impacts. *Transportation Research Record: Journal of the Transportation Research Board*, 1831(03), pp.175–183. Available at: <http://trb.metapress.com/index/a7926m4v4q072985.pdf> [Accessed April 30, 2014].
- Fotel, T., 2006. Space, power, and mobility: car traffic as a controversial issue in neighbourhood regeneration. *Environment and Planning A*, 38(4), pp.733–748. Available at: <http://www.envplan.com/abstract.cgi?id=a36111> [Accessed March 25, 2014].
- Haider, M., Kerr, K. & Badami, M., 2013. Does Commuting Cause Stress? The Public Health Implications of Traffic Congestion. *Social Science Research Network Electronic Journal*, pp.1–18. Available at: <http://www.ssrn.com/abstract=2305010>.
- Handy, S., 1996. Methodologies for exploring the link between urban form and travel behavior. *Transportation Research Part D: Transport and Environment*, 1(2), pp.151–165. Available at: <http://linkinghub.elsevier.com/retrieve/pii/S1361920996000107>.
- Hartmann, D.L., Tank, A.M.G.K. & Rusticucci, M., 2013. IPCC Fifth Assessment Report, Climatic Change 2013: The Physical Science Basis. *IPCC*, AR5, pp.31 – 39.
- Heinen, E., 2011. *Bicycle commuting*, Amsterdam: IOS Press BV.
- Heinen, E. & Maat, K., 2012. Are Longitudinal Data Unavoidable? Measuring Variation in Bicycle Mode Choice. *Transportation Research Record*, 2314(1), pp.72–80. Available at: <Go to ISI>://WOS:000315063300010.
- Heinen, E., Maat, K. & Wee, B., 2012. The effect of work-related factors on the bicycle commute mode choice in the Netherlands. *Transportation*, 40(1), pp.23–43. Available at: <http://link.springer.com/10.1007/s11116-012-9399-4> [Accessed April 29, 2014].
- Heinen, E., Maat, K. & Wee, B. Van, 2011. The role of attitudes toward characteristics of bicycle commuting on the choice to cycle to work over various distances. *Transportation Research Part D: Transport and Environment*, 16(2), pp.102–109.

Available at: <http://linkinghub.elsevier.com/retrieve/pii/S1361920910001306> [Accessed April 29, 2014].

- Heinen, E., van Wee, B. & Maat, K., 2010. Commuting by Bicycle: An Overview of the Literature. *Transport Reviews*, 30(1), pp.59–96. Available at: <http://www.tandfonline.com/doi/abs/10.1080/01441640903187001> [Accessed April 29, 2014].
- IPCC, 2014. Chapter 8: Transport. In *Working Group III - Mitigation of Climate Change*. p. 117.
- Kenworthy, J.R. & Laube, F.B., 1996. Automobile dependence in cities: An international comparison of urban transport and land use patterns with implications for sustainability. *Environmental Impact Assessment Review*, 16(4-6), pp.279–308. Available at: <http://linkinghub.elsevier.com/retrieve/pii/S0195925596000236>.
- Klinger, T., Kenworthy, J.R. & Lanzendorf, M., 2013. Dimensions of urban mobility cultures – a comparison of German cities. *Journal of Transport Geography*, 31, pp.18–29. Available at: <http://linkinghub.elsevier.com/retrieve/pii/S0966692313000793> [Accessed May 1, 2014].
- Kroesen, M. & Handy, S., 2013. The relation between bicycle commuting and non-work cycling: results from a mobility panel. *Transportation*, 41(3), pp.507–527. Available at: <http://link.springer.com/10.1007/s11116-013-9491-4> [Accessed May 15, 2014].
- Lubian, D., 2010. Measuring attitudes: Using branching and numerical scales. *Proceedings of the Survey Research Methods Section, American Statistical Association*, pp.6135–6149. Available at: <https://www.amstat.org/Sections/Srms/Proceedings/y2010/Files/400133.pdf> [Accessed May 16, 2014].
- Ministry of Transport Public Works and Water Management, 2010. *Mobiliteitsbalans 2010*, Den Haag, The Netherlands.
- Mokhtarian, P.L. & Cao, X., 2008. Examining the impacts of residential self-selection on travel behavior: A focus on methodologies. *Transportation Research Part B: Methodological*, 42(3), pp.204–228. Available at: <http://linkinghub.elsevier.com/retrieve/pii/S0191261507000744> [Accessed July 9, 2014].
- Morelli, V.G., Rontos, K. & Salvati, L., 2014. Between suburbanisation and re-urbanisation: revisiting the urban life cycle in a Mediterranean compact city. *Urban Research & Practice*, 7(1), pp.74–88. Available at: <http://www.tandfonline.com/doi/abs/10.1080/17535069.2014.885744> [Accessed April 16, 2014].

- Nelson, A.C., Sanchez, T.W. & Dawkins, C.J., 2004. The effect of urban containment and mandatory housing elements on racial segregation in US metropolitan areas, 1990-2000. *Journal of Urban Affairs*, 26(3), pp.339–350. Available at: <Go to ISI>://WOS:000223033500004.
- Newman, P., Beatly, T. & Boyer, H., 2009. *Resilient Cities: Responding to Peak Oil and Climate Change*, Washington, D.C.: Island Press.
- Newman, P. & Kenworthy, J.R., 1999. Sustainability and Cities: Overcoming automobile dependence. In *Sustainability and Cities: Overcoming automobile dependence*. Washington, D.C.: Island Press, p. 442. Available at: [http://www.worldscientific.com/doi/pdf/10.1142/9789812775290\\_fmatter](http://www.worldscientific.com/doi/pdf/10.1142/9789812775290_fmatter) [Accessed April 17, 2014].
- Nordback, K., 2014. Measuring Traffic Reduction from Bicycle Commuting. *Transportation Research Board 93rd Annual Meeting*, 14-4428. Available at: <http://trid.trb.org/view.aspx?id=1289374> [Accessed May 15, 2014].
- Passafaro, P. et al., 2014. The bicycle and the city: Desires and emotions versus attitudes, habits and norms. *Journal of Environmental Psychology*, 38, pp.76–83. Available at: <http://linkinghub.elsevier.com/retrieve/pii/S0272494413001072> [Accessed April 29, 2014].
- Pelzer, P., 2010. Bicycling as a Way of Life : A Comparative Case Study of Bicycle Culture in Portland , OR and Amsterdam. , (7th Cycling and Society Symposium Oxford 6th September 2010), pp.1–13.
- Pucher, J. et al., 2012. Cycling in megacities: London, Paris, New York, and Tokyo. In R. Buehler & J. Pucher, eds. *City cycling*. Cambridge, MA: MIT Press, pp. 319–346.
- Pucher, J. & Buehler, R., 2008. Making Cycling Irresistible: Lessons from The Netherlands, Denmark and Germany. *Transport Reviews*, 28(4), pp.495–528. Available at: <http://www.tandfonline.com/doi/abs/10.1080/01441640701806612> [Accessed March 20, 2014].
- Pucher, J., Dill, J. & Handy, S., 2010. Infrastructure, programs, and policies to increase bicycling: an international review. *Preventive medicine*, 50, pp.S106–25. Available at: <http://www.ncbi.nlm.nih.gov/pubmed/19765610> [Accessed May 2, 2014].
- Rietveld, P. & Daniel, V., 2004. Determinants of bicycle use: do municipal policies matter? *Transportation Research Part A: Policy and Practice*, 38(7), pp.531–550. Available at: <http://linkinghub.elsevier.com/retrieve/pii/S0965856404000382> [Accessed July 12, 2014].
- Rodríguez, D.A. & Joo, J., 2004. The relationship between non-motorized mode choice and the local physical environment. *Transportation Research Part D: Transport and Environment*, 9(2), pp.151–173. Available at:

<http://linkinghub.elsevier.com/retrieve/pii/S1361920903000889> [Accessed March 25, 2014].

Rueda, S., 2002. Modelos de ordenación del territorio más sostenibles Salvador Rueda. *In Congreso nacional de medio ambiente, Barcelona.*

Saelens, B.E., Frank, L.D. & Med, A.B., 2003. Environmental Correlates of Walking and Cycling: Findings From the Transportation , Urban Design , and Planning Literatures. , 25(2), pp.80–91.

Sener, I., Eluru, N. & Bhat, C., 2010. Who Are Bicyclists? Why and How Much Are They Bicycling? *Transportation Research Record: Journal of the Transportation Research Board*, 2134(1), pp.63–72. Available at: [http://www.ce.utexas.edu/prof/bhat/ABSTRACTS/sener\\_eluru\\_bhat\\_bicycle\\_rev\\_Jan18\\_TRBstyle.pdf](http://www.ce.utexas.edu/prof/bhat/ABSTRACTS/sener_eluru_bhat_bicycle_rev_Jan18_TRBstyle.pdf) [Accessed May 15, 2014].

Statistics Netherlands, 2000. *Hoe doet het CBS dat nou? Standaarddefinitie allochtonen*,

Statistics Netherlands, Official webpage. Available at: <http://www.cbs.nl/en-GB/menu/home/default.htm>.

Steinbach, R. et al., 2011. Cycling and the city: a case study of how gendered, ethnic and class identities can shape healthy transport choices. *Social science & medicine*, 72(7), pp.1123–30. Available at: <http://www.ncbi.nlm.nih.gov/pubmed/21396761> [Accessed March 25, 2014].

Stinson, M. & Bhat, C., 2004. Frequency of bicycle commuting: internet-based survey analysis. *Transportation Research Record: Journal of the Transportation Research Board*, 1878(1), pp.122–130. Available at: <http://trb.metapress.com/index/4835083568127WP8.pdf> [Accessed May 15, 2014].

Susilo, Y.O. & Maat, K., 2007. The influence of built environment to the trends in commuting journeys in the Netherlands. *Transportation*, 34(5), pp.589–609. Available at: <http://link.springer.com/10.1007/s11116-007-9129-5> [Accessed April 16, 2014].

Taipale, S., 2012. The Politics of Proximity: Mobility and Immobility in Practice. *Journal of Urban Technology*, 19(1), pp.107–110. Available at: <http://www.tandfonline.com/doi/abs/10.1080/10630732.2012.673060> [Accessed March 25, 2014].

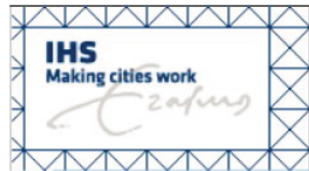
Tal, G. & Handy, S., 2005. The travel behavior of immigrants and race/ethnicity groups: an analysis of the 2001 national household transportation survey. *Institute of Transportation Studies*. Available at: <http://escholarship.org/uc/item/7fp663rn.pdf> [Accessed May 16, 2014].

- Thurstone, L., 1931. The measurement of social attitudes. *The Journal of Abnormal and Social Psychology*, 26(3), p.249. Available at: <http://psycnet.apa.org/journals/abn/26/3/249/> [Accessed August 12, 2014].
- Triandis, H.C., 1980. Values, attitudes, and interpersonal behavior. In *Nebraska Symposium on Motivation*. pp. 195–259.
- Vergragt, P.J. & Brown, H.S., 2007. Sustainable mobility: from technological innovation to societal learning. *Journal of Cleaner Production*, 15(11-12), pp.1104–1115. Available at: <http://linkinghub.elsevier.com/retrieve/pii/S095965260600240X> [Accessed March 25, 2014].
- Wang, X., Grengs, J. & Kostyniuk, L., 2013. Visualizing Travel Patterns with a GPS Dataset: How Commuting Routes Influence Non-Work Travel Behavior. *Journal of Urban Technology*, 20(3), pp.105–125. Available at: <http://www.tandfonline.com/doi/abs/10.1080/10630732.2013.811986> [Accessed March 25, 2014].



# Annex 1. Questionnaire

English



## \* Required Information

page 1

\* Are you currently employed? (If you answer "No", this is the end of the questionnaire since most of the questions are work-related movements) (Select one option)

- ☐ Yes, as academic staff
- ☐ Yes, as management staff
- ☐ Yes, as volunteer
- ☐ Yes, other
- ☐ No

\* Please select the faculty or institute in which you work. (The terms "Institution" and "Faculty" are interchangeable in all of the following questions) (Select one option)

- ☐ Erasmus School of Economics
- ☐ Erasmus School of Law
- ☐ Faculty of Social Sciences
- ☐ Erasmus MC
- ☐ Erasmus School of History, Culture, and Communication
- ☐ Rotterdam School of Management
- ☐ Institute of Health Policy & Management
- ☐ International Institute of Social Studies
- ☐ Human Resources & Finance
- ☐ Other (please specify) \_\_\_\_\_

\* Please indicate the post code of your regular work place (If you work in more than one location, please focus on the one where you spend more time) (Enter your answer in "####@@" format where @ is character and # is number)

\_\_\_\_\_

\* How many days a week do you regularly travel to your place of work? (Select one option)

- ☐ 1 or less
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5 or more

**\* Do you receive a subsidy from your institution to use public transport to travel to your place of work?** (Select one option)

☐ Yes ☐ No

**\* Does your institution offer any kind of direct incentive for you to commute by bicycle to work? (e.g. cash, free days, extra bonus)** (Select one option)

☐ Yes ☐ No

**\* Does your company circulate to you information to receive a tax reimbursement if you purchase a new bicycle?** (Select one option)

☐ Yes ☐ No

**page 2**

**\* Did you commute using the same mode(s) of transport every time you had to travel to your place of work during the past year? (Within 'normal' circumstances)** (Select one option)

☐ Yes  
☐ No (I used at least one different mode of transport more than twice during the past year)

**\* How much time do you regularly spend a total in one way travel to your place of work? (If you use different modes please focus on the one you use more often)** (Select one option)

- ☐ Less than 10 minutes
- ☐ 10-15 minutes
- ☐ 15-20 minutes
- ☐ 20-25 minutes
- ☐ 25-30 minutes
- ☐ 30-40 minutes
- ☐ 40-50 minutes
- ☐ 50-60 minutes
- ☐ More than 60 minutes

**page 3**

**\* Please indicate which of the following means of transport you used last year to travel to your place of work:** (Select one option) [ Answer this question only if answer to Q#8 is NOT (No (I used at least one different mode of transport more than twice during the past year) ) ]

- ☐ Only car
- ☐ Only bicycle
- ☐ Only public transport
- ☐ Only foot
- ☐ Combination of public transport and bicycle
- ☐ Combination of public transport and foot
- ☐ Combination of car and bicycle
- ☐ Combination of car and public transport
- ☐ Other (please specify) \_\_\_\_\_

\* In the last question you indicated that you commuted to work using different modes of transport during the past year. Please check which of the following modes you used (You may select various modes. Select a mode only if you used it more than twice in the given period) [ Answer this question only if answer to Q#8 is NOT (Yes ) ]

- ☐ Only car
- ☐ Only bicycle
- ☐ Only public transport
- ☐ Only foot
- ☐ Combination of public transport and bicycle
- ☐ Combination of public transport and foot
- ☐ Combination of car and bicycle
- ☐ Combination of car and public transport
- ☐ Other (please specify) \_\_\_\_\_

page 4

\* With which transport mode do you think your colleagues expect you to travel to work? (Select one option)

- ☐ Car
- ☐ Public transport
- ☐ Bicycle
- ☐ Foot
- ☐ It doesn't matter

\* With which transport mode do you think the people at home expect you to travel to work? (Select one option)

- ☐ Car
- ☐ Public transport
- ☐ Bicycle
- ☐ Foot
- ☐ It doesn't matter

\* To what extent do you consider it possible to travel your entire journey by bicycle? (Select one option)

Not possible at all 1	2	3	4	Very possible 5
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

\* Which mode of transport would you be more likely to use to go shopping? (Please answer the followign questions spontaneously, following your first instinct) (Select one option)

- ☐ Motor vehicle (car or scooter) ☐ Bicycle
- ☐ Public transport ☐ Foot

\* Which mode of transport would you be more likely to use to attend a social event? (Select one option)

- ☐ Motor vehicle (car or scooter) ☐ Bicycle

☐ Public transport
☐ Foot

**\* Which mode of transport would you be more likely to use for recreation purposes (e.g. relaxing, sports, leisure)? (Select one option)**

☐ Motor vehicle (car or scooter)
☐ Bicycle
☐ Public transport
☐ Foot

**\* Which mode of transport would you be more likely to use to go to work? (Select one option)**

☐ Motor vehicle (car or scooter)
☐ Bicycle
☐ Public transport
☐ Foot

**Opinion on cycling to work**

Please share how the following characteristics of the natural environment may influence your decision to commute by bicycle to work

	Not at all 1	2	3	4	Very much 5
*(a) Rainfall (Select one option)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
*(b) Temperature (Select one option)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
*(c) Strong wind (Select one option)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
*(d) Darkness (Select one option)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**page 5**

**\* Please answer the following questions according to your personal point of view even in the case you do not use bicycle. For me, bicycling the whole journey to work is environmental friendly. (Select one option)**

☐ Agree
☐ Disagree

**\* How strong is your position with regards to your last answer? (Select one option)**

Somewhat strong 1	Strong 2	Very strong 3
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**\* For me, bicycling the whole journey to work is healthy (Select one option)**

☐ Agree
☐ Disagree

**\* How strong is your position with regards to your last answer? (Select one option)**

Somewhat strong 1	Strong 2	Very strong 3
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**\* For me, bicycling the whole journey to work is safe in traffic (Select one option)**

☐ Agree
☐ Disagree

\* How strong is your position in regards to your last answer? (Select one option)

Somewhat strong 1	Strong 2	Very strong 3
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

\* For me, bicycling the whole journey to work is convenient (Select one option)

☐ Agree ☐ Disagree

\* How strong is your position with regards to your last answer? (Select one option)

Somewhat strong 1	Strong 2	Very strong 3
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

\* For me, bicycling the whole journey to work is time-saving (Select one option)

☐ Agree ☐ Disagree

\* How strong is your position in regards with your last answer? (Select one option)

Somewhat strong 1	Strong 2	Very strong 3
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

page 6

\* Please indicate the post code of your residential area (If there are other residential addresses from which you travel to work, please focus on the one from which you commute to work the most) (Enter your answer in "####@" format where @ is character and # is number)

\* Please select the type of your residential area (Select one option)

☐ Rural ☐ Suburban ☐ Urban/downtown

Which of the following facilities are there in your residential area? (you may select more than one)

- |   |  |
|---|--|
| <input type="checkbox"/> Bicycle garage inside the building | <input type="checkbox"/> Train station within 1 km |
| <input type="checkbox"/> Free car parking                   | <input type="checkbox"/> Supermarket within 500 m  |
| <input type="checkbox"/> Tram/bus stop within 500 meters    | <input type="checkbox"/> Shopping within 1 km      |

\* Please indicate your gender (Select one option)

- ☐ Male  
☐ Female

\* What is your age? (in years) (Enter a value between 18 and 99)

\_\_\_\_\_

\_\_\_\_\_

**If you were not born in The Netherlands, please indicate the year in which you move here** (Enter your answer in "####" format where # is number)

\_\_\_\_\_

\_\_\_\_\_

**\* Please indicate the level of education you completed.** (Select one option)

- ☐ Elementary school
- ☐ High school or equivalent
- ☐ Bachelor
- ☐ Master or more advanced

**\* Please indicate your approximate income after taxes per month (in Euros)**  
(Select one option)

- ☐ Less than 500
- ☐ 500-1000
- ☐ 1000-1.500
- ☐ 1.500-2.000
- ☐ 2.000-2.500
- ☐ 2.500-3.000
- ☐ More than 3.000
- ☐ I prefer not to answer

**\* In which country was your father born?** (Select one option)

- ☐ Afghanistan
- ☐ Albania
- ☐ Algeria
- ☐ Argentina
- ☐ Armenia
- ☐ Australia
- ☐ Austria
- ☐ Azerbaijan
- ☐ Bahamas
- ☐ Bahrain
- ☐ Bangladesh
- ☐ Belarus
- ☐ Belgium
- ☐ Bhutan
- ☐ Bolivia
- ☐ Brazil
- ☐ Brunei
- ☐ Bulgaria
- ☐ Cambodia
- ☐ Cameroon
- ☐ Canada
- ☐ Chile
- ☐ China
- ☐ Colombia

- ☐ Costa Rica
- ☐ Croatia
- ☐ Cuba
- ☐ Cyprus
- ☐ Czech Republic
- ☐ Denmark
- ☐ Ecuador
- ☐ Egypt
- ☐ Ethiopia
- ☐ Fiji
- ☐ Finland
- ☐ France
- ☐ Georgia
- ☐ Germany
- ☐ Ghana
- ☐ Greece
- ☐ Haiti
- ☐ Honduras
- ☐ Hong Kong
- ☐ Hungary
- ☐ Iceland
- ☐ India
- ☐ Indonesia
- ☐ Iran
- ☐ Iraq
- ☐ Ireland
- ☐ Israel
- ☐ Italy
- ☐ Jamaica
- ☐ Japan
- ☐ Jordan
- ☐ Kazakhstan
- ☐ Kenya
- ☐ Korea, South
- ☐ Kuwait
- ☐ Kyrgyzstan
- ☐ Lebanon
- ☐ Libya
- ☐ Malaysia
- ☐ Maldives
- ☐ Mauritius
- ☐ Mexico
- ☐ Mongolia
- ☐ Morocco
- ☐ Myanmar
- ☐ Nepal
- ☐ Netherlands

- ☐ New Zealand
- ☐ Nigeria
- ☐ Norway
- ☐ Oman
- ☐ Pakistan
- ☐ Panama
- ☐ Paraguay
- ☐ Peru
- ☐ Philippines
- ☐ Poland
- ☐ Portugal
- ☐ Qatar
- ☐ Romania
- ☐ Russia
- ☐ Saudi Arabia
- ☐ Senegal
- ☐ Singapore
- ☐ Slovakia
- ☐ Slovenia
- ☐ Somalia
- ☐ South Africa
- ☐ Spain
- ☐ Sri Lanka
- ☐ Sudan
- ☐ Sweden
- ☐ Switzerland
- ☐ Syria
- ☐ Taiwan
- ☐ Tajikistan
- ☐ Tanzania
- ☐ Thailand
- ☐ Tunisia
- ☐ Turkey
- ☐ Turkmenistan
- ☐ Uganda
- ☐ Ukraine
- ☐ United Arab Emirates
- ☐ United Kingdom
- ☐ United States of America
- ☐ Uruguay
- ☐ Uzbekistan
- ☐ Venezuela
- ☐ Vietnam
- ☐ Yemen
- ☐ Zambia
- ☐ Zimbabwe
- ☐ I prefer not to answer



\* In which country was your mother born? (Select one option)

- ☐ Afghanistan
- ☐ Albania
- ☐ Algeria
- ☐ Argentina
- ☐ Armenia
- ☐ Australia
- ☐ Austria
- ☐ Azerbaijan
- ☐ Bahamas
- ☐ Bahrain
- ☐ Bangladesh
- ☐ Belarus
- ☐ Belgium
- ☐ Bhutan
- ☐ Bolivia
- ☐ Brazil
- ☐ Brunei
- ☐ Bulgaria
- ☐ Cambodia
- ☐ Cameroon
- ☐ Canada
- ☐ Chile
- ☐ China
- ☐ Colombia
- ☐ Costa Rica
- ☐ Croatia
- ☐ Cuba
- ☐ Cyprus
- ☐ Czech Republic
- ☐ Denmark
- ☐ Ecuador
- ☐ Egypt
- ☐ Ethiopia
- ☐ Fiji
- ☐ Finland
- ☐ France
- ☐ Georgia
- ☐ Germany
- ☐ Ghana
- ☐ Greece
- ☐ Haiti
- ☐ Honduras
- ☐ Hong Kong
- ☐ Hungary
- ☐ Iceland
- ☐ India

- ☐ Indonesia
- ☐ Iran
- ☐ Iraq
- ☐ Ireland
- ☐ Israel
- ☐ Italy
- ☐ Jamaica
- ☐ Japan
- ☐ Jordan
- ☐ Kazakhstan
- ☐ Kenya
- ☐ Korea, South
- ☐ Kuwait
- ☐ Kyrgyzstan
- ☐ Lebanon
- ☐ Libya
- ☐ Malaysia
- ☐ Maldives
- ☐ Mauritius
- ☐ Mexico
- ☐ Mongolia
- ☐ Morocco
- ☐ Myanmar
- ☐ Nepal
- ☐ Netherlands
- ☐ New Zealand
- ☐ Nigeria
- ☐ Norway
- ☐ Oman
- ☐ Pakistan
- ☐ Panama
- ☐ Paraguay
- ☐ Peru
- ☐ Philippines
- ☐ Poland
- ☐ Portugal
- ☐ Qatar
- ☐ Romania
- ☐ Russia
- ☐ Saudi Arabia
- ☐ Senegal
- ☐ Singapore
- ☐ Slovakia
- ☐ Slovenia
- ☐ Somalia
- ☐ South Africa
- ☐ Spain

- ☐ Sri Lanka
- ☐ Sudan
- ☐ Sweden
- ☐ Switzerland
- ☐ Syria
- ☐ Taiwan
- ☐ Tajikistan
- ☐ Tanzania
- ☐ Thailand
- ☐ Tunisia
- ☐ Turkey
- ☐ Turkmenistan
- ☐ Uganda
- ☐ Ukraine
- ☐ United Arab Emirates
- ☐ United Kingdom
- ☐ United States of America
- ☐ Uruguay
- ☐ Uzbekistan
- ☐ Venezuela
- ☐ Vietnam
- ☐ Yemen
- ☐ Zambia
- ☐ Zimbabwe
- ☐ I prefer not to answer

**How many people, including yourself, live in your (main) home address? (Select one option)**

- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5
- ☐ 6
- ☐ 7 or more

**\* In total, how many bicycles are there in your nuclear family (or home)? (Select one option)**

- ☐ None
- ☐ 1
- ☐ 2 or more

**\* In total, how many cars are there in your nuclear family (or home)? (Select one option)**

- ☐ None
- ☐ 1
- ☐ 2 or more

**Finally, we would like to ask you if you are willing to participate in a follow up**

interview. Your opinion is extremely important for us and will help to improve the quality of this research. The interview will take you around 20 minutes. If yes, please write your email in the box below. If not, click on "Submit" to finalize the questionnaire.

Dutch



\* Vereiste informatie.

page 1

\* Hebt u momenteel werk? (Als dit niet het geval is, is dit het einde van de survey, aangezien de meeste vragen werkgerelateerd zijn) (selecteer één optie)

- ☐ Ja, als academisch staflid
- ☐ Ja, als management staflid
- ☐ Ja, als vrijwilliger
- ☐ Ja, anders
- ☐ Nee

\* Selecteer a.u.b. de faculteit of het instituut waar u werkzaam bent (De termen "Instituut" and "Faculteit" zijn inwisselbaar in alle komende vragen) (selecteer één optie)

- ☐ Erasmus School of Economics
- ☐ Erasmus School of Law
- ☐ Faculteit der Sociale Wetenschappen
- ☐ Erasmus MC
- ☐ Erasmus School of History, Culture, and Communication
- ☐ Rotterdam School of Management
- ☐ Instituut Beleid & Management Gezondheidszorg
- ☐ International Institute of Social Studies
- ☐ Human Resources & Finance
- ☐ Anders (namelijk:) \_\_\_\_\_

\* Wat is de postcode van uw werklocatie? (Als u op meer dan een locatie werkt, gelieve de locatie te kiezen waar u het meeste tijd doorbrengt) (Enter your answer in "####@" format where @ is character and # is number)

\* Hoeveel dagen per week reist u naar uw werk normaal gesproken? (selecteer één optie)

- ☐ 1 of minder
- ☐ 2
- ☐ 3
- ☐ 4

☐ 5 of meer

**\* Krijgt u een reiskostenvergoeding van uw instituut om met het openbaar vervoer naar uw werklocatie te reizen? (selecteer één optie)**

☐ Ja ☐ Nee

**\* Wordt u op enigerlei wijze gestimuleerd door uw instituut om met de fiets naar de werklocatie te reizen? (e.g. geld, vrije dagen, bonus) (selecteer één optie)**

☐ Ja ☐ Nee

**\* Geeft uw bedrijf u informatie over een belastingteruggave bij aankoop van een nieuwe fiets? (selecteer één optie)**

☐ Ja ☐ Nee

page 2

**\* Bent u het afgelopen jaar telkens met hetzelfde soort vervoer naar uw werk gegaan? (binnen 'normale' omstandigheden) (selecteer één optie)**

- ☐ Ja
- ☐ Nee (Ik gebruikte minstens één verschillend transportmiddel vaker dan twee keer het afgelopen jaar)

**\* Hoeveel tijd besteedt u in het totaal aan een enkele reis naar uw werk (als u verschillende soorten vervoer gebruikt geef dan alstublieft aan welke u het meest gebruikt)? (selecteer één optie)**

- ☐ Minder dan 10 minutes
- ☐ 10-15 minutes
- ☐ 15-20 minutes
- ☐ 20-25 minutes
- ☐ 25-30 minutes
- ☐ 30-40 minutes
- ☐ 40-50 minutes
- ☐ 50-60 minutes
- ☐ Meer dan 60 minutes

page 3

**\* Welk transportmiddel gebruikte u het afgelopen jaar om naar uw werk te reizen? (selecteer één optie) [ Answer this question only if answer to Q#8 is NOT (No (I used at least one different mode of transport more than twice during the past year) ) ]**

- ☐ Alleen Auto
- ☐ Alleen Fiets
- ☐ Alleen openbaar vervoer
- ☐ Alleen lopen
- ☐ Combinatie van openbaar vervoer en fiets
- ☐ Combinatie van openbaar vervoer en lopen
- ☐ Combinatie van auto en fiets
- ☐ Combinatie van auto en openbaar vervoer
- ☐ Anders (namelijk:) \_\_\_\_\_

**\* Als u bij de vorige vraag hebt aangegeven met meerdere vervoersmiddelen naar uw werklocatie te reizen, geeft u dan a.u.b. aan welke vervoersmiddelen dat zijn (U mag meerdere vervoersmiddelen selecteren. Selecteer alleen de vervoersmiddelen die u vaker dan twee keer hebt gebruikt het afgelopen jaar)**  
 [ Answer this question only if answer to Q#8 is NOT (Yes ) ]

- ☐ Alleen Auto
- ☐ Alleen Fiets
- ☐ Alleen openbaar vervoer
- ☐ Alleen lopen
- ☐ Combinatie van openbaar vervoer en fiets
- ☐ Combinatie van openbaar vervoer en lopen
- ☐ Combinatie van auto en fiets
- ☐ Combinatie van auto en openbaar vervoer
- ☐ Anders (namelijk:) \_\_\_\_\_

**page 4**

**\* Met welk vervoersmiddel, denkt u, verwachten uw collega's dat u naar het werk reist? (selecteer één optie)**

- ☐ Auto
- ☐ Openbaar vervoer
- ☐ Fiets
- ☐ Lopen
- ☐ Maakt niet uit

**\* Met welk vervoersmiddel, denkt u, verwachten uw gezinsleden dat u naar het werk reist? (selecteer één optie)**

- ☐ Auto
- ☐ Openbaar vervoer
- ☐ Fiets
- ☐ Lopen
- ☐ Maakt niet uit

**\* In hoeverre acht u het mogelijk om de hele reis naar uw werklocatie te fietsen? (selecteer één optie)**

Ze er on mo ge lijk 1	2	3	4	Ze er mo ge lijk 5
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**\* Welk vervoersmiddel zult u het meest waarschijnlijk gebruiken als u gaat winkelen? (Gelieve de volgende vragen spontaan te beantwoorden door uw eerste ingeving te volgen) (selecteer één optie)**

- ☐ Motorvoertuig (auto of scooter)
- ☐ Fiets
- ☐ Openbaar vervoer
- ☐ Lopen

**\* Welk vervoersmiddel zult u het meest waarschijnlijk gebruiken als u naar een**

evenement reist? (selecteer één optie)

- ☐ Motorvoertuig (auto of scooter) ☐ Fiets  
☐ Openbaar vervoer ☐ Lopen

\* Welk vervoersmiddel zult u het meest waarschijnlijk gebruiken voor recreatieve doeleinden? (bijvoorbeeld ontspannen, sporten, vrije tijd) (selecteer één optie)

- ☐ Motorvoertuig (auto of scooter) ☐ Fiets  
☐ Openbaar vervoer ☐ Lopen

\* Welk vervoersmiddel zult u het meest waarschijnlijk gebruiken als u naar uw werk gaat? (selecteer één optie)

- ☐ Motorvoertuig (auto of scooter) ☐ Fiets  
☐ Openbaar vervoer ☐ Lopen

**Uw mening over fietsen naar het werk**

Geeft u a.u.b. aan hoe de volgende eigenschappen van de natuurlijke omgeving uw beslissing om naar het werk te fietsen kan beïnvloeden.

	Zeker niet 1	2	3	4	Zeker wel 5
*(a) Regen (selecteer één optie)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
*(b) Temperatuur (selecteer één optie)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
*(c) Sterke wind (selecteer één optie)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
*(d) Donker buiten (selecteer één optie)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

page 5

\* Antwoord de volgende vragen alstublieft naar uw eigen mening, ook als u zelf niet naar het werk fietst. Naar mijn mening is fietsen naar het werk milieuvriendelijk. (selecteer één optie)

- ☐ Eens ☐ Oneens

\* Hoe sterk is uw mening van uw vorige vraag? (selecteer één optie)

Een beetje sterk 1	Sterk 2	Heel sterk 3
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

\* Naar mijn mening is fietsen naar het werk gezond (selecteer één optie)

- ☐ Eens ☐ Oneens

\* Hoe sterk is uw mening van uw vorige vraag? (selecteer één optie)

Een beetje sterk 1	Sterk 2	Heel sterk 3
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

\* Naar mijn mening is fietsen naar het werk veilig in het verkeer (selecteer één optie)

☐ Eens ☐ Oneens

---

**\* Hoe sterk is uw mening van uw vorige vraag? (selecteer één optie)**

Een beetje sterk 1	Sterk 2	Heel sterk 3
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

---

**\* Naar mijn mening is fietsen naar het werk gemakkelijk (selecteer één optie)**

☐ Eens ☐ Oneens

---

**\* Hoe sterk is uw mening van uw vorige vraag? (selecteer één optie)**

Een beetje sterk 1	Sterk 2	Heel sterk 3
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

---

**\* Naar mijn mening is fietsen naar het werk tijdsbesparend (selecteer één optie)**

☐ Eens ☐ Oneens

---

**\* Hoe sterk is uw mening van uw vorige vraag? (selecteer één optie)**

Een beetje sterk 1	Sterk 2	Heel sterk 3
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

---

**page 6**

---

**\* Wat is de postcode van uw woonlocatie (als er meerdere woonlocaties zijn vanwaar u naar uw werk reist, kies dan alstublieft degene waarvandaan u het meest naar uw werk reist) (Enter your answer in "####@" format where @ is character and # is number)**

\_\_\_\_\_

---

**\* Selecteer a.u.b. uw type woongebied (selecteer één optie)**

☐ landelijk ☐ Voorstad ☐ Stedelijk/binnenstad

---

**Welke van de volgende faciliteiten zijn er in uw woonomgeving? (Meerdere antwoorden mogelijk)**

<input type="checkbox"/> Fietsenstalling in het gebouw	<input type="checkbox"/> Treinstation binnen een straal van 1 km
<input type="checkbox"/> Vrij parkeren	<input type="checkbox"/> Supermarkt binnen een straal van 500 m
<input type="checkbox"/> Tram/bus haltes binnen een straal van 500 m	<input type="checkbox"/> Winkelgelegenheid binnen een straal van 1 km

---

**\* Wat is uw geslacht? (selecteer één optie)**

☐ Man  
☐ Vrouw

---

**\* Wat is uw leeftijd? (In jaren) (Enter a value between 18 and 99)**



<div> <div></div> <div></div> </div>
<div> <div>Indien u niet bent geboren in Nederland, geeft a.u.b. aan in welk jaar u hierheen gekomen bent (Enter your answer in "####" format where # is number)</div> <div> <div></div> <div></div> </div> </div>
<div> <div>* Wat is uw opleidingsniveau? (selecteer één optie)</div> <div> <div><input type="radio"/> Basisschool</div> <div><input type="radio"/> Middelbare school</div> <div><input type="radio"/> Bachelor</div> <div><input type="radio"/> Master or hoger</div> </div> </div>
<div> <div>* Wat is, bij benadering, uw inkomen na belastingen per maand (in Euros)? (selecteer één optie)</div> <div> <div><input type="radio"/> Minder dan 500</div> <div><input type="radio"/> 500-1000</div> <div><input type="radio"/> 1000-1.500</div> <div><input type="radio"/> 1.500-2.000</div> <div><input type="radio"/> 2.000-2.500</div> <div><input type="radio"/> 2.500-3.000</div> <div><input type="radio"/> Meer dan 3.000</div> <div><input type="radio"/> Ik geef liever geen antwoord</div> </div> </div>
<div> <div>* In welk land is uw vader geboren? (selecteer één optie)</div> <div> <div><input type="radio"/> Afghanistan</div> <div><input type="radio"/> Albania</div> <div><input type="radio"/> Algeria</div> <div><input type="radio"/> Argentina</div> <div><input type="radio"/> Armenia</div> <div><input type="radio"/> Australia</div> <div><input type="radio"/> Austria</div> <div><input type="radio"/> Azerbaijan</div> <div><input type="radio"/> Bahamas</div> <div><input type="radio"/> Bahrain</div> <div><input type="radio"/> Bangladesh</div> <div><input type="radio"/> Belarus</div> <div><input type="radio"/> Belgium</div> <div><input type="radio"/> Bhutan</div> <div><input type="radio"/> Bolivia</div> <div><input type="radio"/> Brazil</div> <div><input type="radio"/> Brunei</div> <div><input type="radio"/> Bulgaria</div> <div><input type="radio"/> Cambodia</div> <div><input type="radio"/> Cameroon</div> <div><input type="radio"/> Canada</div> <div><input type="radio"/> Chile</div> <div><input type="radio"/> China</div> <div><input type="radio"/> Colombia</div> </div> </div>

- ☐ Costa Rica
- ☐ Croatia
- ☐ Cuba
- ☐ Cyprus
- ☐ Czech Republic
- ☐ Denmark
- ☐ Ecuador
- ☐ Egypt
- ☐ Ethiopia
- ☐ Fiji
- ☐ Finland
- ☐ France
- ☐ Georgia
- ☐ Germany
- ☐ Ghana
- ☐ Greece
- ☐ Haiti
- ☐ Honduras
- ☐ Hong Kong
- ☐ Hungary
- ☐ Iceland
- ☐ India
- ☐ Indonesia
- ☐ Iran
- ☐ Iraq
- ☐ Ireland
- ☐ Israel
- ☐ Italy
- ☐ Jamaica
- ☐ Japan
- ☐ Jordan
- ☐ Kazakhstan
- ☐ Kenya
- ☐ Korea, South
- ☐ Kuwait
- ☐ Kyrgyzstan
- ☐ Lebanon
- ☐ Libya
- ☐ Malaysia
- ☐ Maldives
- ☐ Mauritius
- ☐ Mexico
- ☐ Mongolia
- ☐ Morocco
- ☐ Myanmar
- ☐ Nepal
- ☐ Netherlands

- ☐ New Zealand
- ☐ Nigeria
- ☐ Norway
- ☐ Oman
- ☐ Pakistan
- ☐ Panama
- ☐ Paraguay
- ☐ Peru
- ☐ Philippines
- ☐ Poland
- ☐ Portugal
- ☐ Qatar
- ☐ Romania
- ☐ Russia
- ☐ Saudi Arabia
- ☐ Senegal
- ☐ Singapore
- ☐ Slovakia
- ☐ Slovenia
- ☐ Somalia
- ☐ South Africa
- ☐ Spain
- ☐ Sri Lanka
- ☐ Sudan
- ☐ Sweden
- ☐ Switzerland
- ☐ Syria
- ☐ Taiwan
- ☐ Tajikistan
- ☐ Tanzania
- ☐ Thailand
- ☐ Tunisia
- ☐ Turkey
- ☐ Turkmenistan
- ☐ Uganda
- ☐ Ukraine
- ☐ United Arab Emirates
- ☐ United Kingdom
- ☐ United States of America
- ☐ Uruguay
- ☐ Uzbekistan
- ☐ Venezuela
- ☐ Vietnam
- ☐ Yemen
- ☐ Zambia
- ☐ Zimbabwe
- ☐ Ik antwoord liever niet

\* In welk land is uw moeder geboren? (selecteer één optie)

- ☐ Afghanistan
- ☐ Albania
- ☐ Algeria
- ☐ Argentina
- ☐ Armenia
- ☐ Australia
- ☐ Austria
- ☐ Azerbaijan
- ☐ Bahamas
- ☐ Bahrain
- ☐ Bangladesh
- ☐ Belarus
- ☐ Belgium
- ☐ Bhutan
- ☐ Bolivia
- ☐ Brazil
- ☐ Brunei
- ☐ Bulgaria
- ☐ Cambodia
- ☐ Cameroon
- ☐ Canada
- ☐ Chile
- ☐ China
- ☐ Colombia
- ☐ Costa Rica
- ☐ Croatia
- ☐ Cuba
- ☐ Cyprus
- ☐ Czech Republic
- ☐ Denmark
- ☐ Ecuador
- ☐ Egypt
- ☐ Ethiopia
- ☐ Fiji
- ☐ Finland
- ☐ France
- ☐ Georgia
- ☐ Germany
- ☐ Ghana
- ☐ Greece
- ☐ Haiti
- ☐ Honduras
- ☐ Hong Kong
- ☐ Hungary
- ☐ Iceland
- ☐ India

- ☐ Indonesia
- ☐ Iran
- ☐ Iraq
- ☐ Ireland
- ☐ Israel
- ☐ Italy
- ☐ Jamaica
- ☐ Japan
- ☐ Jordan
- ☐ Kazakhstan
- ☐ Kenya
- ☐ Korea, South
- ☐ Kuwait
- ☐ Kyrgyzstan
- ☐ Lebanon
- ☐ Libya
- ☐ Malaysia
- ☐ Maldives
- ☐ Mauritius
- ☐ Mexico
- ☐ Mongolia
- ☐ Morocco
- ☐ Myanmar
- ☐ Nepal
- ☐ Netherlands
- ☐ New Zealand
- ☐ Nigeria
- ☐ Norway
- ☐ Oman
- ☐ Pakistan
- ☐ Panama
- ☐ Paraguay
- ☐ Peru
- ☐ Philippines
- ☐ Poland
- ☐ Portugal
- ☐ Qatar
- ☐ Romania
- ☐ Russia
- ☐ Saudi Arabia
- ☐ Senegal
- ☐ Singapore
- ☐ Slovakia
- ☐ Slovenia
- ☐ Somalia
- ☐ South Africa
- ☐ Spain

- ☐ Sri Lanka
- ☐ Sudan
- ☐ Sweden
- ☐ Switzerland
- ☐ Syria
- ☐ Taiwan
- ☐ Tajikistan
- ☐ Tanzania
- ☐ Thailand
- ☐ Tunisia
- ☐ Turkey
- ☐ Turkmenistan
- ☐ Uganda
- ☐ Ukraine
- ☐ United Arab Emirates
- ☐ United Kingdom
- ☐ United States of America
- ☐ Uruguay
- ☐ Uzbekistan
- ☐ Venezuela
- ☐ Vietnam
- ☐ Yemen
- ☐ Zambia
- ☐ Zimbabwe
- ☐ Ik antwoord liever niet

**Met hoeveel personen, inclusief uzelf, woont u in uw (hoofd) woning? (selecteer één optie)**

- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5
- ☐ 6
- ☐ 7 of meer

**\* Hoeveel fietsen hebben u en uw gezin (of andere personen thuis)? (selecteer één optie)**

- ☐ Geen
- ☐ 1
- ☐ 2 of meer

**\* Hoeveel auto's hebben u en uw gezin (of andere personen thuis)? (selecteer één optie)**

- ☐ None
- ☐ 1
- ☐ 2 of meer

**Ten slotte willen we u vragen of u bereid zou zijn mee te werken aan een**

vervolginterview. Uw mening is belangrijkd voor ons en zal bijdragen aan een hogere kwaliteit van het onderzoek. Het interview zal ongeveer twintig minuten duren. Indien u hiertoe bereid bent, schrijf a.u.b. uw email in het veld hieronder. Indien niet, klik a.u.b. op 'Indienen' om de vragenlijst af te ronden.

\_\_\_\_\_

\_\_\_\_\_

## **Annex 2. Interviews summary**

\*The names of employees have been changed to protect their identities.

### **Interview N° 1 to part time cyclist**

Wednesday, July 3<sup>rd</sup>, 2014

Q: Interviewer Rafael Verduzco

I: Roger, (Part time cyclist) Information Management & Consulting (IMC) at Rotterdam School of Management Erasmus University

#### **FRAGMENT I**

Q: Do you know if you are eligible to access subsidies to travel in an alternative mode of transport? For example free tax when you purchase a new bicycle, subsidy for public transport.

I: Both apply, the stupid thing in my view, is that I get subsidy when I buy a new bicycle, but I don't want a new bicycle. Instead, I modified my old bicycle, which is 24 years old into an e-bike. So, I'm commuting here by electricity. And the subsidy for public transport is very attractive, but is not very efficient to come here by metro because it takes at least half and hour longer single way, to come here.

#### **FRAGMENT II**

Q: Do you think the way in which you travel to work can affect either positively or negatively your health?

I: Oh yes, positively.

Q: Do you think is safe in traffic to travel by bicycle from your home to your place of work? Can you tell us about your personal experience?

I: No is not. Well, the crossroads are dangerous. The other cyclists they don't pay much attention. And the cars feel that they are superior. However the law, in The Netherlands, has been very protective for cyclists. This is why cyclists are very arrogant some times. Still If you get an accident with cars...I have been top over about three times. It is always at crossroads. When the people really don't pay attention to the cycle path, instead they look at the road, the car road, and they tend to drive to fast, cross the cycle path. In Schiedam there are crossroads that are famous for accidents, apparently for the bad layout of the road. If someone designs crossroads, and roads in general, they usually do it from the point of view of the car. In Rotterdam is for sure they have good fluxes, if you go out of the highway It is always green, they want you in the city, to the south. Is very car friendly Rotterdam. But this means of course that the other people that are in the traffic they have to wait.

### **Interview N°2 to full time cyclist**

July 17<sup>th</sup>, 2014

I: Interviewer

C: Kurt (full time cyclist)



Erasmus MC laboratory researcher.

## FRAGMENT I

I: Do you know if you are eligible to access subsidies or incentives to travel to work on an alternative mode of transport?

C: I'm aware that Erasmus MC has these subsidies for...And I make use of the bike, options...

I: How do you perceive the accessibility of the transport infrastructure here? I'm talking about the, how is it the car parking? or is it accessible the bus stops?....

C: I think in general is quite accessible in many different transport options like public, or car....I think car is maybe most difficult, also to get a free spot here, and it's expensive but for public transport and bike it's very good.

I: Can you tell us about your routinely journey to travel to work and back home?

C: Actually it's always the bike. I can recall that I once took public transport. Yeah maybe I have an appointment at the end of the day in Amsterdam for instances, or I go to a meeting or a congress. But to work even if it's bad weather or whatever I really prefer the bike.

I: You mention for example if the weather is not very good you decide to take the bike

C: I always take the bike yeah.

I: For example if we divide the weather between let's rain, rain, low temperature...

C: Oh no, definitely not. Sometimes maybe snow, if it's really...Then you can cycle but it happens maybe once every five years.

## FRAGMENT II

I: What do you think would be the influence of your income level and the mode of transport you use? For example do you think if your earn more you would travel in different way?

C: No I wouldn't. Maybe a better bike but...hahaha

I: What do you think is the case of your colleagues? Do you think your colleagues that earn more travel in certain mode and the ones who earn less in a different...

C: I don't think so, It's more a practical decision I guess, time wise.

I: Were you born in The Netherlands?

C: Yes.

I: Can I ask where were your parents born?

C: Also in The Netherlands (both too).

I: Do you think foreign people...maybe among your colleagues, they change their behavior across the time with regard of transport?

C: I think they sometimes do, specially regarding bicycling, and not all people are used to cycling and then I can imagine in time they see the benefits also in a city like Rotterdam. So, the also shift to more cycling.

I: Can you remember an example or is just in general?

C: Well, I have one colleague from Pakistan who initially mainly took public transport, and then later on also cycled.

I: Can you remember the period he was riding public transport and then switch..?

C: I think within a year or something

I: How do you think your cultural background influences your decision to chose a mode of transport?

C: I think that's has a great effect. Because I was raised with cycling actually, cycling to school, to sport clubs, always cycling. So that's so common, you learn it very early in your age, so I think that makes a big difference.

I: Have you observed patterns among your colleagues with regards of the cultural background and the mode of transport they use?

C: Yeah, I think so. Like, some colleagues from Morocco, I have the impression that they cycle less. That they less used to, that is not a standard. And I also know it from the school of my daughters that they always goes by bike even if it's 8, 9 or 10 kilometers to school. But many kids specially from other cultures then they take de bus, because they find it so strange to cycle that far, or in the weather or.. just not used to it.

I: Can you remember particular examples with your colleagues?

C: I already mention one, the Pakistan girl... depends on the culture. You also have a lot of Chinese students here, but in Asia they cycle also a lot. So they are more used to, so that's not a relation.

### FRAGMENT III

I: To which extent consider that the expectations of your colleagues of work influence your decision to choose a mode of transport?

C: For me not, But in general I remember, that two years ago my former department that there was one colleague who really lived nearby Erasmus MC, and she always came by car, an it was...I think one or two kilometers haha. So we bullied her a lot with that hahaha...And after some time she saw the light and she always came by bike, and later on she cycle much further distances. So I think, this was I little bit bullying, but talking about it with your colleagues might influence their decision and behavior, I really believe in that. I think there is social pressure, although there is people they just don't care and they even if they live close they take the bus or whatever, they don't like to cycle or only cycle with good weather. But I believe in social pressure.

### FRAGMENT IV

I: In general how do you think car facilities and policies (we are talking about parking or taxes for the car) influence the decision to use bicycle to commute to work?

C: No, for me that car doesn't make a difference. Even if there was parking for free here, I wouldn't come by car.

I: And In general, in the case of your colleagues, how do you think it would be?

C: I think for some, If parking was for free or very cheap, then they might easily take at least now and then the car and maybe also often. Of course you have also the traffic, which is...might be busy and not practical to...But, now is so expensive that people don't think about it.

### FRAGMENT V

I: Did you somehow choose your residential location according to your preferences of transportation?

C: Yeah, definitely. It was really also a practical decision to live not too far from work. Because my wife and I work both in Erasmus MC, so that makes it easier. So we really wanted to be on a cycle distance from work. So that was definitely important.

### Interview N°3 to full time cyclist

June , 2014

Q: Interviewer

J: Franz (Full time cyclist)

#### FRAGMENT I

Q: Do you usually make stops during your way coming here or back?

J: No, it's straight.

Q: Does your colleagues usually travel long distances to come here?

J: Well a number of them do. If you say 12 km is long distance.

Q: For me that would be middle distance

J: Ok, I'm just thinking. Most of them live in Rotterdam, or in the villages around Rotterdam. So that's short to middle distance.

Q: What's the most extreme case you know with regard to distance?

J: Oh one of them lives in Amsterdam, which is about 70 or 80 kilometers. It's an atypical case. One of them lives in Dordrecht is about 15 or 20 kilometers.

#### FRAGMENT II

Q: For the people who were not born in the Netherlands, Do you think their travel behavior have changed across the time?

J: We have some Italian people around. I had one PhD student from Indonesia who came by bike in fact. That's, he lived in the other side of the river, so he always came trough the tunnel by bike. It is the only case whom I know.....

Q: Can you tell us where your parents were born?

J: My father was born in Freesland, in the north. And my mother was born in the east of the country.

Q: How do you think your cultural background influences your decision to choose a mode of transport?

J: That's...how do you \_\_\_\_\_ that to happen?

Q: For example some people who were not born in The Netherlands could be affected by the religion, or their confidence, or the sense of safety.

J: As you know most of the people in The Netherlands feel quite safe in the bike. In that respect you can say is my cultural background which makes me choose using a bike. But I don't think that's very much a cultural thing. But I think if you ask a hounded people who are Dutch they all went to secondary school by bike. And when you are student, well at the moment it's maybe different because now they have free public transport, but when I studied, all student had bikes and rode to the \_\_\_\_\_hose to their bikes, etc, etc...And for me I cycled whit my children when they were in secondary school here in Rotterdam from the village where I live. And in the morning we cycled to Rotterdam with the three of us. You can say that's cultural background.

Q: Have you observed patterns among your colleagues with regard of their cultural background and the mode of transport they use?

J: No. It's very homogenous group. Most of them are Dutch. It's maybe different the other part of the university where many people form abroad are working. But we do have a colleague from Indonesia, who adapted very much to the Dutch system.

#### FRAGMENT II

Q: To which extent do you consider that the expectations of the people at your home might influence your decision to choose a mode of transport?

J: That's difficult to define. I'm very used to do it this way. That's what people expect from me to do. To start with, when I started going by bike it was not on basis of expectations of other people. But, \_\_\_\_\_ my bike expected me to go by bike.... because I have done that for about forty years. So that's ...But there's no pressure in any way.

### FRAGMENT III

Q: How do you think the car facilities and policies influence the decision to use bicycle to commute to work?

J: Well it can influence. Here you have to pay if you're parking your car in the car park. So that makes it rather stupid to come by car in fact, because is rather expensive. So that would certainly influence the situation and it's really much discourage to come by car because the parking space is there, it's primarily used by the patients and not for the people that work here.

Q: So that might influence more than the taxes for example.

J: Yes. But the payment you have to make for the parking place here is really a point.

### FRAGMENT IV

Q: Would you like to add an extra comment?

J: If I come by car it takes me more time. At least 45 minutes because of the traffic jams.

Q: Ok this was the end of the interview. Thank you.

## **Interview N°4 to policy administer at Human Resources and Finance**

Thursday, June 19<sup>th</sup>, 2014

**Rachel** Brussen

Beleidsadviseur HR

Erasmus Universiteit Rotterdam

SSC Human Resources & Finance

Q: Interviewer Rafael Verduzco

R: Rachel Brussen

### FRAGMENT I

Q: Do you think there is a relation with cycling patterns and foreign background? For example people that were born here in The Netherlands but has one or both parents that were born abroad.

R: Uhh... I know like, If you are...I think if you were born here in The Netherlands...If you are raised here from very young age like 2, 3, 4, 5, 6 years old then is very common to learn bicycling. Every kid from like 2 years old already trying to get forwards on little bikes. And then if they are like about 4 years old, the yeah... It would be nice if you could cycling and you know. You have those special institutions for kid's health; one of the questions is "Can your kid cycle?" "How is the motoric development?". So I think cycling is very a part of our culture and also something you ... like a basic need, you need to cycle, you have to...You must cycle it gives you more freedom, you can go independently to places. And of course, it's fun, it is good for health. So, I think every Dutch kid is raised by cycling, learning cycling. And I know you have those special programs for people from abroad who really want to become a citizen of The Netherlands they then, like the municipality has special programs about learning to cycle for women. Just to get them also a bit more independent, that they can go out, they can go to shops, visit friends so...Knowing that are special bicycle projects for foreigners says of course that it is really a cultural thing, and really common.

Q: Do you think there is a change in behavior across the time in people who moved to The Netherlands to use bicycle for commuting to work?

R: Of course I have no facts or figures, but I think it is. The longer you live here, and the longer you see it's common everybody cycles...and then of course if you can if you are willing to learn, more and more foreigners will ride the bike...I think the longer you live the chance you cycle will be bigger as well. Some times I see that people from abroad and...not because they are like German, or American or whatever...They are more willing to wear a helmet. If I see people with helmets on the bike I think oh... Or they have had an accident before and bump their heads or they are maybe from abroad and a bit afraid because they were raised by all those cars passing by and just to feel safe, which is of course very good they wear helmet. I know like Germans, In Germany the cyclists are wearing more often the helmets than Dutch do. Of course it has to do if you feel confident and if you are confident or trained enough to give a quick reaction on the traffic you know it also has to do with how do you feel on the bike. Do you feel safe on the bike? or...That's maybe a nice question about the feeling of safety.

Q: To which extent do you consider that the expectations of the people at the place of work with regards to the way one commute influence the choose of the mode?

R: Besides money is influencing the mode of commuting...Not only money, but first is where do you live, do you live far away from university or nearby and then is easy to get a bike or is it not possible to get a bike because I live in Utrecht and I have to go by car. I think, of course there is influence like if you said well, I am feeling good, I am going by bike every day, It is a good day to cycle. Well, you should do this as well...or if one of my colleagues says I am feeling a bit unhealthy fatter and fatter haha ...I would say: just take the bike! But I don't know if it's really ...Of course It would influence him or her...But I don't know if I am that strong because I think the location, the place where you live is the most important. And besides the place where you live it's also ahh... Do you have children? Do you have to bring to school first? or to the kinder garden....Because we figure it out when introducing the paid parking many people said: well you said that you give me as an employee a free choice in the way of commuting, but I have no free choice because there is no public transport and I live in like a half and hour or one hour driving from Erasmus University and I have to bring my kids first, or I have to pick them up from school. So how dare you, almost, how can you say that I have a free choice? That's why I say the location or where the people live...I think of course if you are going by bike or if you are coming by e-bike you're a \_\_\_\_ modal. And of course I know from every colleague here on the corridor how they commute, by car, by public transport and of course is good, sometimes we make a joke or we say "good for you, you came by bike", So it's more on the positive side of course you are mentioning something but I do not have intention that I can change my colleagues.

Q: Do you think cyclists are more aware of benefits of bicycle environmental benefits health related if you compare it to the ones who don't cycle?

R: Oh yes! I am sure! Because, and that's one of the conclusions of the survey the reason why people chose bicycle or public transport was environment. I won't say that people coming by car aren't or they don't know but in the survey when we asked reason to go by... So it doesn't mean that people coming by car are not aware of environment but in priorities you see people who travel in public transport and by bike are at least more aware or they mentioned it.

Q: Which other conditions of the built environment in the residential area do you think are more influential? You already mentioned the distance, but, Do you think there is another condition of the environment or characteristic of the environment...

R: Yeah the weather of course. I don't know if you... You cannot do something about it, but of course the weather...People say: I'm able to come by bike to work, but only in the summer, so I start cycling at the end of march, or beginning of April until September, and it starts more rain like October until February and cold, I quit, then I take the car, or the metro, or whatever. So weather conditions...I know people who are going by bike everyday, I am not doing it, I know a colleague does. He checks everyday the weather forecast and if he already knows that It starting to rain five in the afternoon, he won't come by bike. And you said besides the distance...If it feels good and safe enough to leave your bike behind, and of course everybody lock his bike but if you know there are good bike sheds, then of course is easier to come by bike if the facilities are good. And of course at the Erasmus we have a good bike sheds for employees, some are even for employees...the one with the pass...And also the opportunity you have for e-bikes, you can plug in your e-bike to recharge, that was also one of

the measures we took last year. Also just to get more people with e-bikes here and also that they don't have to pay for re-charging. I think that's the most important...And we also provide, but not many people use it, like an early-bird card at the Erasmus Sport Center so if you are really fanatic cyclist and you say ok I'm wearing totally my suit and everything I'm cycling one hour then you can take a shower you can change, and become at your work place not sweating. So we have that facility as well. It doesn't get that many people out of the cars but there are a few colleagues who said: Ok, I combine sport and commuting by racing...

Q: But in general you think that facility is not attracting more.... It is just for the ones who already cycle.

R: Yeah, It's just nice to have.

## FRAGMENT II

Q: How do the public transport policies are affecting commuting by bicycle in Rotterdam? For example if there is a subsidy or the price increases or decreases

R: Of course it has a relation, If prices increase or decrease about other ways of commuting, and of course car and bicycle will pop up at first. And I think if prices are rising are willing longer time to commute, then they say: Ok it takes 15 minutes longer but it's cheaper they would choose like the second option or they'll combine, first they go by bike, and then by metro instead of the whole distance by metro. I know also people who said due to the introducing of paid parking, park the car over there and then they cycle the last two or three kilometers to the university. So people are getting of course more creative. And of course is the relation between public transport and cycling. Maybe if PT is getting cheaper people getting more lazy. Or if it is raining just a little bit, now I take the metro instead of the bicycle.

## Interview N°5 to non-cyclist

June , 2014

Q: Interviewer

J: Dave, researcher at IBMG, at Erasmus University

## FRAGMENT I

Q: Do your colleagues usually travel long distances to come here?

J: I think there is about half that travel let's say 30 km or more.

Q: In particular, which is the most extreme case you know among your colleagues?

J: yeah. There is someone travelling from Antwerp, and someone for instance traveling from (Venendal) which is it think 80 kilometers, and there is someone travelling from Maastricht which is 180 kilometers. So there are exceptional cases.

Q: Do you have colleagues a particular mode of transport because of a physical limitation or a particular health condition?

J: No that I know

Q: What could be the influence of your income level and the mode of transport you use?

J: I think...well, if I earned more I would buy a better car! hahaha...But not between modes.

Q: And in the other way round, If you earned less do you think you would be forced to...

J: There is a level of income where you no longer afford a car. Probably then, I would also not work here. I have a colleague who cycles to work but is not because of income. So perhaps he would be cycling for forty kilometers.

Q: What do you think is the case for your colleagues? In relation to the income and the mode of transport they use

J: No, I don't think so. I think it depends more on where you live and accessibility. I have very well earning colleagues, much more than I do, they come by bicycle or by train and have colleagues that earn much less who come by car or bicycle or train. So it is more where you live.

Q: Were you born in The Netherlands?

J: Yes.

Q: Would you mind telling us where your parents were born?

J: In The Netherlands

Q: How do you think your cultural background influences your decision to choose a mode of transport?

J: For long time, before I had \_\_\_\_\_, I always traveled by public transport concerned for the environment primarily. It was a factor that comes from my background. Concerned for the environment was important motivation to use public transport.

Q: Have you observed patterns with your colleagues with regards to the cultural background and the mode of transport they use?

J: Yeah. I think Dutch people use the bike whenever they can. And non Dutch use the bike when the must. It is a generalization of course. I think people for instance living here in Rotterdam and that work here...most of my Dutch colleagues if it's not storming or something or they don't need the car for something else they always come by bike and then my non Dutch colleagues always find reasons why is better to come by tram or to come by car or...whatever. And walking is something Dutch don't do that much, as long as 200 meters is easier to take the bike.

Q: How many bicycles are there at your home?

J: Twelve

## FRAGMENT II

Q: How would you describe the typical case of your colleagues?

J: I think there is divided, there is people who always use the car for whatever and the subgroup that uses the car only when is need it.

Q: With this I meant how is the case for most of your colleagues, do they have 1 car or...

J: I think most have 1 car per household.

Q: To which extent do you consider that the expectations of your colleagues may influence your decision to choose a mode of transport?

J: No....

## FRAGMENT III

Q: Could you give us an example or in which case...?

J: When you lets say, buy a car or bike or whatever, is a household decision. So you decide together with the family what are the...You're going to buy a small car that you only gonna use for work and do the rest by bicycle and public transport. Or you are going to buy a big car and then do more by car. So it's a household decision making. But in the end, if you are the primary user you decide but you take their opinion into account. \_\_\_\_\_ Don't do that with colleagues which wherever\_\_\_\_\_ found. And you look also at their needs, also for instance the kids ...they do sport, once \_\_\_\_\_or \_\_\_\_\_ week you have to drive the teams to an away game. So either you have a car, borrow or rent a car. So those are the things that you take into consideration that have to do with the needs of your family.

## FRAGMENT IV

Q: How do you think the prices and conditions of public transport influence the decision to use bicycle to commute to work?

J: I think it really depends on income and on how flexible your schedule is. In my case the difference has to be very significant. Because my time flexibility is low, my income is fair. So, longer travel time in combination that the bus is infrequent so the inflexibility...Should be very much cheaper before I switched to public transport or car much more expensive.

Q: How do you think car facilities and policies for example paid parking or taxes influences your decision to use bicycle to commute to work?

J: I think they can influence decision considerably. The example I gave you, introducing parking fees here I think reduced the amount of cars considerably. A lot of students were coming by car I think...either they park somewhere else or don't come any longer by car, it's pretty expensive if you don't work here, employees get a reduced fee. So we pay for a day, other users pay per hour. And I think you can see in many countries whenever you introduce tolls, it always has an effect. I think is a very powerful instrument, but really relates to income. So, it affects to people with low income more than people with higher income. It is hard people who don't have a choice, so if you don't have the opportunity to switch from car to public transport, because you need this for work or because public transport is non existent or very poor, you have no other choice to pay if you want to keep your job.

## **Interview N°6 to mobility policy maker**

June , 2014

Giuliano Mingardo

Senior Researcher Transport Economics

Department of Regional, Port and Transport Economics (RHV)

Erasmus University Rotterdam

Biography

Giuliano Mingardo is senior researcher and lecturer at the Department of Regional, Port and Transport Economics (RHV) at Erasmus University Rotterdam and founder of the Mobility Management Academy ([www.eur.nl/mma](http://www.eur.nl/mma)). He has worked in academia since 2000 on several research projects both at national and European level mainly in the fields of urban transport. He is lecturer in transport economics both at Bachelor and Master level.

Giuliano is specialized in parking policy and mobility management and regularly advises local governments and large companies on these issues. He is an acclaimed speaker both at national and international level and organizes master classes for professional audiences as well.

Among others, he is a member of the Advisory Board of the Parking Commission of the Dutch CROW/KpVV and a member of the Scientific and Technical Committee of the European Parking Association (EPA).

Giuliano speaks four languages – Italian, Dutch, English and Spanish – and has gained academic qualifications from the Ca' Foscari University of Venice (MSc. in Economics) and Erasmus University Rotterdam (Master degree in Urban Management). He is pursuing a PhD in parking policy and management at Delft University of Technology.

Interview

Q: Interviewer Rafael Verduzco

G: Giuliano

FRAGMENT I



Q: In the survey you conducted in 2010 how did you define the type of commuters? Was it based on the main mode of the people or commuting more frequent with certain mode?

G: We asked people what is the most common transport mode they use to come to the university, so of course nowadays people change the transport mode very often. It is not every day they travel in the same way. So ok, what is the main one you used the most. So if people that answered for example by bike doesn't mean they come every day by bike but mostly they come by bike.

Q: Did you somehow capture frequencies of the different modes of transport in your survey? Because we are talking about people that sometimes uses a different modes of transport. Did you somehow manage to do it?

G: Depends what you mean. We know how people travel and how often they travel. We didn't go into specific to ask if when you don't come with the main transport mode how do you travel because varies pretty much and from a policy point of view it doesn't tell that many information.

Q: What could be the influence of the income in The Netherlands and commuting by bicycle? Do you think there is a relation?

G: Hard to say...I don't think there would be a direct relation, not necessarily the higher the income the less people would bike. In The Netherlands you might have also people that earn more money they simply go by bike because they like it. Considering the fact that in The Netherlands, on average, one out of four trips are made by bike. So 25% is a lot, and there are also quite a lot of rich people in that 25%. So, I think distance has a more important impact. The larger the distance the less people go by bike. But income I wouldn't know we don't have direct research but I wouldn't expect a direct relation with income and using the bike.

Q: Do you think there is a relation in cycling patterns and the foreign background? For example we are talking about people that probably were born in the Netherlands but has one or both parents that were born abroad.

G: Could be...We know that in some kind of ethnicities bicycle is not well known. In some kind of ethnicities it is simply not allowed to go bi bike. It could be that the ethnicity might have and influence. Dutch people are more used to go by bike, but you might also have all the immigrants, second, third, generation immigrants that they have been born in The Netherlands, they have lived all their lives in The Netherlands so...It is difficult to say.

## FRAGMENT II

Q: Do you think there is a change in behavior across the time for foreign people who move to the Netherlands to use bicycle for commuting to work?

G: Difficult to say...It could be, when you come from abroad this is the country in the world where cycles is most used it is logical that some people understand that it is also possible to go by bike, the infrastructure is better than anywhere else so it's quite logical. It's like when you go to another country, If you live there probably you get used to food, to the language, or other things...here you get used to also to the bikes. I think it is surely part of the integration also to use the bike, but again I think there are other factors more important than this one.

Q: For example?

G: Distance. Distance would be probably the most important effect on it. Age maybe, physical conditions...

Q: To which extent of the expectations of colleagues at work influence the transport mode choice?

G: Very little.

Q: Could you give us an example or why do you think...

G: I've never heard someone expecting you to go by bike or to do something else.... Because you asked about expectations, right?

Q: Yes, only expectations.

G: Personally, I don't know about my colleagues, but I know here, I never heard of a kind of social pressure you have to bike or you have to do something like that. Is not an issue at all, there is no pressure how you have to commute to work.

Q: Do you think personal attitudes towards cycling are different between cyclists and non-cyclists?

G: I don't get the question

Q: How is your attitude towards using bicycle to go to work between the people who are cyclist and non-cyclists? How is the relation from someone who is cyclist to bicycle and how is...do you think is different? Do you think they see the bicycle different?

G: At the end of the day you always use the best mode of transportation for yourself. So if you use the bicycle, probably you think the bicycle is the best way of commuting for yourself. But there are also many people that commute by car but then they like a lot cycling in the weekend and stuff like that. So, I am not sure if I get your question. But I mean the attitude...probably you like bicycle better but I don't...Again, there might be other things that are more important. You might say if you use the bike of course you like it, but if you don't use it. It doesn't necessary means you don't like it. Probably if I live 50 kilometers away from my work maybe I like a lot biking, but I cannot bike to work that's it. I don't think attitude would have a huge influence on the decision.

Q: Do you think cyclists are more aware of benefits of cycling? For example environmental or health related than other kind of commuters.

G: No, everyone knows that the bicycle is more environmental friendly. Is very important for research, don't tell people they have to use the bike because is good for the environment, they know it. Don't tell them is good for health, they also know it. They don't use it for other reasons. This is one of the most common shortcomings of all policy about promoting bike: tell the people is good for environment they know it. Don't waste money with things the people already know it.

Q: Do you consider that the characteristics of the place of residence can influence the decision to commute by bicycle? If yes, which conditions of built environment do you consider more influential?

G: No, I don't think there would have any influence because either you live in the suburbs, outside the city, or in the city and in the suburbs is more or less always the same. The Netherlands has very good bicycle infrastructure. So it doesn't really matter where you live there is always a way to come by bicycle. So if you live in the suburbs there won't be any difference. In the city...If you live in the city you...Well, it is more about the choice of bike that you have because the fact that you probably have to leave the bike outside you don't have the place to put it inside \_\_\_\_\_ the type of bike you buy, so probably you are not going to buy an expensive bike. And this might have an influence on the commuting because if you don't have a very good bike probably you are less willing to take it more often but mainly is still an issue of distance. I mean, is not the quality of the living environment is more the distance of the destination.

### FRAGMENT III

Q: What's the role that bicycle infrastructure in the place of work plays for choosing bicycle as a mode of transport?

G: What do you mean by bicycle infrastructure?

Q: for example racks, or covered parking, showers in the building...

G: This might play a role.... the infrastructure is good everywhere [in the EUR], so ...This might facilitate your decision to go by bike but it will never be a determinant. So it is not ...Because you might have the possibility to go.... For example all employees have a dedicated parking for bikes, is closed access to only employees, let's say if you have an expensive bicycle at least you know it is safe. Of course it might facilitate you, but it is not the main reason the say well, I bike because I can park my bike in a safe environment, again there might be other reason that are more important. But infrastructure is something that must be there, but won't be enough. Of course if you don't have infrastructure, if you don't have a place to park...well you can't complain people don't coming by bike. If you have it, it's not enough. That's the point. So, Infrastructure is a kind of basis, a precondition, but is not enough. It is a necessary condition but is not sufficient.

Q: How do you think the natural environment influence the decision to bicycle for commuting to work?

G: Weather in terms of rain might have an influence on the decision whether to go...Of course if it rains a lot probably less people is willing to go by bike, it seems quite logical. But be aware of the fact that, even if there is a storm in terms of wind very strong wind, probably you are not willing to go by bike but be aware of the fact that The Netherlands is the country where it rains relatively a lot, there is strong wind, and still is the country where people bicycle the most. So the thing that weather has an influence is a kind urban legend. It might have...I think is more the other way round, in Europe, in the Mediterranean countries where the temperature is very hot in the summer, that is a reason not to bike because is too hot, simply. But The Netherlands, the fact it rains and there is some wind is not a big issue.

### FRAGMENT IV

Q: During these two years you have been working in the project, do you think you need to improve in certain part?

G: I think that if we compare it with other companies we did a pretty good job. It went quite smooth at the end, so that a big issue. Communication can always be improved, and that's it. We first have to evaluate, maybe could be a complete failure we don't know. It's difficult to say.

Q: With communication, what exactly do you mean?

G: Especially for the e-bike subsidy was information to the people. We did information campaign, posters, emails, but there was very little reaction, and it was strange...Honestly I wouldn't know what went wrong...We were expecting more people applying for the subsidy for an e-bike, but in some way...maybe that the economic crisis also plays a role. It was two years ago so maybe people were more afraid to spend money, even if we offered a subsidy for an e-bike, probably people were not willing to invest themselves, could be a reason.

## **Interview N°7 to non-cyclist**

June 17<sup>th</sup>, 2014

I: Interviewer

M: Courtney, Rotterdam School of Management

### **FRAGMENT I**

I: How do you perceive the accessibility of the transport infrastructure here? We are talking about car parking space, bus or trams accessible, bicycle racks...

M: I think the campus is accessible by car. I think the access to the parking is good...Well, you see that with the reconstruction they are doing here is sometimes a little bit more difficult. But in general I think by car is easy. By public transport I'm not so convinced, which is also one of the reasons that I don't come by public transport so often. Because the tram stops are...either the one that is relatively close here takes a long time to get to the station or the one, the metro which is a little bit further it goes a bit faster but in general I think it is too much of a hassle. So it's in addition, the metro doesn't stop really at the campus or near the campus, so I find that a bit disappointing.

I: Can you tell us about your routinely journey to travel to work?

M: I get in the car and I drive home hahaha....I drive here, plus or minus the traffic jam.

I: Do you try to avoid traffic jams?

M: Yeah, I try to avoid it. I look on the Internet if there is a traffic jam, and if in the morning it is too busy then I do some work from home first, so I check my email and then leave. In the evening I do the same, and if it is really very very bad then I stay longer, sometimes 'til 7.00 or 7.30. If it's really bad...If I need be home at a certain time I make sure to leave early.

### **FRAGMENT II**

I: Would you mind telling us where were your parents born?

M: They were both born in the Netherlands.

I: How do you think your cultural background influence your decision to choose a mode of transport?

M: Well, I grew up thinking that you would need to do everything by bike, if it's possible you only travel by bike. You only travel by car if it's really necessary...If I lived closer to work or my work were closer to home, I would definitely take the bike, because I like that, but it's too far. But my natural way would be to go to work by bike.

I: Have you observed patterns among your colleagues with regard of their cultural background and the mode of transport they use? For example if they are foreigners, do you think they travel in certain way?

M: That's an interesting question...I wouldn't know. I would think that maybe people who were born and raised in the Netherlands would take a bike easier, also in bad weather...But that a guess. I mean I also have colleagues who come by car even if they don't live too far away, because they have to pick up their children and have to do all kind of other things, and I suppose there's also people who just don't like going on bicycle.

I: How many bicycles are there at your home or are there bicycles at your home?

M: We have four.

I: What kind of use do you have with these bicycles?

M: We have two bicycles for daily use, and the other two are one race bicycle, and another one is a tour bicycle. I have one and my husband has three.

I: How would you describe the typical case of your colleagues? Do they have bicycles and use it in the same way?

M: I don't know.

I: And how many cars do you have at home?

M: Two.

I: And what kind of use do they have?

M: the one I use most is to go back and \_\_\_\_\_ here to work, and the other one is just another one. So that one doesn't have a particular use. When we both need the car, then we have two.

I: How would you describe the typical case of your colleagues? Do they have cars or do they have different use for the cars?

M: I think most have car but I've not discussed with them.

### FRAGMENT III

I: How do you think in general that the prices and conditions of public transport influence the decision to use bicycle to commute to work?

M: That's a good question..No, I think no actually. Because I think most people would in one way or another take the mode of transport which is most convenient for them, and probably the price is secondary to that decision. And if people are convinced that the train is the best way to travel, then they would probably continue to use the train, same with the car.

I: What do you think it would be a representative incentive to use bicycle? for example right now there is this subsidy to get an ebike, but I have heard that not a lot of people is making use of this, do you have an idea why?

M: I think people who would be interested in that probably already tried at one point or maybe they feel it's not very appropried for them. I have colleagues who lives not very close, but also not very far, and they already had ebikes. So I think the incentive is not strong enough, and I mean I think there are a lot of people in this university who do not live in Rotterdam, and then it wouldn't be interesting for them. They would come by car or by train anyway. I don't know how this compare to other universities but if you are not from Rotterdam, or immediate vicinity then it immediatly gets very far away, and then I don't think an ebike is an incentive to change your mode of transportation.

I: Do you think we are missing some important information that may influence the decision to use bicycle in your place of work?

M: I think just the \_\_\_\_\_ distance to home...I think that is the main thing.

I: Would you like to add an extra comment or something else to conclude?

M: No, I think it was a nice survey, I'd be interested to read the results.

### Interview N°8 to Part time cyclist

July 7<sup>th</sup>, 2014

I: Interviewer

R: Johanna, Post-Doc researcher at Erasmus MC. (Part time cyclist)

#### FRAGMENT I

I: How do you perceive the accessibility of the transport infrastructure at your place of work? In regards of for example, car parking, tram/bus stops, safe bicycle garage...

R: I'd say excellent. I think is really great here. I don't know about car parking, but the rest it's I'd say.

#### FRAGMENT II

I: Can you tell about your routinely journey to travel to work and back home?

R: Always bike, the only reason I wouldn't use the bike is it it's very very bad raining. But today I rode even tough it was a little bit rainy.

#### FRAGMENT III

I: Do you have colleagues that use a particular mode of transport because of a physical limitation or a particular health condition?

R: No, I don't know anyone.

I: What could be the influence of your income level and the mode of transport you use? Do you think that if you earned less you would use a different one or the other way round?

R: If I earned more I think I could, like this morning, I think I would get the tram hahaha... Because it was raining. So I think income actually, would negatively impact my choice of active transport.

I: What do you think is the case of your colleagues? Do you think that the ones who earn more travel in certain way, or the ones who earn less travel in other type of transport?

R: I think is about your perception around money. So, I think some people would value arriving with dry hair for instance. I think that there is a perception about this. So they value being dry hahaha! more than the money. Yeah, I think there is a relationship. But also I was thinking of another reason I know here is I just know people that would never cycle. It's not in their brain even if they're close. They live near me but they always take the...

#### FRAGMENT IV

I: Do you think there is a kind of pattern maybe it's income or maybe cultural background or...

R: I think just, there is a perception, even in Australia, that what is normal, is it okay to arrive to work looking cycling. And here people would've cycle. So it's less of a cultural difference, but back home definitely I think there is a big difference what it's okay....

#### FRAGMENT V

I: Have you observed patterns among your colleagues with regard of the cultural background and the mode of transport they use?

R: No... Well...I think native Dutch are more likely to cycle.

I: Can you give an example or remember a case?

R: In my group there's eight people and two of them are Dutch, one has lived here for a long time, German. And then... There's one from Macedonia, and one from India, and another one from maybe Pakistan, and those three don't cycle. So, it's a very distinct three people in the group that don't cycle, and then the people that live here long or Dutch...So if I think of the as a representative sample, yeah...And then it's me so, I'm the...I go with the Dutch hahaha!

## FRAGMENT VI

I: How do think prices and conditions of public transport influence your decision to use bicycle to commute to work?

R: I think any price...Just the fact of paying makes me want to use active transport. So, if someone gave me a free card to use public transport that's only maybe I'd use it more. Even 50 cents, It's rather ride my bike. But it's also the time, time on public transport is longer than if I'd cycle. So that's really important here.

I: How do you think the car facilities and policies for example paid parking taxes influences the decision to commute by bicycle to work?

R: Well, actually in this case we chose not to get a car because we would have to pay for parking at the front of the house. So it did directly limit us in purchasing a car. And also the taxes in The Netherlands for a car are much higher than Germany for instance, so this also limited us purchasing a car. Is not a priority for our money, so it does affect. Otherwise we would have a car, if it was more affordable.

I: What do you think it would be an improvement or representative incentive for you to continue using the bicycle to work or to do it more frequent?

R: Really the thing that is right here is the protected cycling tracks. So that's really the thing that I love about here, and not all roads have them. Some of the roads have a little bit of like a (grid?) [25:45](#) but you are on the road. So that would make me much more secure and that's the only thing...'Coz I cycle so much already.... The protected cycling tracks.

I: Do you think we are missing important information that might influence the decision to use bicycle in your place of work?

R: Yeah, actually there is one thing that I wanted to talk to you about and that's at the beginning when you're talking to me about how far my house is. I made the decision to rent that property so I could cycle to work. And if maybe that is something that influences people's decision about where they live. Because the other option for me was to live in Delft, and then I'd have to get a transport, public transport, and I didn't want that.

I: And do you think it could be the case of some colleagues?

R: Definitely there is...The international students that are here they like to be close to Erasmus here to the building so they can walk. So it's not cycling, but they want to be close enough to walk every day. So it does, if you are interested in active transport rather than just cycling, it is really a noticeable that people want to be that close.