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Determinants and barriers of walking, cycling and using Personal e-Transporters: a survey in nine European cities

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Determinants and barriers of walking, cycling and using Personal e-Transporters: a survey in nine European cities

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Executive summary

This report describes the results of an extensive online survey that has been conducted to collect empirical data on the psychological determinants and barriers of a travel mode shift in favour of active transport modes. The modes that have been focused on are walking, cycling and the use of Personal e-Transporters (PeTs) (e.g. electric scooter, monowheel, Segway,…). The survey was conducted in nine cities spread over the four countries of the consortium partners involved in the ISAAC-project: Tilburg and Groningen (The Netherlands), Ghent and Liège (Belgium), Trondheim and Bergen (Norway), and Dortmund, Düsseldorf and Berlin (Germany). A representative sample (in terms of age and gender) of 250 respondents per city was interviewed. The aim is to better understand people's travel mode choices, and to investigate how the use of more sustainable active transport modes can be increased.

A factor and cluster analysis was conducted to identify coherent groups of participants that are similar to each other regarding psychological determinants of travel mode choice, but different from participants in other groups. Two clusters of participants with similar psychological determinants of travel mode choice were identified. The difference between both clusters was mostly explained by cycling related factors. As a result, a clear 'pro-cycling' cluster was identified (55.6% of participants in the sample), consisting of people with more favourable cycling-related factors, and a 'non-pro-cycling' cluster of people with less favourable cycling-related factors. This suggests that the psychological determinants of cycling have a higher level of variation compared to the psychological determinants of walking. In other words, respondents' answers related to cycling are more diverse than answers related to walking, or alternatively, people's feelings related to cycling are more 'pronounced' than those related to walking.

Significant differences in respondents' characteristics are identified between both clusters. Higher shares of respondents from Groningen, Tilburg, Ghent and Düsseldorf are found in the pro-cycling cluster, while this cluster contains a lower fraction of respondents from Bergen, Liège and Trondheim. In addition, the pro-cycling cluster contains more young people (aged 18-34), more men and higher-educated, and more people living with a partner and children. They possess a higher number of all types of vehicles (including PeTs), except cars. The pro-cycling cluster also contains a higher share of respondents with a season ticket for public transportation and to a car or bike sharing system. The pro-cycling cluster contains fewer people who have difficulties to park a bicycle at home. Respondents in the pro-cycling cluster logically cycle significantly more often, but they also show higher rates of walking, riding a moped or motorbike, taking a taxi and using a PeT.

The analyses confirm that the classic components of the Theory of Planned Behaviour, supplemented by habit, provide the best fit for the behavioural model of cycling and walking. People's intentions to walk/cycle for their everyday trips are most strongly affected by their attitudes related to these modes, and to a lesser extent by norms and perceived behavioural control.

The biggest obstacle indicated by all respondents combined that hinders them from cycling more frequently, is traffic safety. The second biggest obstacle is time, followed by the required physical effort and the environment (climate, hilliness,…). Cost is considered the least important obstacle. Significant differences between cities are observed. Traffic safety is considered a stronger barrier in the Belgian cities (mostly Liège) and in the German cities compared to the Dutch and Norwegian cities. From the cluster analysis it becomes clear that traffic safety is considered to be a significantly more important obstacle for

respondents in the non-pro-cycling cluster. Improving traffic safety will therefore be a key element in realising a modal shift towards more cycling, especially for people who currently do not cycle much yet. The required physical effort and the environment (climate, hilliness,…) are also considered significantly more important obstacles by the non-pro-cycling cluster, but the difference between both clusters is smaller than for the traffic safety. Cost on the other hand is a relatively more important obstacle for the respondents in the pro-cycling cluster.

The biggest obstacle hindering more frequent walking is time. Physical effort, environment and traffic safety receive an approximately equal weight. The pro-cycling group (that walks significantly more than the other group) considers time a significantly more important obstacle for walking more frequently than the other group. There are no significant differences between both groups in terms of the importance of physical effort, environment and traffic safety as obstacles for walking more frequently.

Generally, respondents' perceptions of PeTs are not (yet) very favourable. Respondents' perceptions related to cost and safety received the lowest scores. Significant differences between the cities can be observed. The most favourable perceptions are reported in the German cities, especially in Dortmund. The least favourable perceptions are reported in the Norwegian cities Bergen and Trondheim. The current frequency of use of PeTs is highest in Groningen and in the German cities, where around 10% of participants indicates an occasional/frequent usage of PeTs (at least on a monthly basis, or more often).

The stage model shows that respondents' stage of behavioural change towards using PeTs more frequently is affected by various aspects. Some noteworthy findings are the following. Respondents with higher cycling norms are more likely to be in the higher stages of behavioural change. Respondents who walk more often are more likely to be in the higher stages as well, but respondents with more favourable walking attitudes have a lower probability. Stronger transport mode habits are related to a lower chance of being in the higher stages. Respondents who indicate stronger cycling obstacles have a higher probability of being in the contemplation stage of using PeTs. Respondents with a subscription to a bike sharing service have a lower probability of being in the higher stages of behavioural change.

The findings in this report highlight the intrinsically different nature of walking and cycling as transport modes, with different factors and perceived obstacles affecting their usage. As a result, stimulating these modes will require a different approach. While this may seem like a trivial conclusion, it is not uncommon in research as well as policy and practice to treat 'active modes' as being a coherent way of transportation with similar features.

1 Introduction

Despite the numerous efforts that have been undertaken over the last decades to modify travel behaviour, the private car remains by far the preferred transport mode in all European countries. This preference for cars is observed despite increasing public awareness of the role of motorized transport in global warming and of the recognition that adopting active travel modes is associated with individual health and important societal benefits, such as the reduction of traffic congestion and pollution (Tapp, Davis, Nancarrow, & Jones, 2016). For example, a recent study showed that cycling (and possibly walking, but this mode was not included in the study) is the only transport mode that creates net benefits to society, while all others generate net costs (Delhaye, De Ceuster, Vanhove, & Maerivoet, 2017). Further research is needed to better understand people's travel mode choices, and to investigate how they can be encouraged to use more sustainable active transport modes.

To this aim, an extensive online survey has been conducted to collect empirical data on the psychological determinants and barriers of a travel mode shift. The modes that have been focused on are walking, cycling and the use of Personal e-Transporters (PeTs) (e.g. electric scooter, monowheel, Segway,…). The survey was conducted in nine cities spread over the four countries of the consortium partners involved in the ISAAC-project: Tilburg and Groningen (The Netherlands), Ghent and Liège (Belgium), Trondheim and Bergen (Norway), and Dortmund, Düsseldorf and Berlin (Germany). A representative sample (in terms of age and gender) of 250 respondents per city was interviewed.

2 Background

The content from the background section is adopted from the paper by Dupont et al. (2018).

A literature search was conducted, departing from the examination of recent literature reviews, of which the main findings are summarized in this section. Recent and relevant literature reviews have been identified entering "Mode/modal choice", "travel behaviour", "active travel" and "psychological determinants" together with "psychological models", "review", "meta-analyses" as keywords in the on-line "Web Of Science" information service.

In the research on travel behaviour, three "waves" can be distinguished depending on the underlying approach adopted to account for modal choice.

The first wave of modal choice models departed from a strictly rational view, according to which people would deterministically choose the most advantageous transport mode based on a number of characteristics.

The second wave of research acknowledged the influence of subjective factors, such as attitudes and personal preferences, to account for the fact that the option effectively chosen cannot always be considered as the "best" one. The basic tenet in this second research wave was, however, that people's behaviour and choice would be guided mainly by intentions. The first and second waves are regarded as 'Conscious process approaches'.

More recently, a third wave of research has pointed out that behaviour is not solely determined by intentions, and that many automatic processes and non-conscious influences are at play in human decision-making; the 'Unconscious/automated process approach'.

Below we briefly describe each of the approaches.

2.1 Conscious process approaches

Early attempts to model travel behaviour and mode choice were mainly based on a "Rationalist Approach" (De Witte, Hollevoet, Dobruszkes, Hubert, & Macharis, 2013) or on "Utility Theory" (van de Kaa, 2010). According to this approach, individuals would rationally weigh the costs and benefits (e.g., time and money) associated with various alternatives to choose the option that yields the highest utility. Although this approach is still often applied (see Buehler, 2011, for example), there is a growing recognition of the fact that it is largely insufficient to effectively account for travel behaviour: the growing traffic congestion in many cities is a blatant illustration that people often fail to choose the alternative with the highest utility. Based on this conclusion, in a second wave of research, increased interest has been shown for the role played by psychological and social determinants. Different models have been applied to account for the influence of subjective parameters – such as attitudes and personal preferences – on travel mode choice. From their review, De Witte et al. (2013, p. 340) concluded "It is therefore vital to stress the importance of taking the subjective component into account when studying modal choice decisions".

The Theory of Planned Behaviour (TPB - Figure 1) is the model most often mentioned and most often applied to travel behaviour (Panter & Jones, 2010). TPB is based on the central tenet that human behaviour is determined primarily by intentions. Intentions are themselves defined as being shaped by attitudes (the degree to which a person has a favourable or unfavourable evaluation or appraisal of the behaviour in question – Ajzen, 1991), perceived behavioural control (the belief that one is effectively capable and free to behave in a particular way – Francis et al., 2004) and subjective norms (an individual's perceptions of what "significant others" (friends, relatives) consider to be an appropriate behaviour).

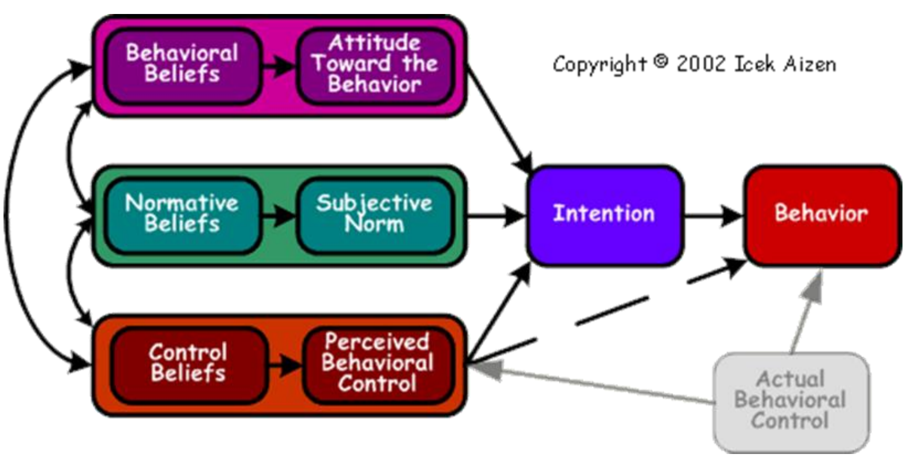

Figure 1: The Theory of Planned Behaviour – Retrieved from http://people.umass.edu/ajzen/tpb.diag.html

The TPB has been extensively applied in a wide variety of research fields (including research focusing on public health, pro-environmental behaviour). Its ability to predict behaviour has been assessed extensively, and has made the object of meta-analyses. This is an important advantage, as the theory's weak/strong points are relatively well known. Of all socio-psychological models that have been applied to account of modal choice, this is clearly the most integrative one. However it is also clear that it needs be extended in some important ways – for example to integrate components identified on the basis of other theoretical approaches.

The Norm Activation Model ("NAM", Schwartz, 1977), as the name indicates, focuses strongly on normative influences and feelings of moral obligation. These are also considered important determinants in the TPB, yet the way they are defined in each theoretical approach is not identical. The emphasis that the NAM model places on personal norms as a feeling of moral obligation has been found to be important in several studies and will consequently be integrated here. The TPB and the NAM approach of behaviour stress the importance of different types of norms (others' evaluation in the case of TPB and one's personal conception of right/wrong in the case of NAM).

The TPB model assumes that our behaviour is determined mainly by our intentions. Yet, a growing body of evidence from the cognitive sciences indicates that our decisions do not always result from a conscious evaluation, and that our intentions often fail to determine our behaviour. Actually, fast, automatic and non-conscious processes happen to determine a good deal of the choices that we make on a daily basis. "Behavioural economics" - a field of research integrating knowledge from the neurosciences and from economy to better understand human decision making - has provided countless illustrations of the role of these "fast" processes in human decision-making.

2.2 Unconscious/automated process approach

According to the third and most recent wave of behavioural research, modal choice is actually determined for a considerable part by habits (De Witte et al., 2013; Schwanen, Banister, & Anable, 2012; Willis, Manaugh, & El-Geneidy, 2015; Yalachkov, Naumer, & Plyushteva, 2014). A habitual behaviour is a behaviour that is repetitively displayed in a stable context. With time, the mere presence of characteristics of the context ("contextual cues") appears sufficient for the behaviour to be elicited in an automatic way. Because of their automatic nature habitual behaviours are unlikely to be questioned or evaluated by the individuals, and these cannot be expected to give much consideration to possibly suitable alternatives. Habitual use of a travel mode increases the chance that this mode will be chosen again in the future; and for a variety of travel purposes. Behaviours that are repeatedly performed in a stable context tend to become automatic and habitual. Travel behaviour is for a large part repetitive (commuting to work, purchases at the grocery stores, getting the children from and to school). Put differently, transport mode choice habits can "cut" conscious decision making aspects such as intentions and attitudes and can be directly elicited from context (Friedrichsmeier, Matthies, & Klöckner, 2013).

Performing a specific behaviour can affect the attitudes towards that behaviour, as indicated in the Self-Perception Theory (Bem, 1967, 1972) and Cognitive Dissonance Theory (Festinger, 1962). If people repeatedly perform a specific behaviour, their attitudes towards that behaviour will become more favourable in order to achieve cognitive consonance (a state in which behaviour and attitudes are in line with each other). One could therefore say that there is a "feedback loop" from behaviour to attitudes. However, external justification for performing the behaviour that is dissonant with the person's attitudes might prevent attitudes from changing in line with the actual behaviour. This could be the case for example, when using strong financial incentives for walking or cycling might lead people to walk or cycle while still maintaining a negative attitude towards it and come back to behaviours in line with their attitudes once the incentive is withdrawn.

It is now clear that a fully rational view of mode choice is insufficient to account for actual travel mode choice. The proposed model (Figure 2) therefore integrates the main behavioural components of the different waves mentioned above. It consequently rests on the idea that there are two main types of influences on modal choice:

The first one is a conscious – albeit not entirely “rational” – assessment of the behaviour to be performed and of the various alternatives available that will shape the individual’s *intentions* to adopt that behaviour or not. The factors affecting behavioural intentions (such as personal attitudes towards the various choice options, one’s perception of what is the appropriate choice to be made are included in the model (Figure 2) on the basis of the Theory of Planned Behaviour (Ajzen, 1991, 2005).

The second reflects the impact of automatic and non-conscious processes, that can intervene and weaken – or even interrupt – the relationship between intentions and behaviour, as a result of habitual mode choice for example.

In addition to the behavioural components of the model also socio-demographic, safety and security factors are part of the model. These factors are included as context that can enhance the actual behaviour or encourage behavioural change related to modal choice. Examples of social- demographic factors are: age distribution of citizens, educational level, climate and hilliness. Safety and security factors include: criminality, traffic safety figures and feelings of safety.

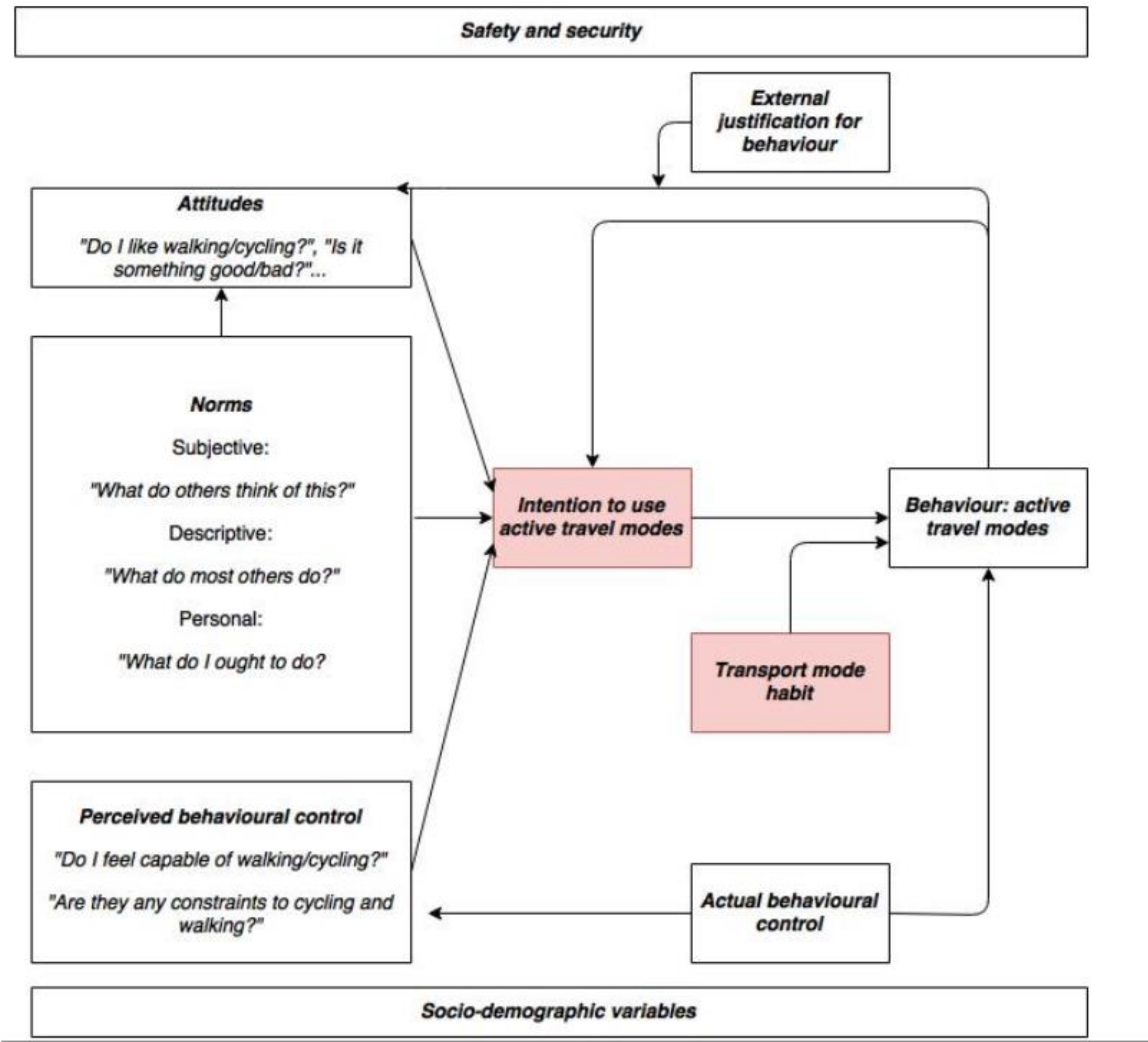

Figure 2: Proposed behavioural model accounting for travel mode choice.

3 Methodology

3.1 Research questions

Based on the work done in the first work package of the ISAAC project, and based on discussions with the CEDR project officer, the following research questions are formulated:

1. Among the factors identified in the literature, which ones can be considered as determinants of variations in the intentions to shift from car use to active travel modes?
2. Are there different groups of persons having common determinants of variations in the intentions?
3. How do the groups differ in terms of living environment and situation/current habitual use of mobility modality?
4. What are the obstacles that they (persons within and between groups) respectively perceive to this modal shift?
5. What are the interests for various Personal e-Transporters and their perceived (dis)advantages?

3.2 Survey design

An extensive online survey has been conducted in nine cities in the four countries of the ISAAC-consortium: Ghent and Liège (Belgium), Tilburg and Groningen (Netherlands), Trondheim and Bergen (Norway), and Düsseldorf, Dortmund and Berlin (Germany). The initial aim was to collect data from a representative sample of 250 respondents in two mid-sized cities (+/- 125,000 – 300,000 inhabitants). Due to circumstances, none of the contacted field work partners could provide the requested samples in German cities of this size. Düsseldorf and Dortmund were the best available options, and it was decided to include a third, large German city as well, namely Berlin.

Representativeness was monitored using soft quota based on city level population data of gender and age (three categories). Only respondents aged 18 or older were included. The data collection took place from 15th till 27th June 2018.

The full English master version of the questionnaire is added in Appendix 1. The structure of the questionnaire is briefly introduced here. The questionnaire was translated to German (Düsseldorf, Dortmund and Berlin), Norwegian (Trondheim and Bergen), French (Liège), 'Flemish' Dutch (Ghent) and 'Netherlands' Dutch (Tilburg and Groningen).

The questionnaire started with a general introduction and a number of questions to screen whether the respondent met the inclusion criteria. Questions related to country and postal code, birth year and whether they experience physical difficulties to walk or cycle. Respondents who indicate that walking as well as cycling are physically impossible for them were screened out.

In the next step, various socio-demographic variables were collected. These included gender, education level, living situation, vehicle ownership, license possession, possession of a season ticket for public transport, subscription to a bike or car sharing system and whether they could easily park a bicycle at home.

Then, respondents are asked how frequently they use various transport modes.

The next blocks dealt with the psychological determinants of transport mode choice. The order of the blocks was randomised to prevent possible biases due to order effects. All questions were asked on a 7-point Likert scale. Walking and cycling were treated in separate questions, and were kept as similar as possible between modes.

Walking and cycling attitudes were questioned in five items (fast, convenient, safe, good, pleasant). Norms were interviewed using three questions, each of which related to one of the different types of norms identified in our theoretical model (subjective norm, descriptive norm, personal norm). Perceived behavioural control was assessed for controllability (3 items for cycling and 2 for walking) and self-efficacy (3 items for each mode). Intentions were measured using 3 items for each mode. Behaviour was measured by asking respondents to fill in the number of trips by bike/foot they made in the past 3 days for 3 types of activities.

For walking as well as cycling, one question was asked to measure in which stage of behavioural change towards cycling or walking more frequently the respondent is. The different stages are based on previous work by Bamberg (2007). We distinguish the following stages:

- Pre-contemplation stage: the participant indicates that s/he has never thought about traveling by bicycle/by foot.
- Contemplation: the participant indicates that s/he has never travelled by bicycle, but sometimes considers it.
- Contemplation without preparation stage: the participant indicates that s/he sometimes travels by bicycle/by foot, but is not really considering to do it more regularly.
- Preparation stage: the participant indicates that s/he sometimes travels by bicycle/by foot, and is seriously thinking about doing so more regularly.
- Action stage: the participant indicates that s/he recently started to travel more frequently by bicycle/by foot, and is planning to keep on doing so in the future.
- Maintenance: the participant indicates that s/he has been travelling more frequently by bicycle/by foot for some time now.

Habit is measured using three questions, asking to what extent several types of trips are considered an 'ingrained routine'. People's environmental consciousness is measured using 6 questions from The New Ecological Paradigm Scale (NEPS) that appeared to be relevant in a previous study on road pricing by Cools et al. (2011). Finally, respondents were asked how important/problematic five obstacles (physical effort, time, cost, physical environment (climate, hilliness,…) and traffic safety) were for them to walk/cycle more frequently.

The final part of the survey interviewed respondents' interest in Personal e-Transporters. Personal e-Transporters ("PeTs") are compact devices with an electric engine that you can take with you, and that allow the user to travel for several kilometres. Examples are the electric scooter, Segway, solowheel and hoverboard. Before starting this part of the questionnaire, respondents received explanation on what PeTs are, including pictures of examples. Their possession rate of such devices was interrogated first. Then, the question about the stage of behavioural change is asked, as well as the frequency of usage in the last 12 months. Finally, respondents' perceptions of PeTs are measured on 6 items (fast, convenient, fashionable/cool, safe, cheap, pleasant/fun).

3.3 Data analysis

Several data analysis and modelling techniques are used to analyse the data. It is decided to explain them within the next section upon first usage because we believe this is a more convenient approach for the reader.

4 Analyses and results

4.1 Factor and cluster analysis

4.1.1 Data preparation

The data preparation stage concerned the (*i*) labelling and formatting of variables, (*ii*) advanced data cleaning, and (*iii*) weighting of the observations. In terms of data cleaning, from an original 2308 observations, 2159 observations were retained for further analysis. Reasons for deletion were (*i*) respondents indicating that they did not complete the question in an honest way, (*ii*) straight-liners, and (*iii*) respondents with abnormal responses (e.g. unrealistic age, too high vehicle possessions).

In terms of weighting, the joint age (18-34, 35-54, 55+)/gender distribution was used, using the most recently available (complete) joint distribution per city. The population data used to determine the weights were retrieved from Eurostat. The minimum weight equalled 0.588, the maximum 3.051. These extremes are in line with typical cut-off values used in weights for travel surveys, such as OVG, which adopts cut-off values of 0.35 and 3.00 (Cools, Declercq, Janssens, & Wets, 2011). By definition, the average weight per city equalled 1. An overview of the weights is provided in Table 1.

Table 1: Sample weights per city.

Ghent			**Liège**			**Tilburg**		
	Male	Female		Male	Female		Male	Female
18-34	1.786	0.989	18-34	1.292	1.014	18-34	1.556	0.677
35-54	1.208	0.708	35-54	1.174	0.853	35-54	1.379	0.891
55+	0.701	1.186	55+	0.766	1.090	55+	0.804	1.192
Groningen			**Dusseldorf**			**Dortmund**		
	Male	Female		Male	Female		Male	Female
18-34	2.421	0.761	18-34	0.924	1.019	18-34	1.097	0.749
35-54	0.792	0.997	35-54	1.251	0.869	35-54	1.147	0.875
55+	0.668	1.343	55+	0.862	1.135	55+	0.928	1.276
Berlin			**Bergen**			**Trondheim**		
	Male	Female		Male	Female		Male	Female
18-34	0.914	0.915	18-34	3.051	0.588	18-34	1.960	0.605
35-54	1.178	0.918	35-54	0.997	1.035	35-54	0.967	1.104
55+	0.965	1.118	55+	0.588	2.219	55+	0.614	2.445

4.1.2 Descriptive statistics of city data

In this section, the data from the survey will be described from the perspective of the individual cities. The descriptive statistics concern the weighted results. An overview of the socio-demographic characteristics of the sample is presented in Table 2. The percentages of the distribution of age and gender match perfectly with the population statistics of the city as the weighting is based on the (joint) distribution of these characteristics. For degree and living situation, no data about the full population is available. In terms of degree and living situations, noticeable (significant) differences exist in sample composition between the different cities (p-values of corresponding chi²-test smaller than 0.001).

Some noteworthy differences between the cities are the following:

- While Groningen (NL) generally has a younger population than the other surveyed cities, the German cities Dortmund and Düsseldorf (and to a lesser extent Berlin) have an older population
- The respondents from Trondheim (NO) and Ghent (BE) in the sample represent a higher educated population than the other cities. Respondents from Tilburg (NL) and Groningen (NL) reported a lower level of education compared to the other cities included in the survey.
- The highest share of participants who live alone is found in Berlin (DE), the lowest share in Bergen (NO). The highest share of participants living without a partner but with children is found in Liège (BE), while the lowest share is found in Groningen (NL) and Dortmund (DE). The highest share of participants indicating that they live with their parents is found in Ghent (BE) and Dortmund (DE). The highest share of people living with a partner but without children is found in Dortmund (DE) and Ghent (BE), while the lowest share is found in Trondheim (NO). The highest share living with a partner and children is found in Bergen (NO), Tilburg (NE) and Düsseldorf (DE), while the lowest share is found in Berlin (DE). Bergen and Trondheim (NO) have a relatively high proportion of participants indicating that they have a different living situation.

Table 2: Sample description per city: socio-demographic.

Variable	Ghent	Liège	Tilburg	Groningen	Düsseldorf	Dortmund	Berlin	Bergen	Trondheim	*Full sample*
Age										
18-34	33.1%	29.7%	32.4%	46.1%	27.6%	27.3%	28.7%	33.5%	35.3%	*32.7%*
35-54	32.9%	32.5%	34.4%	27.8%	35.3%	33.1%	34.2%	34.9%	34.2%	*33.3%*
55+	34.1%	37.8%	33.2%	26.1%	37.1%	39.6%	37.1%	31.6%	30.5%	*34.1%*
Gender										
Male	49.1%	48.1%	49.5%	49.6%	47.8%	48.7%	48.6%	50.0%	50.2%	*49.1%*
Female	50.9%	51.89%	50.5%	50.4%	52.2%	51.3%	51.4%	50.0%	49.8%	*50.9%*
Degree										
None/Primary education	2.6%	4.9%	3.1%	1.2%	4.6%	6.3%	4.5%	3.9%	2.4%	*3.7%*
Secondary education	40.2%	45.4%	56.8%	41.6%	54.9%	55.3%	52.4%	37.3%	28.8%	*45.7%*
Bachelor's degree or similar	33.6%	32.3%	31.9%	45.0%	25.1%	25.3%	25.5%	38.2%	35.9%	*32.5%*
Master's degree or higher	23.7%	17.4%	8.2%	12.2%	15.5%	13.2%	17.6%	20.5%	32.9%	*18.1%*
Living situation										
I live alone	28.7%	35.5%	28.1%	37.8%	32.2%	34.7%	39.9%	24.4%	29.7%	*32.2%*
I live without partner. with children	5.3%	10.1%	4.6%	3.3%	5.5%	3.1%	6.0%	4.4%	7.00%	*5.5%*
I live with my parents	11.4%	9.6%	8.6%	5.8%	12.7%	11.1%	6.9%	3.9%	3.3%	*8.1%*
I live with partner. without children	30.8%	24.8%	32.1%	26.9%	23.4%	35.7%	28.8%	25.3%	22.8%	*27.8%*
I live with partner and children	20.7%	17.3%	23.9%	18.4%	23.4%	13.6%	14.7%	23.9%	22.8%	*19.9%*
Other living situation	3.2%	2.7%	2.7%	7.8%	2.8%	1.8%	3.8%	18.2%	14.4%	*6.5%*

In terms of vehicle ownership, one could depict from Table 3 that large differences in household ownership of vehicles exist. Regarding bikes, especially the much larger ownership in the Netherlands with respect to e-bikes can be highlighted. Liège and Bergen show the lowest levels of (e-)bike possession. When it comes to possession rate of regular bikes, the Dutch cities have the highest number of bicycles per household on average, but they are closely followed by Ghent, Trondheim and Düsseldorf. Regarding possession of Personal e-Transports (PeTs) (Segway, electric scooter, solo-wheel, and hoverboard), one could see that ownership is still extremely limited. The ownership of PeTs is lowest in the Belgian and Norwegian cities.

Table 3: Sample description per city: vehicle ownership.*

Variable	Statistic	Ghent	Liège	Tilburg	Groningen	Düsseldorf	Dortmund	Berlin	Bergen	Trondheim	*Full sample*
Bike	Mean	1.72	0.74	1.88	1.94	1.57	1.19	1.41	1.03	1.60	*1.45*
	Std Dev	1.54	1.09	1.51	1.45	1.22	1.22	1.19	1.23	1.40	*1.38*
E-bike	Mean	0.19	0.05	0.34	0.37	0.09	0.10	0.12	0.05	0.11	*0.16*
	Std Dev	0.47	0.28	0.71	0.91	0.35	0.35	0.56	0.22	0.33	*0.52*
Moto	Mean	0.10	0.06	0.19	0.22	0.15	0.18	0.13	0.10	0.07	*0.13*
	Std Dev	0.32	0.29	0.48	0.68	0.42	0.48	0.40	0.41	0.28	*0.43*
Car	Mean	1.04	0.82	1.06	0.90	1.02	1.05	0.81	0.96	1.04	*0.97*
	Std Dev	0.74	0.70	0.90	0.82	0.78	0.80	0.78	0.79	0.84	*0.80*
Segway	Mean	0.00	0.02	0.06	0.08	0.08	0.08	0.03	0.00	0.02	*0.04*
	Std Dev	0.05	0.12	0.33	0.41	0.39	0.42	0.22	0.00	0.20	*0.28*
Electric scooter	Mean	0.03	0.01	0.06	0.08	0.08	0.09	0.08	0.00	0.01	*0.05*
	Std Dev	0.27	0.07	0.30	0.40	0.45	0.43	0.48	0.01	0.11	*0.33*
Solo-wheel	Mean	0.00	0.00	0.05	0.05	0.03	0.05	0.02	0.00	0.00	*0.02*
	Std Dev	0.05	0.00	0.34	0.34	0.23	0.28	0.21	0.00	0.05	*0.21*
Hoverboard	Mean	0.03	0.03	0.06	0.09	0.09	0.10	0.06	0.03	0.02	*0.05*
	Std Dev	0.19	0.26	0.24	0.41	0.43	0.43	0.33	0.16	0.12	*0.31*

* In the questionnaire the number of vehicles was queried for the 0-5 vehicles. If a household possessed more than 5 vehicles, a value of 6 was indicated. The mean value thus might be a (slight) underestimation of the true mean value.

The lowest subscription rate to a season ticket for using public transportation is found in Trondheim (26%), followed by Bergen (35%). The highest subscription rates are found in Düsseldorf, Berlin and Dortmund (50-53%). The higher subscription rate in the German cities could relate to their larger size, which usually implies a more extensive public transport network.

The highest driving license possession is found in Trondheim (90%), the lowest in Berlin (75%) and Groningen (78%). The highest subscription rates to a car sharing system are found in Berlin (24%) and in Düsseldorf (22%), the lowest rates are found in Liège, Tilburg, Trondheim and Ghent (<3%). The subscription rates to a bicycle sharing system are highest in Düsseldorf and Berlin (10% each), the lowest in the Norwegian and Belgian cities (<2% each).

Table 4: Sample description per city: subscription/access to transportation services.

Variable	Ghent	Liège	Tilburg	Groningen	Düsseldorf	Dortmund	Berlin	Bergen	Trondheim	*Full sample*
Season ticket for using public transportation										
Yes	47.8%	46.8%	43.8%	45.5%	52.9%	50.6%	51.6%	35.2%	26.23%	*44.3%*
No	52.2%	53.3%	56.2%	54.5%	47.1%	49.5%	48.4%	64.8%	73.7%	*55.7%*
Car driving license or permit										
No	17.7%	20.4%	17.6%	22.3%	13.3%	16.1%	25.1%	15.9%	10.3%	*17.6%*
Yes	82.3%	79.6%	82.5%	77.7%	86.7%	83.9%	74.9%	84.1%	89.7%	*82.5%*
Subscription to a car sharing system										
Yes	2.3%	0.6%	1.6%	5.7%	22.2%	8.8%	23.5%	3.2%	2.3%	*7.8%*
No	95.0%	92.9%	90.2%	84.2%	71.8%	86.4%	73.7%	93.3%	91.3%	*86.6%*
I do not know what a car sharing system is	2.8%	6.6%	8.2%	10.1%	6.0%	4.7%	2.8%	3.6%	6.5%	*5.6%*
Subscription to a bicycle sharing system										
Yes	1.0%	1.1%	5.1%	7.1%	10.1%	6.9%	9.6%	0.9%	0.9%	*4.7%*
No	92.6%	88.9%	83.8%	78.9%	82.2%	86.1%	85.6%	92.5%	91.3%	*87.0%*
I do not know what a bicycle sharing system is	6.4%	10.1%	11.1%	14.0%	7.7%	7.0%	4.8%	6.6%	7.8%	*8.3%*

Generally, the large majority of respondents considers it easy to park a bicycle at their home. The possibilities for parking a bicycle were perceived lowest in Liège (72% answered that they can easily park their bike), in all other cities more than 85% found it easy to park a bicycle at home.

The highest share of respondents indicating that they are not able to ride a bicycle are found in Liège (11%) and Dortmund (5%). These are also the cities with the highest share of participants who indicate physical difficulties in cycling. The full sample consisted of 81% of participants who indicate that they do not have any physical difficulties to cycle, 90% indicated that they do not have any physical difficulties to walk. Cycling is impossible for 5% of the participants in the sample, and walking for less than 1%. Recall that respondents who could neither cycle nor walk were screened out and are not included in the sample.

Table 5: Sample description per city: walk/cycle restrictions.

Variable	Ghent	Liège	Tilburg	Groningen	Düsseldorf	Dortmund	Berlin	Bergen	Trondheim	*Full sample*
Parking easily a bicycle at home										
Yes	86.1%	71.6%	96.4%	98.1%	88.6%	85.3%	90.0%	87.5%	96.3%	*89.0%*
No	14.0%	28.5%	3.7%	1.9%	11.5%	14.7%	10.0%	12.5%	3.7%	*11.0%*
Bike ability (Do you know how to ride a bicycle?)										
Yes	95.1%	88.1%	97.9%	99.0%	98.1%	92.5%	96.5%	94.7%	97.4%	*95.5%*
No	4.4%	10.9%	0.9%	1.0%	1.9%	7.0%	3.5%	5.3%	1.7%	*4.0%*
Prefer not to answer	0.5%	1.0%	1.2%	0.0%	0.0%	0.5%	0.0%	0.0%	1.0%	*0.5%*
Cycling difficulties because of physical reasons										
Is no problem for me	78.6%	66.6%	84.2%	86.5%	78.9%	69.0%	83.1%	86.3%	92.2%	*80.7%*
Is possible for me. but with difficulty	13.5%	20.0%	8.0%	8.0%	13.1%	19.7%	8.4%	9.3%	4.9%	*11.6%*
Is only possible for me with special assistance	2.0%	2.3%	3.9%	3.4%	3.0%	2.9%	2.0%	0.2%	0.8%	*2.3%*
Is impossible for me	5.9%	11.1%	4.0%	2.2%	5.0%	8.4%	6.5%	4.2%	2.1%	*5.5%*
Walking (for at least 10 minutes) difficulties because of physical reasons										
Is no problem for me	88.1%	87.0%	88.4%	87.7%	90.3%	84.6%	88.6%	96.0%	96.4%	*89.8%*
Is possible for me. but with difficulty	7.9%	12.0%	7.4%	8.8%	5.7%	13.1%	10.2%	3.3%	2.4%	*7.8%*
Is only possible for me with special assistance	3.2%	1.0%	2.9%	3.5%	3.0%	2.3%	0.8%	0.7%	0.5%	*2.0%*
Is impossible for me	0.8%	0.0%	1.4%	0.0%	1.0%	0.0%	0.4%	0.0%	0.8%	*0.5%*

Table 6 shows to what extent participants find several potential obstacles a barrier to cycle or walk more frequently (the same data are visualised in Figure 3 and Figure 4) as well. Generally, traffic safety (or the lack thereof) received the highest score as a barrier for cycling more frequently, followed by time, the required physical effort and the physical environment (climate, hilliness). Costs received the lowest score. Some differences between cities can be observed. A general difference between the cities is that the respondents from Dutch cities consistently give lower scores to the different possible obstacles, while respondents from Liège report a higher importance for each of the obstacles.

Traffic safety as a barrier for cycling more frequently receives by far the highest score in Liège, followed by the three German cities and Ghent. In the Dutch cities and in Trondheim, traffic safety received a relatively lower value as a barrier for cycling more frequently. The physical environment is also perceived the highest barrier in Liège. The fact that the scores for physical environment are quite average for the Norwegian cities, could implicitly be considered as an indication that hilliness is considered a more relevant element of the physical environment than climate since the Norwegian climate can be considered the least favourable for cycling. Somewhat related to the environment, physical effort is considered a larger barrier by respondents from Liège. The mutual differences in scores given to 'time' follow largely the general difference between the cities.

When we look at the obstacles against walking more frequently, it can be noted that time is considered by far the most important obstacle for walking more frequently. Time is considered the biggest barrier in Trondheim and in Ghent. Traffic safety is a considerably less important barrier for walking in comparison with the scores for cycling. Especially in Trondheim, Bergen and Groningen, the values indicate that traffic safety is not a major obstacle for walking more frequently. On the other hand, in Liège, traffic safety remains a relatively big obstacle.

Table 6: Sample description per city: importance* of obstacles for walking cycling.

Variable	Statistic	Ghent	Liège	Tilburg	Groningen	Düsseldorf	Dortmund	Berlin	Bergen	Trondheim	*Full sample*
Obstacle to cycle more frequently											
Physical effort	Mean	3.93	4.31	3.37	3.20	3.62	4.32	3.97	3.35	3.15	*3.68*
	Std Dev	1.88	1.77	2.00	2.03	1.85	1.91	1.92	1.88	1.89	*1.95*
Time	Mean	4.07	4.27	3.69	3.33	4.06	4.05	3.94	4.05	3.78	*3.91*
	Std Dev	1.82	1.79	1.82	2.02	1.95	2.01	1.97	2.12	2.06	*1.97*
Costs	Mean	3.04	3.54	2.52	2.49	2.59	3.02	2.68	2.46	2.30	*2.72*
	Std Dev	1.91	1.81	1.76	1.86	1.96	2.02	1.85	1.79	1.68	*1.88*
Environment (climate. hilliness)	Mean	3.66	4.51	2.94	2.92	3.65	3.89	3.46	3.80	3.30	*3.56*
	Std Dev	1.88	1.76	1.82	1.90	1.89	1.94	2.04	2.09	1.94	*1.97*
Traffic safety	Mean	4.35	5.38	3.38	2.90	4.49	4.60	4.84	4.15	3.36	*4.14*
	Std Dev	1.84	1.59	1.87	1.91	1.85	1.92	1.88	2.08	1.88	*2.01*
Obstacle to walk more frequently											
Physical effort	Mean	3.53	3.86	3.40	3.41	3.36	3.89	3.52	2.66	2.58	*3.35*
	Std Dev	2.06	1.89	2.06	2.14	1.91	2.14	2.14	1.81	1.86	*2.05*
Time	Mean	4.57	4.16	4.00	4.29	4.37	4.06	4.24	4.22	4.62	*4.28*
	Std Dev	2.01	1.98	1.93	2.19	2.04	2.18	2.13	2.20	2.15	*2.10*
Costs	Mean	2.75	2.26	2.29	2.25	2.35	2.46	2.30	1.68	1.71	*2.22*
	Std Dev	2.04	1.81	1.71	1.84	1.88	2.01	1.85	1.32	1.38	*1.80*
Environment (climate. hilliness)	Mean	3.20	4.19	2.86	2.81	3.43	3.65	3.14	2.77	2.56	*3.17*
	Std Dev	1.95	1.89	1.91	1.96	2.04	2.08	2.07	1.89	1.74	*2.00*
Traffic safety	Mean	3.66	4.00	3.06	2.67	3.38	3.50	3.21	2.50	2.38	*3.14*
	Std Dev	2.03	1.94	1.94	1.90	2.12	1.96	2.03	1.70	1.79	*2.00*

*Importance measured on 7-point Likert-scale, ranging from 1 'very unimportant' to 7 'very important'.

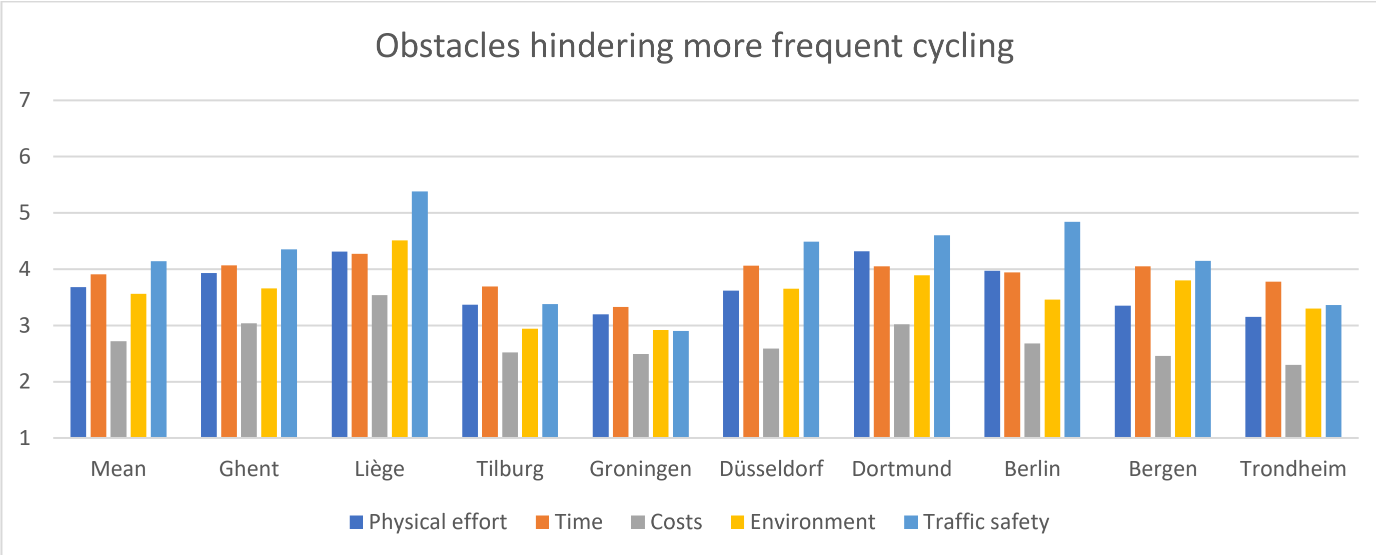

Figure 3: Obstacles hindering more frequent cycling.

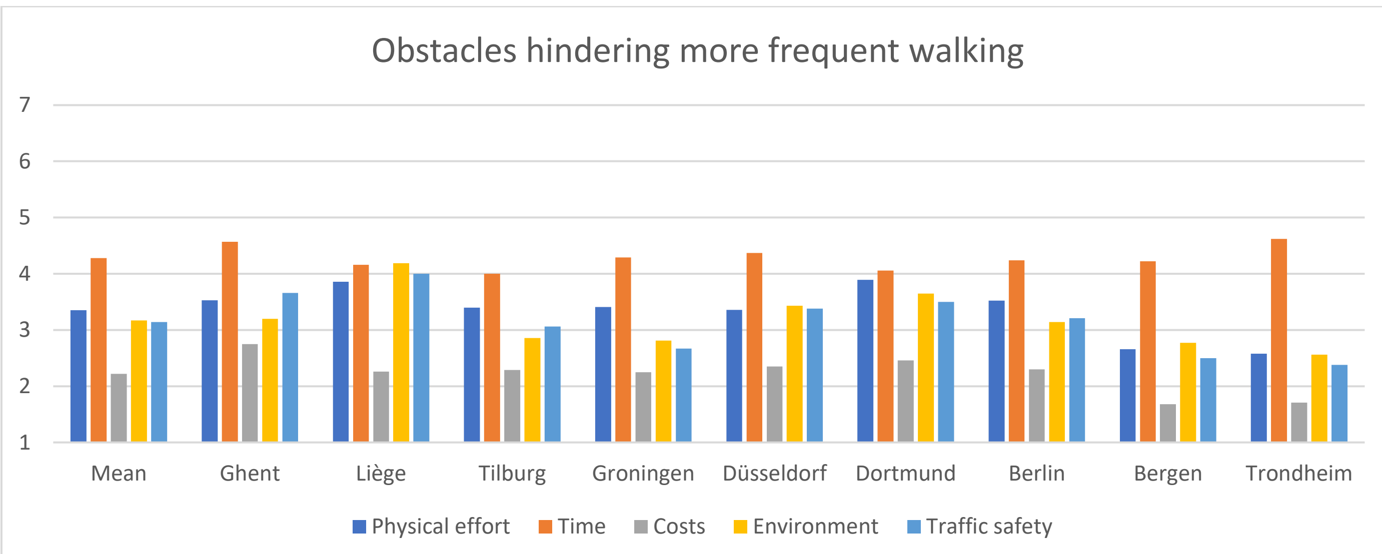

Figure 4: Obstacles hindering more frequent walking.

Walking frequency is highest in Berlin, where 69% of the respondents walk at least 5 days per week, followed by Düsseldorf (57%). The lowest share of walking is found in Trondheim and Ghent. Bicycle usage is by far the highest in Groningen, where 52% of the respondents indicate to cycle at least 5 days per week. Tilburg and Ghent also have high rates of cycling, with 30% of participants indicating that they cycle at least 5 days per week. The rates of cycling are extremely low in Liège and Bergen, where less than 5% cycle at least 5 days per week.

The rates of moped/motorbike riding are generally low, but seem slightly higher in the German and Dutch cities, compared to the Belgian and Norwegian cities. The highest rates of public transport use are found in the German cities, Ghent and Bergen, each with more than 25% of respondents indicating that they use public transport at least 5 times per week. The relatively high rates in Berlin, Düsseldorf and Dortmund could relate to the fact that these cities are larger than the cities in the other countries and therefore have higher service levels of public transport.

Usage of car as a driver is lowest in Groningen, where only 12% of the respondents use their car at least five times per week. Car usage as a driver is highest in the Norwegian cities and in Dortmund. Usage of car as a passenger and usage of taxis are relatively limited and do not show distinct patterns.

The current usage of Personal e-Transporters is highest in Groningen and the German cities, where around 10% of participants mentions occasional/frequent usage (at least on a monthly basis, or more often). Current usage is lowest in the Norwegian cities.

Table 7: Modal practice per city.

Variable	Ghent	Liège	Tilburg	Groningen	Düsseldorf	Dortmund	Berlin	Bergen	Trondheim	*Full sample*
Usage frequency past 12 months (all motives): By foot (>= 10 minutes)										
Never	2.7%	0.9%	3.0%	3.7%	2.5%	3.2%	1.6%	3.0%	1.7%	*2.5%*
One to a few days a year	6.9%	6.5%	4.4%	4.4%	4.1%	5.7%	3.1%	4.1%	7.6%	*5.2%*
One to a few days per month	15.2%	12.9%	11.0%	10.8%	11.9%	11.8%	7.1%	13.4%	10.0%	*11.6%*
One to a few days per week	33.1%	31.1%	35.4%	34.2%	24.4%	27.9%	18.9%	24.9%	40.0%	*30.0%*
At least 5 days per week	42.0%	48.7%	46.2%	46.9%	57.1%	51.3%	69.3%	54.7%	40.8%	*50.8%*
Usage frequency past 12 months (all motives): Bicycle										
Never	21.5%	54.1%	12.9%	7.0%	19.3%	34.0%	19.8%	49.7%	25.7%	*27.1%*
One to a few days a year	13.1%	19.3%	7.4%	6.0%	16.6%	14.3%	17.5%	24.9%	20.0%	*15.5%*
One to a few days per month	15.5%	16.3%	17.3%	7.7%	26.0%	24.0%	23.2%	11.8%	15.0%	*17.4%*
One to a few days per week	20.4%	7.1%	32.3%	27.5%	25.6%	21.2%	25.7%	9.2%	20.4%	*21.0%*
At least 5 days per week	29.6%	3.2%	30.2%	51.9%	12.6%	6.6%	13.8%	4.6%	19.1%	*19.0%*

Usage frequency past 12 months (all motives): Moped/motorbike										
Never	89.1%	93.9%	78.5%	82.7%	81.5%	80.1%	85.0%	92.1%	90.6%	*86.0%*
One to a few days a year	2.8%	3.2%	6.1%	5.3%	4.6%	9.1%	4.0%	3.2%	4.0%	*4.7%*
One to a few days per month	4.3%	1.0%	6.6%	5.0%	6.2%	7.4%	3.9%	2.2%	3.4%	*4.4%*
One to a few days per week	2.1%	1.6%	7.0%	5.0%	5.3%	2.5%	3.8%	1.0%	1.8%	*3.3%*
At least 5 days per week	1.7%	0.3%	1.9%	2.0%	2.4%	0.9%	3.4%	1.6%	0.2%	*1.6%*
Usage frequency past 12 months (all motives): Public transport										
Never	9.6%	12.4%	20.8%	9.9%	4.6%	9.4%	4.6%	1.3%	4.4%	*8.5%*
One to a few days a year	21.2%	24.9%	31.6%	35.0%	15.8%	22.2%	11.1%	18.7%	17.5%	*21.9%*
One to a few days per month	28.3%	19.0%	22.4%	25.3%	22.4%	16.1%	18.6%	26.5%	36.1%	*24.0%*
One to a few days per week	22.0%	18.7%	17.2%	27.2%	23.2%	26.5%	26.3%	25.3%	28.4%	*23.9%*
At least 5 days per week	19.0%	25.1%	8.0%	2.7%	34.0%	25.7%	39.5%	28.2%	13.7%	*21.8%*
Usage frequency past 12 months (all motives): Taxi (incl. companies like Uber)										
Never	64.1%	59.1%	59.8%	62.0%	33.7%	37.5%	40.4%	27.6%	27.1%	*45.4%*
One to a few days a year	28.3%	33.3%	33.1%	30.1%	46.6%	46.8%	45.1%	55.1%	60.1%	*42.3%*
One to a few days per month	4.5%	6.5%	3.7%	2.8%	14.6%	12.7%	13.0%	15.9%	11.2%	*9.5%*
One to a few days per week	3.2%	0.5%	1.5%	4.1%	3.4%	2.6%	0.8%	1.0%	1.4%	*2.0%*
At least 5 days per week	0.0%	0.6%	2.0%	1.1%	1.6%	0.5%	0.8%	0.4%	0.2%	*0.8%*
Usage frequency past 12 months (all motives): Car as a driver										
Never	24.2%	27.8%	27.4%	32.0%	20.9%	19.6%	33.7%	17.9%	12.8%	*23.9%*
One to a few days a year	7.1%	4.7%	5.5%	9.8%	9.2%	4.0%	9.5%	9.2%	11.7%	*7.9%*
One to a few days per month	13.2%	11.1%	10.4%	13.3%	12.8%	10.8%	13.3%	12.5%	11.6%	*12.1%*
One to a few days per week	30.2%	19.4%	28.0%	30.8%	26.0%	25.7%	18.6%	22.5%	22.5%	*24.8%*
At least 5 days per week	25.4%	37.0%	28.8%	14.2%	31.1%	39.8%	25.0%	37.9%	41.5%	*31.3%*
Usage frequency past 12 months (all motives): Car as passenger										
Never	9.6%	8.2%	8.6%	7.5%	9.1%	8.7%	15.5%	1.8%	4.5%	*8.1%*
One to a few days a year	27.7%	24.5%	24.0%	23.5%	22.1%	24.6%	25.5%	24.1%	23.1%	*24.3%*
One to a few days per month	32.6%	31.7%	30.5%	32.4%	33.7%	25.6%	27.0%	39.0%	39.6%	*32.5%*
One to a few days per week	26.6%	29.5%	32.1%	31.2%	24.9%	30.1%	22.3%	25.0%	26.9%	*27.6%*
At least 5 days per week	3.6%	6.2%	4.8%	5.4%	10.3%	11.1%	9.7%	10.2%	5.9%	*7.5%*
Usage frequency past 12 months (all motives): Personal e-Transporters										
Never	91.1%	93.0%	87.5%	83.8%	80.2%	81.5%	83.7%	97.9%	94.2%	*88.1%*
One to a few days a year	6.2%	4.3%	4.7%	6.6%	9.7%	7.9%	7.4%	0.7%	3.8%	*5.7%*
One to a few days per month	1.2%	0.0%	1.8%	2.1%	5.2%	5.7%	5.4%	1.1%	2.0%	*2.7%*
One to a few days per week	1.0%	2.2%	3.4%	2.7%	2.9%	3.7%	2.0%	0.2%	0.0%	*2.0%*
At least 5 days per week	0.6%	0.6%	2.5%	4.8%	2.0%	1.3%	1.4%	0.0%	0.0%	*1.4%*

Table 8 indicates the stage of behaviour change towards more cycling, walking, and using Personal e-Transporters. The different stages were explained in section 3.2. For cycling, we see a quite dispersed pattern. The largest group of participants are in the Maintenance stage (28%). The pre-contemplation (17%), contemplation without preparation (20%) and preparation stage (19%) are quite large as well. Clear differences between cities can be observed. In the Dutch cities Tilburg and Groningen, the majority of respondents are in the higher stages, with an exceptionally high share of 71% of respondents in the Maintenance stage in Groningen. Ghent has a high share of respondents in the Maintenance stage (40%) as well, but has a slightly higher share of respondents in the pre-contemplation stage compared to other medium-to-well performing cities. In Bergen and Liège, participants are comparatively speaking in the lowest stages of the investigated cities.

Walking generally has a higher share of respondents in the highest stages of behavioural change than cycling. The differences between cities are less pronounced. Berlin has the highest share of people in the highest (Maintenance) stage (52%), followed by Düsseldorf (49%) and Groningen (48%). Bergen generally shows respondents in the lowest levels of behavioural change towards more walking, with only 30% in the Maintenance stage, followed by Trondheim (32%). Both cities also have the highest shares of respondents in the lowest (Pre-contemplation) stage (19% and 11%, respectively).

Not unexpected, the vast majority of respondents are in the Pre-contemplation stage when it comes to using PeTs. Generally, we see the lowest share of respondents that are in the lowest (pre-contemplation) stage in the German cities (60-65%). The highest share of respondents in the lowest stage are found in Ghent (85%).

Table 8: Stage in the cycle of change per city.

Variable	Ghent	Liège	Tilburg	Groningen	Düsseldorf	Dortmund	Berlin	Bergen	Trondheim	*Full sample*
Cycling: Stage in the cycle of change towards more cycling										
Pre-contemplation	12.5%	32.6%	5.7%	1.1%	9.0%	19.0%	9.4%	40.7%	21.2%	*16.8%*
Contemplation	3.6%	22.2%	3.9%	0.9%	5.7%	10.8%	5.8%	17.2%	14.0%	*9.2%*
Contemplation. no preparation	20.9%	27.0%	18.4%	10.9%	24.3%	19.1%	24.2%	20.9%	19.2%	*20.5%*
Preparation	16.2%	10.7%	20.7%	8.7%	28.0%	25.4%	26.5%	12.3%	19.6%	*18.7%*
Action	6.9%	1.6%	11.6%	7.3%	9.7%	9.6%	9.6%	2.0%	3.9%	*6.9%*
Maintenance	40.0%	5.9%	39.7%	71.1%	23.4%	16.2%	24.6%	6.9%	22.1%	*28.0%*
Walking: Stage in the cycle of change towards more walking										
Pre-contemplation	2.0%	7.7%	1.8%	0.6%	1.1%	3.4%	1.1%	18.8%	10.9%	*5.4%*
Contemplation	0.6%	2.6%	1.1%	0.6%	1.3%	2.6%	1.2%	3.0%	4.7%	*2.0%*
Contemplation. no preparation	26.9%	23.7%	28.2%	26.4%	17.3%	24.7%	21.7%	24.2%	28.1%	*24.6%*
Preparation	17.4%	17.7%	16.6%	12.3%	18.9%	21.8%	16.5%	19.4%	19.0%	*17.8%*
Action	11.4%	12.1%	15.7%	12.7%	12.8%	11.6%	6.9%	4.5%	5.4%	*10.3%*
Maintenance	41.8%	36.2%	36.6%	47.5%	48.6%	35.9%	52.6%	30.1%	32.0%	*40.1%*

E-assisted transport modes: Stage in the cycle of change towards more frequent use of Personal e-Transporters										
Pre-contemplation	84.9%	72.0%	81.9%	79.0%	65.4%	60.3%	63.7%	77.0%	75.9%	*73.4%*
Contemplation	10.2%	23.8%	8.8%	10.0%	24.3%	25.9%	27.5%	20.5%	20.9%	*19.1%*
Contemplation. no preparation	1.9%	2.0%	2.2%	5.9%	4.9%	5.0%	3.6%	0.9%	1.2%	*3.0%*
Preparation	1.5%	0.5%	1.5%	3.4%	3.4%	5.0%	3.2%	0.5%	1.6%	*2.3%*
Action	0.7%	0.6%	1.9%	1.1%	0.0%	1.8%	1.7%	0.0%	0.0%	*0.9%*
Maintenance	0.9%	1.1%	3.7%	0.6%	2.1%	2.1%	0.4%	1.1%	0.4%	*1.4%*

Table 9 shows respondents' perceptions related to using Personal e-Transporters for daily travel (the same data are visualised in Figure 5 as well). Since 4 is the neutral value in the 7-point scale, we can see that on average, respondents' attitudes towards PeTs are not yet very favourable. Generally, respondents' perceptions related to cost and safety received the lowest scores. Significant differences between the cities can be observed. The most favourable perceptions are reported in the German cities, especially in Dortmund. Perhaps most noteworthy are their more favourable perceptions related to cost and safety. The least favourable perceptions are reported in Bergen and Trondheim.

Table 9: Perceptions of PeTs per city.

Variable	Ghent		Liège		Tilburg		Groningen		Düsseldorf		Dortmund		Berlin		Bergen		Trondheim		*Full sample*		ANOVA
	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	*Mean*	*Std Dev*	P-value
Fast	3.79	1.75	3.98	1.75	3.34	1.90	3.80	1.84	4.02	1.81	4.24	1.87	3.93	1.98	2.51	1.65	3.06	1.86	*3.62*	*1.90*	< 0.001
Convenient	3.28	1.73	3.65	1.82	3.10	1.85	3.50	2.01	3.75	1.88	4.07	2.03	3.81	2.04	2.31	1.64	2.54	1.75	*3.32*	*1.94*	< 0.001
Fashionable/ cool	3.33	1.80	3.94	1.88	3.05	1.86	3.26	1.97	3.60	2.01	3.82	2.11	3.54	2.04	2.50	1.65	2.58	1.78	*3.28*	*1.96*	< 0.001
Safe	2.65	1.51	2.86	1.56	2.77	1.69	3.09	1.66	3.48	1.77	3.65	1.80	3.27	1.80	2.28	1.53	2.57	1.65	*2.95*	*1.72*	< 0.001
Cheap	2.60	1.48	2.70	1.63	2.56	1.73	2.68	1.77	3.33	1.84	3.53	2.02	3.09	1.85	2.49	1.72	2.61	1.67	*2.84*	*1.78*	< 0.001
Pleasant/fun	3.35	1.75	3.99	1.75	3.20	1.88	3.63	1.92	3.76	1.96	4.02	2.06	3.71	2.04	2.54	1.68	2.87	1.82	*3.44*	*1.93*	< 0.001

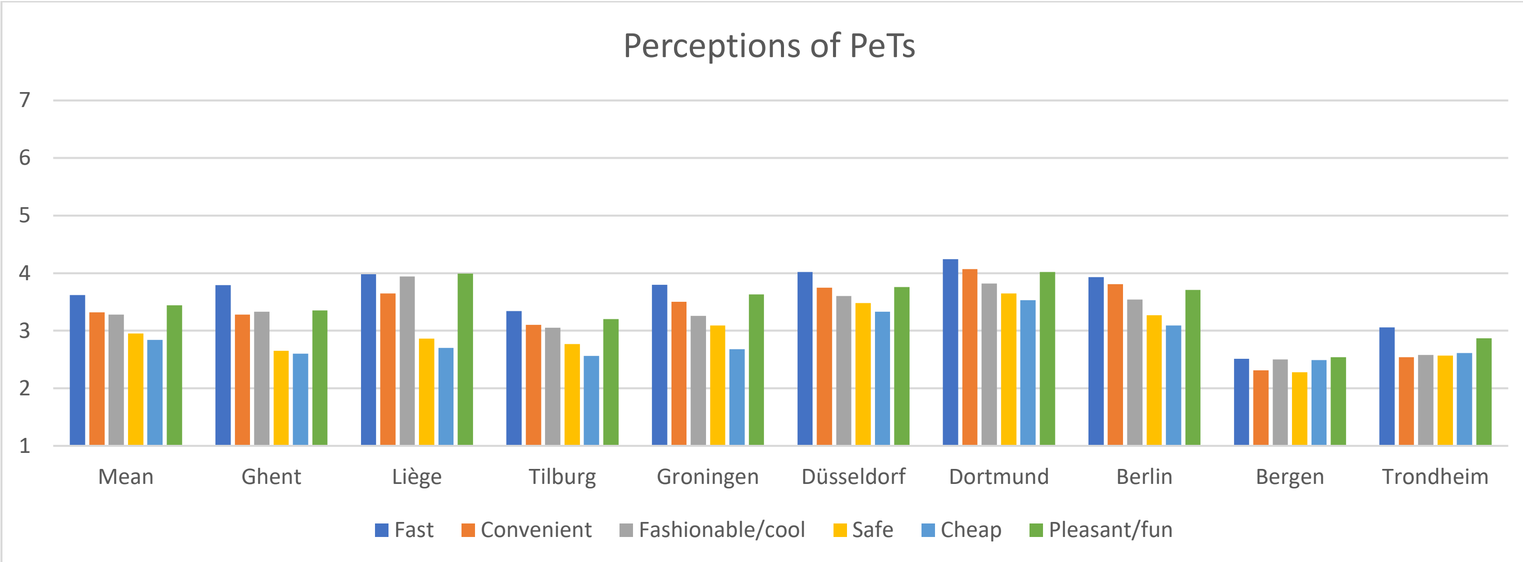

Figure 5: Perceptions of PeTs per city.

Table 10 shows the values of the different participants on a number of questions derived from the New Ecological Paradigm Scale (NEPS). More specifically, the questions that appeared to be relevant in a previous study on road pricing by Cools et al. (2011) were included. Generally, the values are lowest in Tilburg, which implies that respondents from Tilburg have the least strong pro-environmental orientation of the investigated cities. The values are highest in Dortmund.

Table 10: Pro-environmental orientation (NEPS) per city.

Variable	Ghent		Liège		Tilburg		Groningen		Düsseldorf		Dortmund		Berlin		Bergen		Trondheim		*Full sample*		ANOVA
	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	*Mean*	*Std Dev*	P-value
NEPS 1	4.98	1.43	5.31	1.40	4.92	1.38	4.87	1.48	5.67	1.36	5.72	1.52	5.73	1.38	5.26	1.52	5.24	1.42	*5.30*	*1.47*	< 0.001
NEPS 2	5.47	1.42	5.98	1.26	5.29	1.30	5.65	1.24	5.90	1.44	6.07	1.24	5.86	1.36	5.40	1.55	5.58	1.47	*5.68*	*1.39*	< 0.001
NEPS 3	5.64	1.25	5.68	1.39	5.24	1.34	5.56	1.31	5.82	1.32	5.79	1.31	5.83	1.31	5.80	1.49	6.07	1.20	*5.72*	*1.34*	< 0.001
NEPS 4 (Reversed)	4.93	1.69	5.14	1.69	4.36	1.55	4.82	1.72	5.04	1.87	5.21	1.70	5.04	1.75	5.07	1.82	5.44	1.60	*5.01*	*1.73*	< 0.001
NEPS 5	5.30	1.32	5.63	1.33	5.14	1.34	5.17	1.36	5.72	1.45	5.79	1.38	5.74	1.35	5.24	1.55	5.35	1.45	*5.45*	*1.42*	< 0.001
NEPS 6	5.15	1.45	5.45	1.46	4.65	1.52	4.94	1.50	5.30	1.51	5.35	1.56	5.26	1.64	4.72	1.81	5.10	1.64	*5.10*	*1.59*	< 0.001

4.1.3 Comparison of theory of planned behaviour variables and habit per city

To assess whether the different variables corresponding to the theory of planned behaviour differ between the different cities, for each of the variables, an ANOVA test was carried out. In contrast to the (categorical) factor analysis that was carried out, the ANOVA tests assume that the likert-scale variables can be interpreted as a ratio scale. The main motivation for adopting ANOVA tests is the fact that this assumption is commonly accepted, and that non-parametric alternatives cannot be used in combination with (non-integer) weights.

Table 11 shows respondents' attitudes towards cycling and walking, expressed as the extent to which they agree that cycling/walking for their everyday travel is fast (attitude 1), convenient (attitude 2), safe (attitude 3), good (attitude 4) and pleasant (attitude 5). The attitude dimensions that have been interrogated are fast (attitude 1) Cycling as well as walking attitudes differ significantly between cities. The most favourable cycling attitudes are found in Groningen and in Tilburg, the least favourable in Bergen. The most favourable walking attitudes are found in Groningen, Tilburg, Trondheim and Ghent, while walking attitudes are least favourable in Dortmund.

Table 11: Cycling and walking attitudes per city.

Variable	Ghent		Liège		Tilburg		Groningen		Düsseldorf		Dortmund		Berlin		Bergen		Trondheim		*Full sample*		ANOVA
	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	*Mean*	*Std Dev*	P-value
Cycling Attitude 1	4.77	1.76	3.76	1.81	4.84	1.76	5.64	1.57	4.54	1.76	4.08	1.88	4.48	1.90	2.99	2.01	4.30	2.08	*4.38*	*1.97*	< 0.001
Cycling Attitude 2	4.79	1.77	3.81	1.76	5.00	1.73	5.70	1.62	4.47	1.72	4.06	1.94	4.64	1.92	2.84	1.97	4.08	2.19	*4.38*	*2.01*	< 0.001
Cycling Attitude 3	4.00	1.75	3.04	1.60	4.99	1.59	5.56	1.46	4.29	1.68	4.07	1.81	3.91	1.77	3.35	1.86	4.57	1.89	*4.21*	*1.86*	< 0.001
Cycling Attitude 4	4.91	1.69	4.40	1.70	5.26	1.61	5.79	1.39	4.56	1.72	4.19	1.86	4.67	1.88	3.55	2.03	4.55	2.00	*4.65*	*1.88*	< 0.001
Cycling Attitude 5	4.51	1.81	3.87	1.80	4.89	1.72	5.53	1.56	4.24	1.71	3.80	1.86	4.26	1.89	3.14	1.91	4.21	1.93	*4.27*	*1.91*	< 0.001
Walking Attitude 1	4.05	1.84	3.55	1.96	4.10	1.84	4.19	1.86	3.83	1.84	3.92	1.95	3.96	1.98	3.72	2.18	3.94	2.06	*3.92*	*1.96*	0.017
Walking Attitude 2	4.68	1.63	4.25	1.86	4.69	1.74	4.71	1.73	4.45	1.80	4.31	1.94	4.69	1.85	4.14	2.20	4.48	1.99	*4.49*	*1.88*	0.001
Walking Attitude 3	5.23	1.38	4.71	1.77	5.36	1.41	5.57	1.44	5.06	1.59	4.79	1.83	5.17	1.68	5.23	1.84	5.59	1.63	*5.19*	*1.65*	< 0.001
Walking Attitude 4	5.29	1.33	5.08	1.61	5.29	1.45	5.28	1.54	4.79	1.68	4.70	1.78	4.92	1.77	5.03	1.77	5.31	1.66	*5.08*	*1.64*	< 0.001
Walking Attitude 5	5.00	1.47	4.62	1.74	4.91	1.65	5.03	1.64	4.53	1.65	4.37	1.84	4.67	1.76	4.65	1.94	5.17	1.68	*4.77*	*1.73*	< 0.001

Cycling norms and walking norms differ significantly between cities as well (Table 12). Norm 1 refers to the subjective norm, norm 2 to descriptive norm and norm 3 to personal norm. Cycling norms seem generally highest in Groningen, despite the fact that the value for cycling norm 1 is somewhat lower, followed by Tilburg and Ghent. The lowest values for cycling norms are found in Bergen, followed by Liège. The values regarding walking norms are generally highest in Dortmund and lowest in Bergen.

Table 12: Cycling and walking norms per city.

Variable	Ghent		Liège		Tilburg		Groningen		Düsseldorf		Dortmund		Berlin		Bergen		Trondheim		*Full sample*		ANOVA
	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	*Mean*	*Std Dev*	P-value
Cycling Norm 1	3.08	1.78	2.59	1.61	3.12	1.85	2.58	1.79	3.15	1.94	3.31	1.90	2.91	1.98	2.39	1.63	2.72	1.79	*2.87*	*1.84*	< 0.001
Cycling Norm 2	4.01	1.75	2.56	1.54	4.02	1.69	4.56	1.67	3.58	1.82	3.58	1.96	3.63	1.87	2.28	1.62	3.40	1.95	*3.52*	*1.89*	< 0.001
Cycling Norm 3	4.03	2.05	2.64	1.85	3.91	1.93	4.27	1.87	3.66	1.89	3.50	1.93	3.62	2.20	2.29	1.78	3.18	2.08	*3.46*	*2.05*	< 0.001
Walking Norm 1	3.06	1.79	3.26	1.76	3.11	1.76	2.68	1.78	3.40	1.92	3.43	2.03	2.99	1.98	2.83	1.89	2.90	1.79	*3.07*	*1.87*	< 0.001
Walking Norm 2	3.77	1.71	3.47	1.71	3.62	1.57	3.62	1.57	4.18	1.76	4.16	1.85	4.03	1.79	3.17	1.85	3.27	1.61	*3.69*	*1.75*	< 0.001
Walking Norm 3	4.28	1.80	3.84	2.01	3.92	1.85	3.78	1.85	4.30	1.86	3.97	1.95	3.90	2.13	3.50	2.16	3.67	1.98	*3.90*	*1.97*	< 0.001

Generally, the values related to PBC self-efficacy are very high for walking and cycling, and also the values for PBC controllability are quite high. Again, significant differences can be found between the cities.

The self-efficacy regarding cycling is highest in Groningen, followed by Trondheim, Düsseldorf and Tilburg, and lowest in Liège. Cycling controllability is highest in Tilburg and Groningen, and lowest in Liège.

Walking self-efficacy is highest in Bergen and Trondheim, followed by Ghent, and lowest in Dortmund and Liège. Walking controllability received the highest scores in Groningen, followed by Tilburg and Düsseldorf, and the lowest scores in Liège.

Table 13: Perceived behavioural control regarding cycling and walking norms per city.

Variable	Ghent		Liège		Tilburg		Groningen		Düsseldorf		Dortmund		Berlin		Bergen		Trondheim		*Full sample*		ANOVA
	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	*Mean*	*Std Dev*	P-value
Cycling PBC - Controllability 1	4.22	1.64	2.98	1.63	5.22	1.50	5.69	1.26	4.30	1.68	3.98	1.74	4.05	1.81	3.23	1.73	4.79	1.56	*4.29*	*1.81*	< 0.001
Cycling PBC - Controllability 2	4.52	1.82	3.30	1.89	5.33	1.59	5.11	1.64	4.76	1.97	4.50	1.97	4.59	1.95	4.06	2.07	4.96	1.78	*4.59*	*1.94*	< 0.001
Cycling PBC - Controllability 3	4.31	1.64	3.59	1.87	5.62	1.62	5.37	1.78	4.80	1.86	3.90	1.73	4.79	1.71	3.40	1.92	4.27	1.88	*4.46*	*1.92*	< 0.001

Walking PBC - Controllability 1	4.88	1.41	5.06	1.63	5.15	1.37	5.61	1.22	5.38	1.42	5.03	1.43	5.28	1.52	5.36	1.45	5.50	1.42	*5.25*	*1.45*	< 0.001
Walking PBC - Controllability 2	5.21	1.64	4.39	1.83	5.73	1.64	5.71	1.65	5.39	1.77	4.62	1.72	5.36	1.78	5.32	1.72	5.57	1.56	*5.26*	*1.75*	< 0.001
Cycling PBC - Self-efficacy 1	5.14	1.88	4.08	1.89	5.73	1.57	6.13	1.20	5.62	1.64	5.07	2.05	5.52	1.76	4.68	2.17	5.48	1.84	*5.29*	*1.88*	< 0.001
Cycling PBC - Self-efficacy 2	4.68	1.94	3.40	1.86	4.73	1.85	5.30	1.69	4.81	1.92	4.19	2.08	4.75	1.94	4.69	2.10	5.43	1.80	*4.69*	*1.99*	< 0.001
Cycling PBC - Self-efficacy 3	5.52	1.88	4.69	2.03	5.70	1.67	6.14	1.48	6.03	1.50	5.33	2.01	5.90	1.63	5.55	1.93	6.19	1.55	*5.69*	*1.80*	< 0.001
Walking PBC - Self-efficacy 1	6.34	1.15	6.02	1.35	6.08	1.40	6.36	1.03	6.08	1.47	5.85	1.54	5.97	1.42	6.68	0.79	6.60	0.97	*6.23*	*1.28*	< 0.001
Walking PBC - Self-efficacy 2	5.75	1.58	5.08	1.83	5.17	1.83	5.52	1.86	5.52	1.72	5.16	2.00	5.41	1.86	6.42	1.27	6.48	1.17	*5.63*	*1.76*	< 0.001
Walking PBC - Self-efficacy 3	6.19	1.36	5.87	1.58	5.81	1.64	5.98	1.69	6.21	1.41	5.74	1.88	6.02	1.58	6.54	1.23	6.65	1.04	*6.12*	*1.53*	< 0.001

The intentions to cycle instead of using the car for trips in the next weeks are highest in Groningen, followed by Tilburg, and lowest in Bergen and Liège (Table 14). The intentions to walk differ somewhat less between cities, but are generally slightly higher in Ghent, Groningen and Berlin, while they are slightly lower in Bergen, Liège, and Dortmund.

Table 14: Cycling and walking intentions per city.

Variable	Ghent		Liège		Tilburg		Groningen		Düsseldorf		Dortmund		Berlin		Bergen		Trondheim		*Full sample*		ANOVA
	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	*Mean*	*Std Dev*	P-value
Cycling Intention 1	4.32	2.24	2.67	1.85	4.83	1.99	5.75	1.77	3.95	2.01	3.72	2.08	4.16	2.11	2.66	2.04	3.86	2.27	*4.00*	*2.24*	< 0.001
Cycling Intention 2	4.44	2.32	2.62	1.87	4.68	2.08	5.75	1.82	3.88	2.02	3.53	2.09	3.91	2.23	2.45	2.10	3.66	2.39	*3.89*	*2.32*	< 0.001
Cycling Intention 3	4.43	2.35	2.54	1.87	4.75	2.08	5.68	1.83	4.01	2.07	3.60	2.11	3.99	2.24	2.28	2.04	3.61	2.39	*3.89*	*2.34*	< 0.001
Walking Intention 1	4.82	1.70	4.38	2.05	4.48	1.82	4.76	1.76	4.64	1.87	4.49	2.01	4.72	1.99	4.22	2.27	4.52	2.00	*4.56*	*1.96*	0.013
Walking Intention 2	4.62	1.85	4.45	2.15	4.44	1.90	4.62	1.94	4.58	1.98	4.30	2.07	4.62	2.05	4.10	2.36	4.34	2.19	*4.45*	*2.06*	0.061
Walking Intention 3	4.75	1.87	4.42	2.17	4.33	1.95	4.77	1.97	4.68	2.00	4.40	2.07	4.71	2.06	4.10	2.38	4.40	2.24	*4.50*	*2.09*	0.003

Table 15 shows the mode choice behaviour per city, expressed as the mean number of trips taken in the last 30 days for work/school activities (behaviour 1), shopping activities (behaviour 2) and leisure activities (behaviour 3) by the respondents.

By far the highest number of cycling trips are reported in Groningen, followed by Tilburg and Ghent. The lowest number of cycling trips are reported in Liège and in Bergen. The highest number of walking trips are reported in Berlin, Düsseldorf, Dortmund and Bergen. The lowest number of walking trips is reported in Tilburg.

Table 15: Mode choice behaviour per city (in number of trips per respondent in the last 30 days).

Variable	Ghent		Liège		Tilburg		Groningen		Düsseldorf		Dortmund		Berlin		Bergen		Trondheim		*Full sample*		ANOVA
	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	*Mean*	*Std Dev*	P-value
Cycling Behav. 1	7.61	11.71	0.94	4.87	6.70	9.88	12.17	13.31	3.92	7.36	2.38	5.23	3.92	7.38	1.52	4.74	5.37	10.24	*5.00*	*9.44*	< 0.001
Cycling Behav. 2	6.36	9.62	1.64	5.82	7.57	10.24	13.12	13.79	5.08	8.14	4.47	6.27	4.21	6.29	1.47	4.01	3.57	7.21	*5.29*	*9.02*	< 0.001
Cycling Behav. 3	4.64	6.01	1.54	3.94	5.75	8.39	8.98	9.15	4.24	6.65	4.09	6.28	3.76	6.08	1.32	3.83	2.70	5.84	*4.12*	*6.81*	< 0.001
Walking Behav. 1	4.66	9.64	5.86	11.34	3.10	6.87	3.73	7.80	5.28	8.91	4.57	8.96	5.55	9.40	8.42	13.70	5.04	8.97	*5.15*	*9.80*	< 0.001
Walking Behav. 2	9.41	11.77	8.93	9.85	8.18	9.38	10.15	9.77	10.64	12.03	9.75	9.25	13.06	11.79	8.52	8.61	9.71	11.12	*9.82*	*10.54*	< 0.001
Walking Behav. 3	5.55	8.13	5.53	8.41	4.69	7.66	6.06	10.27	6.46	7.90	7.86	10.31	7.52	8.89	5.47	7.64	4.79	7.07	*5.99*	*8.58*	< 0.001

Generally, respondents indicate that the way they travel to shopping locations is the strongest ingrained routine (‘habit 2’), followed by the way they go to work/school (‘habit 1’). The way they travel to leisure locations (‘habit 3’) is a somewhat less strongly ingrained routine.

Generally, respondents agree more strongly that their travel behaviour is an ingrained routine in Groningen, Bergen and Trondheim. Respondents in Liège indicate the lowest level of routine.

Table 16: Transport mode habit.

Variable	Ghent		Liège		Tilburg		Groningen		Düsseldorf		Dortmund		Berlin		Bergen		Trondheim		*Full sample*		ANOVA
	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	*Mean*	*Std Dev*	P-value
Habit 1	5.42	1.93	4.73	2.06	5.10	2.10	5.35	1.99	5.48	2.05	5.11	2.15	5.25	2.23	5.42	2.07	5.66	1.71	*5.29*	*2.05*	< 0.001
Habit 2	5.57	1.48	4.85	1.72	5.58	1.52	5.75	1.32	5.63	1.47	5.65	1.42	5.86	1.35	5.64	1.61	5.50	1.61	*5.56*	*1.52*	< 0.001
Habit 3	4.85	1.76	4.22	1.87	4.98	1.79	5.37	1.57	4.64	1.73	4.61	1.75	4.58	1.87	5.26	1.89	5.29	1.81	*4.87*	*1.82*	< 0.001

4.1.4 Categorical principal component analysis (CatPCA) of TPB variables

Compared to "classic" principal component analysis, categorical principal component analysis (CatPCA) has the advantage that it cannot only handle numerical variables but also ordinal and nominal variables. Since the categories of the items of the four just mentioned scales are all Likert scales (with 7 categories ranging from 1 = 'strongly disagree' to 7 = 'strongly agree') we treated all items on an ordinal measurement level. Treating a variable on an ordinal measurement level gives CatPCA the freedom to apply a monotone transformation to the categories of each item. The order in the values before and after transformation is unchanged, but the distances between consecutive categories after transformation are no longer necessarily the same, and some consecutive categories are even allowed to get identical quantifications. These transformations are chosen in such a way that they optimize the variance of the data accounted for in the CatPCA solution.

The included results concern the results after VARIMAX rotation with Kaiser Normalisation. Note that this concerns the weighted observations, for which both cycling and walking responses were recorded. As a consequence, respondents who either were unable to cycle or walk were excluded from the analysis. Furthermore, respondents who were unable to cycle and unable to walk were screened out in the recruitment procedure of the survey.

For reasons of brevity, the results of the CatPCAs of the different dimensions of the TPB variables are not included in the body of the report. The interested reader is referred to Appendix 2 for a more detailed description of these analyses. The 14 identified factors, that are used for the cluster analysis in the next section, are the following:

- Attitude factor 1: General cycling attitude
- Attitude factor 2: General walking attitude
- Norm factor 1 (descriptive and personal norm)
- Norm factor 2 (injunctive norm)
- PBC factor 1: Self-efficacy (capability) in walking skills
- PBC factor 2: Self-efficacy (capability) in cycling skills
- PBC factor 3: inducive cycling and walking facilities
- PBC factor 4: Hills/levels/slops hinder routine cycling and walking
- Habit factor 1: shopping and leisure
- Habit factor 2: work/school
- BEH Factor 1: Cycling behaviour
- BEH Factor 2: Walking behaviour
- Intention Factor 1: Cycling intention
- Intention Factor 2: Walking intention

4.1.5 Cluster analysis based on the results of the categorical principal component analysis

The 14 different factors that were obtained in the categorical principal component analysis are used as the input for a cluster analysis. A cluster analysis aims at identifying groups of observations that are similar to each other but different from observations in other groups.

The two-step clustering algorithm embedded in SPSS was used to perform the cluster analysis. The procedure involves two consecutive steps, and is capable of handling both continuous and categorical variables. First, the records are pre-clustered in small sub-clusters. Consecutively, the sub-clusters from the pre-cluster step are clustered in the desired number of clusters (SPSS, 2001). Given the exploratory goal of the cluster analysis in the ISAAC study, the number of clusters is automatically determined by the algorithm.

Model Summary

Algorithm	TwoStep
Inputs	14
Clusters	2

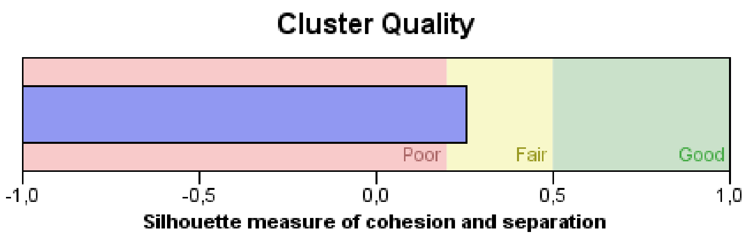

Figure 6: Silhouette measure cluster analysis.

The silhouette coefficient is a measure of cohesion within and separation between clusters. The silhouette measure lies between 0.2 and 0.5, suggesting an acceptable (fair) model fit.

The following figure displays the importance of the different factors in terms of prediction of cluster membership (i.e. in separating the clusters). From this figure, one can observe that especially cycling related factors are explaining differences between the two clusters, since they have the highest Predictor Importance value.

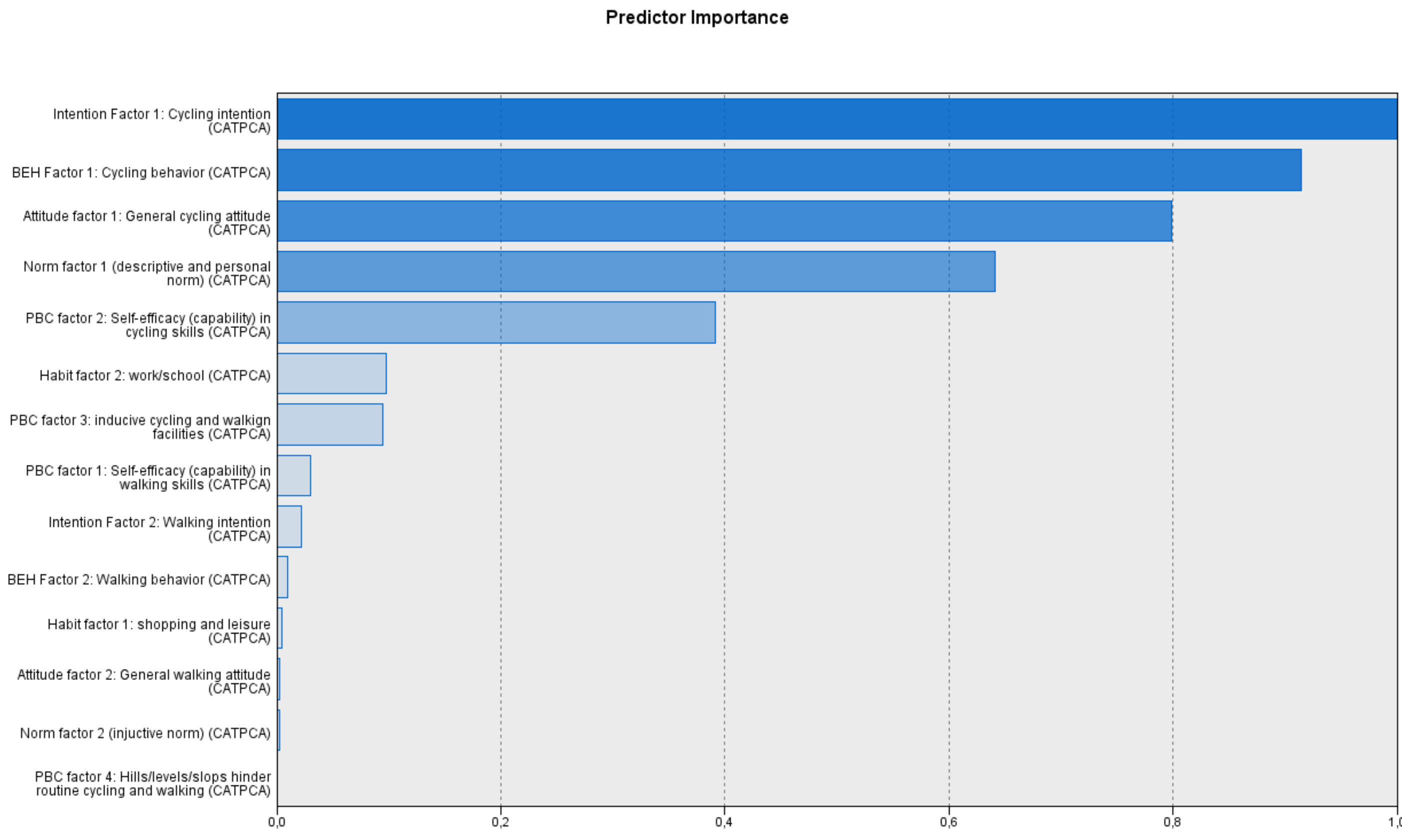

Figure 7: Predictor importance of factors within cluster analysis.

In order to label the different clusters, the differences in factor values between the two clusters are displayed in Table 17. In line with Figure 7, the first cluster can be interpreted as a "pro-cycling" cluster, whereas the second cluster is typified by travellers with a considerable lower cycling orientation. Cluster 1 has amongst others significantly higher scores for general cycling attitude, self-efficacy in cycling skills, cycling behaviour and cycling intention than cluster 2. In the remainder of the report, the first cluster will be referred to as the "pro-cycling cluster", the second cluster as the "non-pro-cycling cluster".

Table 17: Comparison of factors in clusters.

	Cluster 1		Cluster 2		2-sample t-test	
Categorical Principal Component Analysis Factor	Mean	Std Dev	Mean	Std Dev	t-value	P-value
Attitude factor 1: General cycling attitude	0.58	0.62	-0.73	0.91	37.07	< 0.001
Attitude factor 2: General walking attitude	0.01	0.88	-0.02	1.13	0.58	0.563
Norm factor 1 (descriptive and personal norm)	0.54	0.63	-0.68	0.96	32.80	< 0.001
Norm factor 2 (injunctive norm)	0.04	1.05	-0.05	0.93	2.09	0.037
PBC factor 1: Self-efficacy (capability) in walking skills	-0.14	0.93	0.18	1.06	-7.06	< 0.001
PBC factor 2: Self-efficacy (capability) in cycling skills	0.44	0.56	-0.55	1.14	23.99	< 0.001
PBC factor 3: inducive cycling and walking facilities	0.21	0.99	-0.26	0.95	10.91	< 0.001
PBC factor 4: Hills/levels/slops hinder routine cycling and walking	0.00	1.03	0.01	0.96	-0.21	0.831
Habit factor 1: shopping and leisure	-0.03	1.00	0.04	0.99	-1.57	0.116
Habit factor 2: work/school	0.23	0.71	-0.28	1.22	11.10	< 0.001
BEH Factor 1: Cycling behaviour	0.61	0.91	-0.76	0.43	44.83	< 0.001
BEH Factor 2: Walking behaviour	0.06	1.02	-0.08	0.97	3.26	0.001
Intention Factor 1: Cycling intention	0.73	0.55	-0.91	0.62	61.85	< 0.001
Intention Factor 2: Walking intention	0.09	0.86	-0.12	1.14	4.64	< 0.001

Table 18 shows the division into the two clusters for each of the cities, where data was collected. Noticeable differences can be depicted between the different cities. The first (pro-cycling) cluster contains 55.6% of the respondents and is therefore slightly larger than the second cluster (44.4%).

Table 18: Distribution of respondents of different cities in clusters.

City	Pro-cycling cluster	Non-pro-cycling cluster
Ghent	65.5%	34.5%
Liège	30.3%	69.7%
Tilburg	73.9%	26.1%
Groningen	87.7%	12.3%
Düsseldorf	63.8%	36.2%
Dortmund	54.9%	45.1%
Berlin	58.3%	41.7%
Bergen	18.4%	81.6%
Trondheim	47.1%	52.9%
Full sample	*55.6%*	*44.4%*

In the remaining analyses, we investigated whether there is a relationship between different explanatory factors and the two identified clusters. To this end, the results of two-sample t-tests (for continuous variables) and chi-square independence tests (for categorical variables) are tabulated.

Table 19 shows that the pro-cycling cluster contains a significantly higher proportion of young and middle-aged respondents, while the non-pro-cycling cluster contains more older respondents. The pro-cycling cluster contains a higher proportion of male respondents, while the non-pro-cycling cluster contains more female respondents. The pro-cycling cluster has a significantly higher education level than the non-pro-cycling cluster. The pro-cycling cluster contains a higher share of respondents indicating that they live with a partner and children, while the non-pro-cycling cluster contains a relatively higher share of respondents living in an 'other' living situation as well as living without a partner but with children.

Table 19: Distribution socio-demographic variables in clusters.

Variable	Pro-cycling cluster (55.6%)	Non-pro-cycling cluster (44.4%)	Chi²-value	P-value
Age			74.00	< 0.001
18-34	66.0%	34.0%		
35-54	57.1%	42.9%		
55+	42.8%	57.2%		
Gender			8.92	0.003
Male	58.9%	41.1%		
Female	52.3%	47.7%		
Degree			19.09	< 0.001
None/Primary education	31.8%	68.2%		
Secondary education	54.4%	45.6%		
Bachelor's degree or similar	57.4%	42.6%		
Master's degree or higher	59.5%	40.5%		
Living situation			18.33	0.003
I live alone	55.5%	44.5%		
I live without partner. with children	50.5%	49.5%		
I live with my parents	56.3%	43.7%		
I live with partner. without children	52.9%	47.1%		
I live with partner and children	63.6%	36.4%		
Other living situation	46.1%	53.9%		

Respondents in the pro-cycling cluster have a significantly higher possession of all non-car transport modes. Car possession is significantly higher in the non-pro-cycling cluster, although the difference in car possession between both clusters is small in absolute numbers.

Table 20: Vehicle possession in clusters (number of vehicles available in household).

	Pro-cycling cluster (55.6%)		Non-pro-cycling cluster (44.4%)		Difference	2-sample t-test	
Variable	Mean	Std Dev	Mean	Std Dev	Mean	t-value	P-value
Nr of bicycles	1.90	1.359	1.06	1.25	0.84	14.30	< 0.001
Nr of e-bike	0.24	0.613	0.06	0.34	0.18	8.14	< 0.001
Nr of motorcycles	0.18	0.499	0.08	0.33	0.10	5.84	< 0.001
Nr of cars	0.95	0.817	1.03	0.77	-0.08	-2.37	0.018
Nr of segways	0.07	0.362	0.01	0.14	0.06	4.62	< 0.001
Nr of e-scooters	0.08	0.438	0.01	0.10	0.07	5.58	< 0.001
Nr of solowheels	0.04	0.282	0.01	0.09	0.03	4.07	< 0.001
Nr of hoverboards	0.09	0.390	0.02	0.14	0.07	5.66	< 0.001

The pro-cycling cluster shows a significantly higher share of participants who have a subscription to a season ticket for public transport, a car sharing system and/or a bicycle sharing system than the non-pro-cycling cluster. The level of car driving license possession is however not significantly different between both clusters.

Table 21: Subscriptions and licence possession in clusters.

Variable	Pro-cycling cluster (55.6%)	Non-pro-cycling cluster (44.4%)	Chi²-value	P-value
Season ticket for using public transportation			15.02	< 0.001
No	51.8%	48.2%		
Yes	60.4%	39.6%		
Car driving licence or permit			0.62	0.430
No	57.5%	42.5%		
Yes	55.2%	44.8%		
Subscription to a car sharing system			31.37	< 0.001
Yes	75.5%	24.5%		
No	53.4%	46.6%		
I do not know what a car sharing system is	61.2%	38.8%		
Subscription to a bicycle sharing system			45.63	< 0.001
Yes	88.6%	11.5%		
No	54.0%	46.1%		
I do not know what a bicycle sharing system is	53.4%	46.6%		

Not surprisingly, the pro-cycling cluster contains a smaller proportion of people who indicate that it is not easy for them to park their bicycle at home. The vast majority of participants who indicate that they do not know how to ride a bicycle are in the non-pro-cycling cluster.

Table 22: Bike ability and ease of parking a bicycle in clusters.

Variable	Pro-cycling cluster (55.6%)	Non-pro-cycling cluster (44.4%)	Chi²-value	P-value
Parking easily a bicycle at home			82.65	< 0.001
No	24.7%	75.3%		
Yes	58.8%	41.2%		
Bike ability (Do you know how to ride a bicycle?)			32.06	< 0.001
Yes	56.5%	43.5%		
No	14.4%	85.6%		
Prefer not to answer	22.6%	77.4%		

Significant differences in travel behaviour patterns are found between both clusters for each transport mode (see Table 23). Not surprisingly, the largest differences can be found in bicycle usage. The pro-cycling cluster contains the vast majority of participants who indicate that they cycle a few days per week or more, while it contains a lower proportion of bicyclists who only cycle a few days per year and very few participants who never cycle. The participants in the pro-cycling cluster also show higher rates of walking, riding a moped or motorbike, taking a taxi and using a personal e-transporter. The non-pro-cycling cluster contains a higher share of participants who use the car at least 5 days per week, while a somewhat higher share of participants in the pro-cycling cluster indicate that they drive a car one to a few days per week, month or year.

Somewhat more participants in the pro-cycling cluster travel occasionally (one to a few days per month or per week) by public transport and as a car passenger. A higher share of participants in the non-pro-cycling cluster never use public transport. The other cluster also includes a higher share of participants who never travel as a car passenger as well as participants who travel at least 5 days per week as a car passenger.

Table 23: Usage frequency of different modes in clusters.

Variable	Pro-cycling cluster (55.6%)	Non-pro-cycling cluster (44.4%)	Chi²-value	P-value
Usage frequency past 12 months (all motives): By foot (>= 10 minutes)			44.86	< 0.001
Never	41.6%	58.39%		
One to a few days a year	37.2%	62.84%		
One to a few days per month	43.8%	56.17%		
One to a few days per week	54.0%	46.03%		
At least 5 days per week	61.4%	38.56%		
Usage frequency past 12 months (all motives): Bicycle			1039.53	< 0.001
Never	6.3%	93.75%		
One to a few days a year	26.9%	73.08%		
One to a few days per month	61.3%	38.68%		
One to a few days per week	85.9%	14.09%		
At least 5 days per week	97.5%	2.52%		
Usage frequency past 12 months (all motives): Moped/motorbike			83.50	< 0.001
Never	51.6%	48.36%		
One to a few days a year	68.3%	31.68%		
One to a few days per month	83.4%	16.56%		
One to a few days per week	88.6%	11.43%		
At least 5 days per week	79.1%	20.89%		

Usage frequency past 12 months (all motives): Public transport			33.68	< 0.001
Never	37.3%	62.69%		
One to a few days a year	54.2%	45.82%		
One to a few days per month	61.1%	38.90%		
One to a few days per week	59.8%	40.19%		
At least 5 days per week	53.2%	46.79%		
Usage frequency past 12 months (all motives): Taxi (incl. companies like Uber)			24.35	< 0.001
Never	55.1%	44.86%		
One to a few days a year	52.9%	47.08%		
One to a few days per month	61.3%	38.68%		
One to a few days per week	82.5%	17.55%		
At least 5 days per week	89.2%	10.82%		
Usage frequency past 12 months (all motives): Car as a driver			89.96	< 0.001
Never	57.1%	42.9%		
One to a few days a year	70.2%	29.8%		
One to a few days per month	66.1%	33.9%		
One to a few days per week	62.7%	37.3%		
At least 5 days per week	41.2%	58.8%		
Usage frequency past 12 months (all motives): Car as passenger				
Never	49.0%	51.0%	14.47	0.0059
One to a few days a year	51.3%	48.7%		
One to a few days per month	59.4%	40.6%		
One to a few days per week	58.4%	41.6%		
At least 5 days per week	49.4%	50.6%		
Usage frequency past 12 months (all motives): Personal e-Transporters			72.35	< 0.001
Never	52.2%	47.8%		
One to a few days a year	76.7%	23.3%		
One to a few days per month	85.1%	14.9%		
One to a few days per week	87.0%	13.0%		
At least 5 days per week	81.5%	18.5%		

In general, the importance of several of the possible obstacles for cycling more frequently is considered higher by participants in the non-pro-cycling cluster (see Table 24). The largest difference relates to traffic safety, which is considered a significantly bigger barrier by participants in the non-pro-cycling cluster. The required physical effort is also a stronger barrier for participants in the non-pro-cycling cluster. The physical environment (climate and/or hilliness) is considered a slightly larger barrier by participants in the second cluster, although the difference is quite small. Costs are considered a significantly higher obstacle by participants in the pro-cycling cluster, although it should be mentioned that it is considered the least important barrier by both clusters. Time is considered an equally important obstacle by both clusters.

The obstacles for walking more frequently show a very different picture. Participants in both clusters consider time the most important obstacle to walk more, but it is considered significantly more important by participants in the pro-cycling cluster. Cost is also considered a significantly more important obstacle to walk more by participants in the pro-cycling cluster, although the importance of cost as an obstacle is generally by far the lowest. Regarding the perception of physical effort, physical environment and traffic safety, no significant differences are observed between both clusters.

The value of the summated scale of the New Ecological Paradigm does not differ significantly between both clusters.

Table 24: Obstacles and NEPS in clusters.

	Pro-cycling cluster (55.6%)		Non-pro-cycling cluster (44.4%)		Difference	2-sample t-test	
Variable	Mean	Std Dev	Mean	Std Dev	Mean	t-value	P-value
Obstacle for you to use the bicycle more frequently: Physical effort	3,47	1,87	3,92	2,02	-0,45	-5,27	< 0.001
Obstacle for you to use the bicycle more frequently: Time	3,86	1,85	3,97	2,11	-0,11	-1,19	0,235
Obstacle for you to use the bicycle more frequently: Costs	2,86	1,91	2,55	1,83	0,31	3,73	< 0.001
Obstacle for you to use the bicycle more frequently: Environment (climate, hilliness)	3,48	1,90	3,66	2,05	-0,18	-2,00	0,045
Obstacle for you to use the bicycle more frequently: Traffic safety	3,84	1,88	4,50	2,12	-0,66	-7,24	< 0.001
Obstacle for you to walk more frequently: Physical effort	3,30	1,99	3,16	2,03	0,14	1,62	0,106
Obstacle for you to walk more frequently: Time	4,54	1,93	4,05	2,25	0,49	5,23	< 0.001
Obstacle for you to walk more frequently: Costs	2,51	1,93	1,80	1,48	0,71	8,99	< 0.001
Obstacle for you to walk more frequently: Environment (climate, hilliness)	3,15	1,95	3,07	2,02	0,08	0,96	0,336
Obstacle for you to walk more frequently: Traffic safety	3,18	1,96	3,01	2,03	0,17	1,91	0,056
New Ecological Paradigm Scale (Summated scale)	5,40	1,01	5,35	1,16	0,05	0,91	0,365

4.2 Structural Equation Modelling

SEM-analyses were modelled in AMOS. The fit indices of full SEM models were not above the postulated minimal thresholds. As a result, a path model (cycling) and a hybrid model (walking) were fit.

The path model for cycling is shown in Figure 8. It can be seen that the structure of the model represents that of the Theory of Planned Behaviour, plus a direct link from ‘habit’ to ‘behaviour’. None of the other concepts in our theoretical model described in the background remain in the final model, since adding these values reduces model fit. Cycling behaviour is highly influenced by cycling intention (standardized coefficient = 0.62). Cycling intention is strongly affected by cycling attitudes (0.52), and to a lesser extent by cycling norms (0.26) and cycling perceived behavioural control (0.15). Attitudes, norms and PBC show substantial mutual correlations as well. Habit only has a small effect on cycling behaviour (0.05).

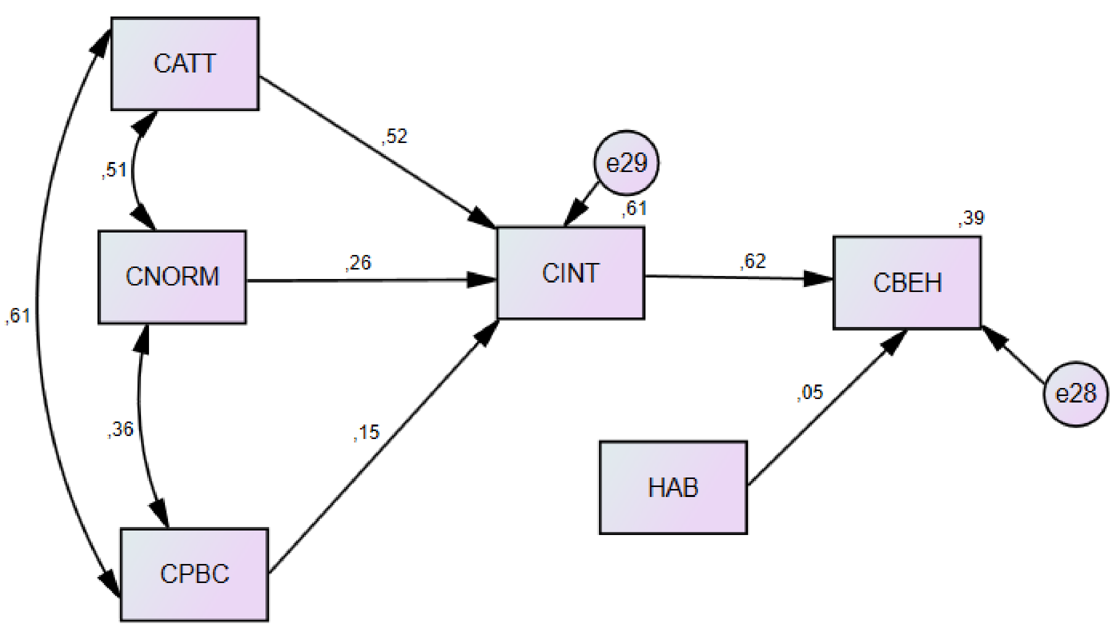

Figure 8: Path model cycling.

Table 25: Evaluation indices path model cycling

RMR, GFI

Model	RMR	GFI	AGFI	PGFI
Default model	,333	,978	,933	,326
Saturated model	,000	1,000		
Independence model	2,781	,498	,297	,356

Baseline Comparisons

Model	NFI Delta1	RFI rho1	IFI Delta2	TLI rho2	CFI
Default model	,969	,934	,971	,937	,971
Saturated model	1,000		1,000		1,000
Independence model	,000	,000	,000	,000	,000

Parsimony-Adjusted Measures

Model	PRATIO	PNFI	PCFI
Default model	,467	,452	,453
Saturated model	,000	,000	,000
Independence model	1,000	,000	,000

The hybrid model for walking is shown in Figure 9. It follows the same structure as the cycling model and consists of the different components of the TPB plus habit. The coefficients are quite similar as well. Walking behaviour is highly influenced by walking intention (standardized coefficient = 0.54). Cycling intention is strongly affected by walking attitudes (0.48), and to a lesser extent by walking norms (0.28) and walking perceived behavioural control (0.10). Attitudes, norms and PBC show substantial mutual correlations as well. Habit only has a small effect on walking behaviour (0.07).

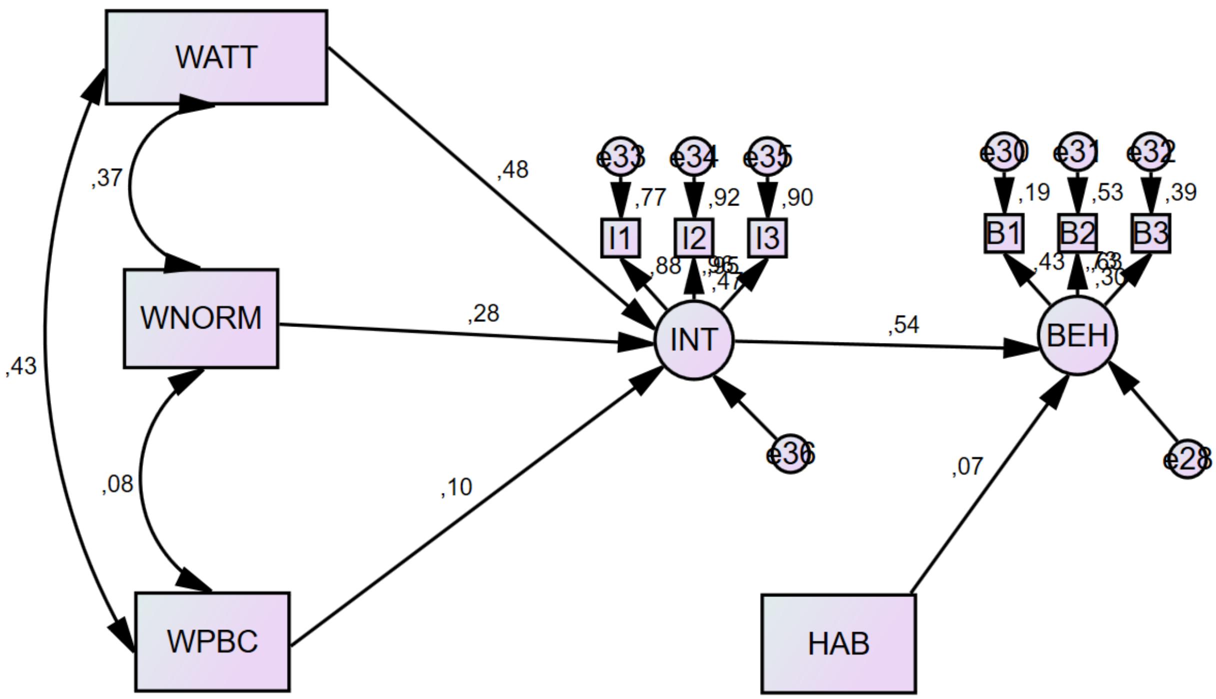

Figure 9: Hybrid model walking.

Table 26: Evaluation indices hybrid model walking.

RMR, GFI

Model	RMR	GFI	AGFI	PGFI
Default model	,766	,955	,920	,538
Saturated model	,000	1,000		
Independence model	8,096	,437	,312	,357

Baseline Comparisons

Model	NFI Delta1	RFI rho1	IFI Delta2	TLI rho2	CFI
Default model	,952	,930	,955	,934	,955
Saturated model	1,000		1,000		1,000
Independence model	,000	,000	,000	,000	,000

Parsimony-Adjusted Measures

Model	PRATIO	PNFI	PCFI
Default model	,689	,656	,658
Saturated model	,000	,000	,000
Independence model	1,000	,000	,000

4.3 Stage Models

All variables are transformed to binary or continuous for ease of interpretation. For binary variables, the estimate values of the model indicate the odds of being in that stage compared to the odds of being in the first (pre-contemplation) stage for respondents for which the value of the binary indicator is 1 compared to those for which it is 0. For continuous variables, it shows the increase in the odds of being in that stage compared to the odds of being in the first (pre-contemplation) stage for a one unit increase in the value of the continuous variable. The presented models have been checked for multicollinearity. The Variance Inflation Factors in all models were below 4, which means that there are no issues with multicollinearity.

The following subsections describe the results and interpretations for the stage models of cycling, walking and Personal e-Transporters. For reasons of brevity, the model output is not included in the body of the report. The interested reader is referred to Appendix 3 for more detailed information and output from the different stage models.

4.3.1 Stage model cycling

The following variables are included in the final model, and therefore have an influence on respondents' stage of travel mode change towards cycling more frequently: current cycling behaviour (CBEH), cycling intention (CINT), cycling attitudes (CATT), cycling norms (CNORM), cycling perceived behavioural control (CPBC), transport mode habit (HAB), NEPS, age, bicycle possession, car possession, obstacles for cycling more frequently, subscription to a bike sharing system and driving license.

The current cycling behaviour has a significant effect on the stage the respondent is in. Respondents who cycle more have a significantly higher probability of being in the higher stages (action or maintenance) of cycling more frequently. Similarly, respondents with more favourable cycling intentions, cycling attitudes, cycling norms and perceived behavioural control have higher odds of being in the higher stages. Respondents with a stronger transport mode habit have a lower probability of being in the higher stages of the model than respondents with lower levels of transport mode habits. The impact of NEPS is significant, but less distinct. Respondents with a higher value on the NEPS seem to have somewhat increased odds of being in the third stage (preparation), but lower odds of being in the fifth stage (maintenance). Respondents younger than 55 have a higher probability of being in stage 2-4 (contemplation, preparation or action) compared to older respondents. Bicycle possession significantly increases the odds in being in any stage higher than the first (pre-contemplation) stage. Noteworthy is that participants who possess a car have significantly higher odds of being in the third (preparation) or fourth (action) stage compared to respondents without a car. Respondents with higher values of cycling obstacles have lower odds of being in the fifth stage (maintenance) compared to other stages than respondents with lower values of cycling obstacles. Respondents with a subscription to a bike sharing system have higher odds of being in the second (contemplation), fourth (action) or fifth (maintenance) stage of cycling more frequently. Respondents with a driving license have lower odds of not being in the first stage (pre-contemplation).

Factors that were inserted in the model, but were eliminated during the backwards elimination process are subscription to a season ticket of public transport, education level, living with a partner, living with a child, subscription to a car sharing system and possession of a personal e-transporter. This indicates that these variables do not have a significant effect on participants' stage of travel mode change towards cycling more frequently.

4.3.2 Stage model walking

The following variables are included in the final model, and therefore have an influence on respondents' stage of travel mode change towards cycling more: current walking behaviour (WBEH), walking intention (WINT), walking attitude (WATT), walking norm (WNORM), bicycle possession (BICYCLEPOS), car possession (CARPOS), walking obstacles (WOBST), subscription to a car sharing system (CarShare), driving license possession (DrivLic), and having a season ticket for public transport (AboPT).

Respondents who currently already walk more often have a higher likelihood of being in the higher stages of behavioural change compared to respondents who walk less frequently. Respondents with more favourable walking intentions and walking norms have a higher probability of begin in the higher stages. Respondents with more favourable walking attitudes have a higher probability of being in the highest stage (maintenance). Respondents who own a bicycle have a higher probability of not being in the non-contemplation stage of walking. Respondents who own a car have a higher probability of being in the contemplation stage instead of the preparation or action stage. Respondents who have lower perceived obstacles related to walking have a significantly higher probability of being in the maintenance stage. Respondents who have a subscription to a car sharing system have a lower probability of being in the third (preparation) stage instead of the contemplation, action or maintenance stage. Respondents who possess a driving license are less likely to be in the maintenance stage instead of the contemplation stage. Respondents with a season ticket for public transport are more likely to be in the higher stages than respondents without a public transport season ticket.

Factors that were inserted in the model, but were eliminated during the backwards elimination process are degree of education, transport mode habit, subscription to a bicycle sharing system, having children, age category, perceived behavioural control of walking, possession of a Personal e-Transporter, having a partner, and value on the NEPS scale. This indicates that these variables do not have a significant effect on participants' stage of travel mode change towards walking more frequently.

4.3.3 Stage model PeTs

Exploratory analyses showed that the number of respondents in the preparation, action and maintenance (stage 3-5) stage were low; 43, 15 and 29 respondents, respectively. In order to obtain a more robust model, it was decided to fit a limited model with only three stages, in which these highest three stages were merged into a single stage. The stages in this reduced model are therefore

- The pre-contemplation stage (not thinking about making a change) (N=1607)
- The contemplation stage (thinking about making a change) (N=465)
- The 'initiative stage' (taking actual initiatives: preparation, action or maintenance) (N=87)

The following variables are included in the final model, and therefore influence respondents' stage of travel mode change towards using Personal e-Transporters more often: cycling norm (CNORM), current walking behaviour (WBEH), walking attitude (WATT), habit (HAB), New Ecological Paradigm Scale (NEPS), possession of a PeT (PETPOS), cycling obstacles (COBST), and subscription to a bike sharing service (BikeShare).

Participants with stronger cycling norms have a significantly higher probability of being in the higher stages of behavioural change. Participants who indicate that they walk more frequently are significantly more likely to be in the higher stages. However, participants with higher walking attitudes are significantly less likely to be in the higher stages. Participants with stronger transport mode habits are significantly less likely to be in the higher stages. NEPS significantly affects the stage of behaviour change, but the effect is non-linear; while participants with a higher NEPS are significantly more likely to be in the contemplation stage, they are significantly less likely to be in the highest (initiative) stage. Unsurprisingly, respondents with a higher possession of PeTs are significantly more likely to be in a higher stage. Respondents with higher perceived cycling obstacles are significantly more likely to be in the contemplation stage. Finally, respondents with a subscription to a bike sharing service are less likely to be in the higher changes.

Factors that were inserted in the model, but were eliminated during the backwards elimination process are walking intentions, having children, having a season ticket for public transport, driving license possession, car possession, living together with a partner, education level, having a subscription to a car sharing service, walking obstacles, bicycle possession rate, age, walking perceived behavioural control, current cycling behaviour, cycling intentions, cycling attitudes, cycling perceived behavioural control and walking norms. This indicates that these variables do not have a significant effect on participants' stage of travel mode change towards using PeTs more frequently.

5 Discussion & conclusions

5.1 Answers to the formulated research questions

1. Among the factors identified in the literature, which ones can be considered as determinants of variations in the intentions to shift from car use to active travel modes?

The analyses confirm that for walking and cycling, the classic psychological components of the Theory of Planned Behaviour, supplemented by habit, provide the best fit. The importance of the other constructs included in the extended theoretical model could not be confirmed.

Behaviour (number of walking/cycling trips) is strongly determined by intentions, and to a more limited extent by habit. The latter finding is not in line with other literature that suggests that habit is a strong predictor of behaviour.

Intentions are determined by attitudes, norms and perceived behavioural control. For walking as well as for cycling, attitudes have by far the strongest impact on intention (coefficient 0.52 for cycling and 0.48 for walking), followed by norms (0.26 and 0.28) and PBC (0.15 and 0.10). This indicates that it will be important to improve people's attitudes towards cycling and walking to increase their intentions to make use of these modes.

2. Are there different groups of persons having common determinants of variations in the intentions?

Two groups of respondents were identified by the cluster analysis, which can be referred to as a "pro-cycling" cluster, and a "non-pro-cycling" cluster. This suggests that the psychological determinants of cycling have a higher level of variation compared to the psychological determinants of walking. In other words, respondents' answers related to cycling are more diverse than answers related to walking, or alternatively, people's feelings related to cycling are more 'pronounced' than those related to walking. This is probably related to the fact that virtually everyone walks occasionally (even if it is just from a parking lot to their final destination), even when they do not consider that to be a "trip", while not everyone cycles. The pro-cycling cluster includes 55.6% of the respondents, the other cluster 44.4%.

3. How do the groups differ in terms of living environment and situation/current habitual use of mobility modality?

Respondents in the "pro-cycling" cluster have more favourable values about cycling-related factors such as cycling attitudes, cycling self-efficacy ('perceived capability') and cycling intentions. They also have higher values for norms, and for the PBC factor 'inducive cycling/walking facilities'. In their current behaviour, they already cycle significantly more often than the other cluster. Respondents from the pro-cycling cluster have a stronger transport mode habit for work-school trips than respondents in the other cluster, but there is no significant difference in habit related to shopping and leisure trips.

It is noteworthy that, while respondents in the pro-cycling cluster walk significantly more than those in the other cluster (although the difference is rather small in absolute numbers), their attitudes towards walking does not differ significantly from the other cluster, and they even have a significantly lower walking self-efficacy ('perceived capability'). The PBC factor about the transport environment (climate/hilliness) does not differ significantly between both clusters.

The pro-cycling cluster contains 87.7% of the respondents from Groningen, the city with the highest cycling rate of the sample. It also contains a higher share of respondents from Tilburg (73.9%), Ghent (65.5%) and Düsseldorf (63.8%). The pro-cycling cluster contains a lower fraction of respondents from Bergen (18.4%), Liège (30.3%) and Trondheim (47.1%).

In addition, the pro-cycling cluster contains more young people (aged 18-34), more men and higher-educated, and more people living with a partner and children. They possess a higher number of all types of vehicles (including significantly higher ownership of PeTs), except cars. The pro-cycling cluster also contains a higher share of respondents with a season ticket for public transportation and to a car or bike sharing system. The pro-cycling cluster contains fewer people who have difficulties to park a bicycle at home. Respondents in the pro-cycling cluster logically cycle significantly more often, but they also show higher rates of walking, riding a moped or motorbike, taking a taxi and using a PeT.

4. What are the obstacles that they (persons within and between groups) respectively perceive to this modal shift?

The biggest obstacle indicated by all respondents combined that prevents them from cycling more frequently, is traffic safety. The second biggest obstacle is time, followed by the required physical effort and the environment (climate, hilliness,…). Cost is considered the least important obstacle.

From the cluster analysis it becomes clear that traffic safety is considered to be a significantly more important obstacle for respondents in the non-pro-cycling cluster. The required physical effort and the environment (climate, hilliness,…) are also considered significantly more important obstacles by the non-pro-cycling cluster, but the difference between both clusters is smaller than for the traffic safety. There is no significant difference between both clusters in their perception of time as an obstacle to cycle more. Cost is the lowest barrier to cycle more, but has a significantly higher importance in the pro-cycling cluster. A possible interpretation of this last finding could be that some respondents might mention cost as an obstacle, because they believe that they will need to invest in a more expensive type of bicycle (e-bike, speed pedelec, cargo bike,…) to cycle more frequently than they are already doing today.

The biggest obstacle hindering walking more frequently is time. Physical effort, environment and traffic safety receive an approximately equal weight. Unsurprisingly, cost is considered an unimportant obstacle.

The pro-cycling group (that walks significantly more than the other group) considers time a significantly more important obstacle for walking more frequently than the other group. There are no significant differences between both groups in terms of the importance of physical effort, environment and traffic safety as obstacles for walking more frequently.

5. What are the interests for various Personal e-Transporters and their perceived (dis)advantages?

Generally, respondents' perceptions of PeTs are not (yet) very favourable. Respondents' perceptions related to cost and safety received the lowest scores. Significant differences between the cities can be observed. Generally, the most favourable perceptions are reported in the German cities, especially in Dortmund. The least favourable perceptions are reported in the Norwegian cities Bergen and Trondheim.

The stage model shows that respondents' stage of behavioural change towards using PeTs more frequently is affected by various aspects. Some noteworthy findings are the following. Respondents with higher cycling norms are more likely to be in the higher stages of behavioural change. Respondents who walk more often are more likely to be in the higher stages as well, but respondents with more favourable walking attitudes have a lower probability. Stronger transport mode habits are related to a lower chance of being in the higher stages. Respondents who indicate stronger cycling obstacles have a higher probability of being in the contemplation stage of using PeTs. Respondents with a subscription to a bike sharing service have a lower probability of being in the higher stages of behavioural change.

5.2 Implications and recommendations for policy and practice

General recommendations:

- The findings in this report clearly highlight the intrinsically different nature of walking and cycling as transport modes, with different factors and (perceived) obstacles affecting their usage. As a result, it is important to make a clear distinction between walking and cycling as very different transport modes in policy and practice. While this may seem a trivial conclusion, it is common in research as well as policy and practice to treat 'active modes' as being a coherent way of transportation with similar features. This study clearly stresses that walking and cycling have very different motivations and perceived obstacles, and stimulating them will therefore need a different approach.
- Generally, literature suggests that it is easier to change behaviour when there is no or a less strong habit, since transport mode habits can circumvent rational decision making and therefore make people 'immune' to changes in the different transport modes. Since respondents generally express a lower level of transport mode habit for leisure trips, it is expected that this type of trips might be most susceptible to a modal shift. Generally, respondents in Liège show the lowest level of transport mode habit, which might indicate that a modal shift could be more easily accomplished in Liège than in the other investigated cities.

Recommendations related to stimulating cycling:

- Traffic safety has been mentioned by respondents as the most important obstacle preventing them from cycling more. This was especially the case for the non-pro-cycling cluster. This indicates that one of the key elements to stimulate cycling in cities is to improve traffic safety (both objectively and subjectively). Various strategies can contribute to improving traffic safety for bicyclists. These include:
    - Providing more and better infrastructure for bicyclists. High-quality infrastructural design that takes into account the safety of bicyclists is one of the key elements to make cycling a safe and attractive transport mode. Well-designed infrastructure does not only contribute to safety, but also to making cycling a fast, convenient and attractive means of transportation
    - Awareness raising campaigns and legislation
    - Stimulating protective gear such as helmets and high-visibility clothing

  For more detailed recommendations on how to improve safety, we refer to the various measures included in the PedBikePlanner webtool that was developed within this project (www.pedbikeplanner.eu), and to Schepers et al. (2017).
- Since travel time, required physical effort, and the physical environment (hilliness, climate,…) are relevant obstacles as well, all measures that address one or more of these elements have potential to stimulate cycling as well. E-bikes are quite promising, because compared to regular bicycles,

they offer benefits on all three dimensions; for most users they will increase average speed and therefore reduce the trip time, and the support of the electric engine will reduce the required physical effort and make it easier to overcome slopes and warm weather. Financial or other incentives to stimulate e-bike possession/use therefore seem promising. It will, however, be important to ensure that encouraging e-bikes does not conflict with the previous recommendation of improving traffic safety. The higher speed of the e-bikes could lead to an increase in the number and severity of accidents, so it will be important to take the higher speed into account in the design of the cycling infrastructure.

- A high-quality network of cycling infrastructure can contribute to reducing the required travel time and physical effort as well, for instance by providing fast and direct routes between important destinations, reducing unnecessary stops, etc. Denser and more diversified urban areas can also reduce the average trip length by providing many suitable destinations within short distances, hence reducing the required trip time by bicycle and increasing the number of trips that could potentially be cycled. Land use planning therefore has the potential to increase walking.
- The non-pro-cycling cluster includes a large proportion of the respondents who indicate that they cannot easily park a bicycle at their home. This indicates that lack of possibility to park a vehicle correlates with less favourable perceptions of cycling and with less cycling behaviour. As a result, it could be a barrier for people to cycle. While the percentage of people reporting difficulties to park their bicycle is relatively small, it is worthwhile to critically assess the availability of decent and safe (public) bicycle parking spaces, and increase bicycle parking capacity in areas where the current availability may not suffice.
- Having access to a bicycle is a necessary prerequisite to make cycling a viable transport mode option. The stage model showed that higher bicycle possession as well as subscription to a bike sharing service correlate with being in a higher stage of behaviour change towards cycling more frequently. Various measures can be considered to increase bicycle ownership/accessibility. Financial incentives can be considered to encourage acquisition. However, given the findings, it seems to be especially worthwhile in urban areas to implement bike sharing systems. Somewhat related to this, is to ensure that people's personal bicycles can be parked securely, because research suggests that 7% of stolen bicycles are not replaced (Van Lierop, Grimsrud, & El-Geneidy, 2015). This implies that some people will stop cycling after a bicycle is stolen.
- Various psychological constructs positively affect people's intention to cycle more frequently, but cycling attitudes show by far the strongest relation. Improving people's attitudes towards cycling will therefore contribute to increasing cycling.

Recommendations related to stimulating walking:

- Time is mentioned by respondents as the most important obstacle for walking more frequently. To stimulate walking, reducing travel time will therefore be an important strategy. Measures to stimulate walking through reducing travel time are creating direct routes (for example by creating short cuts for pedestrians) and reducing the number of necessary crossings and waiting times at crossings. In addition, denser and more diversified urban areas can reduce the trip length by providing many suitable destinations within short distances, hence reducing the required trip time by foot and increasing the number of trips that could potentially be walked. Land use planning therefore has the potential to increase walking.
- Various psychological constructs positively affect people's intention to walk more frequently, but walking attitudes show by far the strongest relation. Improving people's attitudes towards walking will therefore contribute to increasing walking.
- Respondents with a public transport season ticket are in the higher stages of behavioural change towards walking more frequently, which implies that there is a positive relation between public

transport use and walking. This most likely relates to walking as a first/last mile solution when using public transport. Walking can therefore indirectly be stimulated through enhancing and encouraging public transportation.

Recommendations related to stimulating PeTs:

- Improve the safety of PeTs. An important aspect of this will be to improve stability and safety of the devices themselves. This can be achieved through a clear regulatory framework and rules of conduct, and through safety standards for PeTs. Another important element will be to improve the infrastructure for usage by PeTs. The rise of PeTs will add to the growing variation in the types of vehicles that make use of cycling infrastructure; the infrastructure will need to be designed and updated to allow for safe usage by these diverse users. PeTs can also put pressure and safety hazards on pedestrian areas and sidewalks.
- Lowering the costs of PeTs could increase the number of people using PeTs. It is, however, questionable whether one should prioritise providing (financial) incentives for PeTs. There are some concerns about the safety of these devices, and they may replace more active transport modes such as walking and cycling that have additional benefits. A possible way for a city to make PeTs available for users at a low cost could be to invest in a system of shared electric scooters.
- Interventions could be targeted at improving people's perceptions of PeTs. While safety and cost turned out to be the most problematic aspects of perception, other aspects received relatively low scores as well. This emphasizes the importance of improving people's attitudes towards PeTs in order to encourage their usage as a transport mode in urban areas.
- Given the exploratory nature of this study, further research is needed to further investigate people's opinions on PeTs, and how vehicles as well as regulations and infrastructure can be designed to stimulate their use without compromising safety.

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Appendix 1: Questionnaire (English master version)

Master Questionnaire Template

Length of interview: max 14 minutes
Start fieldwork: 15/06/2018
End fieldwork: 27/06/2018
Methodology: CAWI

I. SAMPLE VARIABLES

II. QUOTA CHECK

9 cities in 4 countries

NO: Bergen (n=250) & Trondheim (n=250)
BE: Gent (n=250) en Luik (n=250)
NL: Tilburg (n=250) & Groningen (n=250)
DE: Düsseldorf (n=250) & Dortmund (n=250) & Berlin (n=250)

Representativeness based on age and gender
http://ec.europa.eu/eurostat/web/cities/data/database

foresee field follow up link where we can monitor per hid_city

- *Hid_agecat*
- *Gender (Q1)*

III. INTRODUCTION

Base: all respondents

Info1 [info]

The present survey aims at improving our understanding of the reasons underlying peoples' choice(s) for different transport modes, and more specifically, the motivation to make a shift towards using **walking and cycling** more frequently as a transport mode.

Please read each question carefully and answer it to the best of your ability. There are no correct or incorrect responses; we are merely interested in your personal point of view. Note that all responses to this survey are completely confidential. All identifying information will be removed from the questionnaire.

Thank you for your participation in this study.

III. SCREENING QUESTIONS

Base: all respondents

S0 [S]

Country

1. Belgium
2. Netherlands
3. Germany
4. Norway

Base: S0 = 1

S1A [Q] (4 digits)

Please indicate the postal code of your home location?

Base: S0 = 3

S1B [Q] (5 digits) (allow postal codes starting with 0, min=01000]

Please indicate the postal code of your home location?

Base: S0 = 2

S1D [Q] (4 digits)

Please indicate the postal code of your home location?

Base: S0 = 4

S1E [Q] (4 digits)

Please indicate the postal code of your home location?

Base: all respondents

Hid_city [Q]

City = 1 “Gent” If S0 = 1 & S1A =

9000
9030
9031
9032
9040
9041
9042
9050
9051
9052

City = 2 “Liège” if S0 = 1 & S1A =

4000
4020
4030
4031
4032

City = 3 “Tilburg” if S0 = 2 & S1D is between 5000 and 5049 or 5056 or 5070 or 5071
City = 4 “Groningen” if S0 = 2 & S1D is between 9700 and 9747
City = 5 “Dusseldorf” If S0 = 3 & S1B between 40210 and 40721
City = 6 “Dortmund” If S0 = 3 & S1B between 44135 and 44388
City = 7 “Berlin” If S0 = 3 & S1B between 10115 and 14199
City = 8 “Bergen” if S0 = 4 & S1E between 5003 and 5268
City = 9 “Trondheim” if S0 = 4 & S1E between 7010 and 7099
Else = 10

Scripter: if hid_city =10, SCREEN OUT

Base: all respondents

Q2 **[Q, 4 digits, min=1900 , max = 2018]**
In which year were you born?
…

Scripter: if Q2 >2000, SCREEN OUT

Base: all respondents

Hid_Q2 **[Q]**

Scripter: calculate hid_q2 = 2018-answer Q2

Base: all respondents

Hid_agecat **[S]**

Recode hid_q2 into
18-34
35-54
55+

Base: all respondents

Q11 **[SGRID]**
To what extent do you experience difficulties in using certain transport modes because of physical reasons (for instance due to a permanent impairment, high age, etc.)?

Rows (randomize)
1. Walking (for at least 10 minutes)
2. Cycling
3. Entering and exiting a car
4. Driving a car
5. Access to bus/tram stops
6. Access to train/metro stations/platforms
7. Entering and exiting bus/tram/metro/train (vehicle)

Colums
1. Is no problem for me
2. Is possible for me, but with difficulty
3. Is only possible for me with special assistance or specific facilities
4. Is impossible for me

SCRIPTER: If Rows 1 & 2 = 4 --> SCREEN OUT

IV. SOCIO-DEMOGRAPHIC INFORMATION

Base: all respondents

Q1 **[S]**

Are you …

1. Male
2. Female

Base: all respondents

Q3 **[S]**

What is the highest qualification or educational certificate you obtained?

1. None
2. Primary education
3. Secondary education
4. Bachelor's degree or similar
5. Master's degree or higher

Base: all respondents

Q4 **[S]**

Which description best describes your current living situation?
Children that no longer live at home should not be considered here.

1. I live alone
2. I live without partner, with children
3. I live with my parents
4. I live with partner, without children
5. I live with partner and children
6. Other living situation

Base: all respondents

Q5 **[S – dropdown box]**

How many of the following vehicles are available in your household which you could use?
We are interested in all vehicles that you could use for private purposes, including company vehicles if you can use these outside of the work context.

Items

1. Bicycle (non-electric): [dropdown box]
2. Electric bicycle: [dropdown box]
3. Moped/motorcycle: [dropdown box]
4. Passenger car/van/pick-up: [dropdown box]

SCRIPTER: Dropdown box with "0" as default value and options "1", "2", "3", "4", "5" and "More than 5"

Base: if Q5=0 for all items

Q5a **[S]**

You indicated that none of these vehicles are available in your household for you to use.
Is this correct?

1. Yes
2. No *Scripter: return to Q5 so that respondent can correct his answer*

Base: all respondents

Q6 [S]

Do you have a car driving license or permit?

1. Yes
2. No

Base: all respondents

Q7 [S]

Do you currently own a season ticket for using public transportation?

1. Yes
2. No

Base: all respondents

Q8 [S]

Do you currently have a subscription to a bicycle sharing system?

1. Yes
2. No
3. I do not know what a bicycle sharing system is

Base: all respondents

Q9 [S]

Do you currently have a subscription to a car sharing system?

1. Yes
2. No
3. I do not know what a car sharing system is

Base: all respondents

Q10 [S]

Can you easily park a bicycle at home?

1. Yes
2. No

V. INFORMATION ABOUT MOBILITY

Base: Base: all respondents

Q12 [S]

Do you know how to ride a **bicycle**?

1. Yes
2. No
3. Prefer not to answer

Base: all respondents

Info2 **[info]**

In the remainder of the questionnaire, walking and cycling refers to **all trips you make to participate in activities** such as work, school, shopping, leisure, etc.

This also includes the trips in which you **cycled/walked as before/after transport**, e.g.: when you cycle to a public transport stop, and consequently use public transport.

Please note that touring trips, such as going for a walk, walking your dog, or making a cycling tour should **NOT** be taken into account.

Base: all respondents

Q13 **[SGRID]**

In the past 12 months, how many times did you use the following transport modes, irrespective of the reason?

Rows (randomize):

1. By foot (for at least 10 minutes)
2. Bicycle
3. Moped/motorbike
4. Public transport
5. Taxi (incl. companies like Uber)
6. Car as a driver
7. Car as passenger

Columns:

1. Never
2. One to a few days a year
3. One to a few days per month
4. One to a few days per week
5. At least 5 days per week

VI. INFORMATION ABOUT CYCLING AND WALKING

Info3 **[info]**

As a reminder: in the remainder of the questionnaire, walking and cycling refers to **all trips you make to participate in activities** such as work, school, shopping, leisure, etc.

This also includes the trips in which you **cycled/walked as before/after transport**, e.g.: when you cycle to a public transport stop, and consequently use public transport.

Please note that touring trips, such as going for a walk, walking your dog, or making a cycling tour should **NOT** be taken into account.

Scripter: RANDOMIZE the following blocks of questions:

- *Q14&Q15*
- *Q16&Q17*
- *Q18&Q19*
- *Q20&Q21*
- *Q22a&Q22b&Q23a&Q23b*

Base: Q11_2 IS NOT 4

Q14 **[SGRID]**
To what extent do you agree with the following statement?
For me, **to cycle** for my daily travel from my current place of residence would be…

Rows (randomize the same as Q15):
1. Fast
2. Convenient
3. Safe
4. Good
5. Pleasant

Columns:
1. 1 - Strongly disagree
2. 2
3. 3
4. 4
5. 5
6. 6
7. 7 - Strongly agree

Base: Q11_1 IS NOT 4

Q15 **[SGRID]**
To what extent do you agree with the following statement?
For me, **to walk** for daily travel from my current place of residence would be…

Rows (randomize the same as Q14):
1. Fast
2. Convenient
3. Safe
4. Good
5. Pleasant

Columns:
1. 1 - Strongly disagree
2. 2
3. 3
4. 4
5. 5
6. 6
7. 7 - Strongly agree

Base: Q11_2 IS NOT 4

Q16 **[SGRID]**

To what extent do you agree with the following statements?

Rows (randomize the same as Q17):

1. People who are important to me think I should **cycle** more
2. People who are important to me **cycle** for their daily travel
3. Because of my own values/principles I feel an obligation to **cycle** instead of using the car for everyday trips

Columns:

1. 1 - Strongly disagree
2. 2
3. 3
4. 4
5. 5
6. 6
7. 7 - Strongly agree

Base: Q11_1 IS NOT 4

Q17 **[SGRID]**

To what extent do you agree with the following statements?

Rows (randomize the same as Q16):

1. People who are important to me think I should **walk** more
2. People who are important to me **walk** for their daily travel
3. Because of my own values/principles I feel an obligation to **walk** instead of using the car for everyday trips

Columns:

1. 1 - Strongly disagree
2. 2
3. 3
4. 4
5. 5
6. 6
7. 7 - Strongly agree

Base: Q11_2 IS NOT 4

Q18 **[SGRID]**

To what extent do you agree with the following statements regarding **cycling** in your city?

Rows (randomize):

1. In my city, the existing infrastructure (cycle lanes, cycle paths and cycle pavements) makes it easier for me to **cycle**
2. I could/can park my **bicycle** securely
3. In my city, there are hills, changes in level and slopes which hinder routine **cycling**

Columns:

1. 1 - Strongly disagree
2. 2
3. 3
4. 4
5. 5
6. 6

7. 7 - Strongly agree

Base: Q11_1 IS NOT 4

Q19 **[SGRID]**

To what extent do you agree with the following statements regarding **walking** in your city?~~2~~

Rows (randomize):

1. In my city, the existing infrastructure (sidewalks, pedestrian crossings and pavements) makes it easier for me to **walk**
2. In my city, there are hills, changes in level and slopes which hinder routine **walking**

Columns:

1. 1 - Strongly disagree
2. 2
3. 3
4. 4
5. 5
6. 6
7. 7 - Strongly agree

Base: Q11_2 IS NOT 4

Q20 **[SGRID]**

To what extent do you agree with the following statements?

Rows (randomize the same as Q21):

1. I am capable of riding my **bicycle** through traffic
2. I am capable of going uphill or over rough terrain on a **bicycle**
3. I am capable of riding my **bicycle** for at least 30 minutes

Columns:

1. 1 - Strongly disagree
2. 2
3. 3
4. 4
5. 5
6. 6
7. 7 - Strongly agree

Base: Q11_1 IS NOT 4

Q21 **[SGRID]**

To what extent do you agree with the following statements?

Rows (randomize the same as Q20):

1. I am capable of crossing a street as a **pedestrian** with dense traffic
2. I am capable of **walking** uphill or over rough terrain
3. I am capable of **walking** for at least 30 minutes

Columns:

1. 1 - Strongly disagree
2. 2
3. 3
4. 4
5. 5

6. 6
7. 7 - Strongly agree

Base: Q11_2 IS NOT 4

Q22a **[S]**

How strong/likely is the following intention?

My intention to **cycle** instead of using the car in the next few weeks for everyday trips is…

1. 1 - Very weak
2. 2
3. 3
4. 4
5. 5
6. 6
7. 7 - Very strong

Base: Q11_2 IS NOT 4

Q22b **[SGRID]**

How strong/likely are the following intentions?

Rows (randomize the same as Q23b):

1. How likely is it, that in the next weeks you will **cycle** instead of using the car for everyday routes in your city
2. I intend to **cycle** instead of using the car in the next few weeks for everyday trips in my city

Columns:

1. 1 - Very unlikely
2. 2
3. 3
4. 4
5. 5
6. 6
7. 7 - Very likely

Base: Q11_1 IS NOT 4

Q23a **[S]**

How strong/likely is the following intention?

My intention to **walk** instead of using the car in the next few weeks for everyday trips is…

1. 1 - Very weak
2. 2
3. 3
4. 4
5. 5
6. 6
7. 7 - Very strong

Base: Q11_1 IS NOT 4

Q23b [SGRID]
How strong/likely are the following intentions?

Columns:
1. 1 - Very unlikely
2. 2
3. 3
4. 4
5. 5
6. 6
7. 7 - Very likely

Rows (randomize the same as Q22b):
1. How likely is it, that in the next weeks you will **walk** instead of using the car for everyday routes in your city
2. I intend to **walk** instead of using the car in the next few weeks for everyday trips in my city

Base: Q11_2 IS NOT 4

Q24 [S]
Which of the following statements describes you best?

1. I have never thought about traveling **by bicycle**
2. I have never travelled **by bicycle**, but sometimes I consider it
3. I sometimes travel **by bicycle**, but I am not really considering to do it more regulary
4. I sometimes travel **by bicycle** and I am seriously thinking about doing so more regulary
5. Recently I started traveling more frequently **by bicycle**, and I am planning to keep on doing so in the future
6. For some time now, I am traveling more frequently **by bicycle**

Base: Q11_1 IS NOT 4

Q25 [S]
Which of the following statements describes you best?

1. I have never thought about traveling **by foot**
2. I have never travelled **by foot**, but sometimes I consider it
3. I sometimes travel **by foot**, but I am not really considering to do it more regulary
4. I sometimes travel **by foot** and I am seriously thinking about doing so more regulary
5. Recently I started traveling more frequently **by foot**, and I am planning to keep on doing so in the future
6. For some time now, I am traveling more frequently **by foot**

Base: Q11_2 IS NOT 4

Info4 [info]
Please indicate the number of trips you made.
Include the trips in which you used the **bicycle** as before/after transport, e.g. when you cycle to a public transport stop, and consequently use public transport. If you did not make any trips, type ‘0’ in the answer box.

Base: Q11_2 IS NOT 4

Q26 **[Q] [min 0, max 999]**
In the past 30 days, how many trips did you make **by bicycle**

1. to work/school?
...
2. to do shopping and errands?
…
3. to participate in leisure activities?
…

Scripter: show Info4 and Q26 on same screen

Base: Q11_1 IS NOT 4

Info5 **[info]**

Please indicate the number of trips you made.
Include the trips in which you **walked** for at least 10 minutes as before/after transport, e.g. when you walk to a public transport stop and consequently use public transport. If you did not make any trips, type '0' in the answer box.

Base: Q11_1 IS NOT 4

Q27 **[Q] [min 0, max 999]**
In the past 30 days, how many trips did you **walk**

1. to work/school?
...
2. to locations where you did shopping and errands?
…
3. to locations where you participated in leisure activities?
…

Scripter: show Info5 and Q27 on same screen

Base: all respondents

Q28 **[SGRID]**
To what extent do you agree with the following statements?

Rows (randomize):
1. The way I travel to work/school is an ingrained routine
2. The way I travel to shopping locations is an ingrained routine
3. The way I travel to leisure locations is an ingrained routine

Columns:
1. 1 - Strongly disagree
2. 2
3. 3
4. 4
5. 5
6. 6
7. 7 - Strongly agree

Base: all respondents

Q29 **[SGRID]**

To what extent do you agree with the following statements?

Rows (randomize):

1. When humans interfere with nature it often produces disastrous consequences
2. Humans are severly abusing the environment
3. Despite our special abilities humans are still subject to the laws of nature
4. The so-called “ecological crisis” facing humankind has been greatly exaggerated
5. The balance of nature is very delicate and easily upset
6. If things continue on their present course, we will soon experience a major ecological catastrophe

Columns:

1. 1 - Strongly disagree
2. 2
3. 3
4. 4
5. 5
6. 6
7. 7 - Strongly agree

Base: Q11_2 IS NOT 4

Q30 **[SGRID]**

To what extent are the following aspects an **obstacle** for you to use the **bicycle** more frequently?

Rows (randomize as Q31):

1. Physical effort
2. Time
3. Costs
4. Environment (climate, hilliness…)
5. Traffic safety

Columns:

1. 1 - Very unimportant
2. 2
3. 3
4. 4
5. 5
6. 6
7. 7 - Very important

Base: all respondents

Q31 **[SGRID]**

How important are the following aspects an **obstacle** for you to **walk** more frequently

Columns:

1. 1 - Very unlikely
2. 2
3. 3
4. 4
5. 5
6. 6
7. 7 - Very likely

Rows (randomize as Q30):

1. Physical effort
2. Time
3. Costs
4. Environment (climate, hilliness…)
5. Traffic safety

VII. INTEREST IN E-ASSISTED TRANSPORT MODES

Base: all respondents

Info6 **[info]**

In this part, we would like to ask about your interest in, and experience with, so-called '**e-assisted transport modes**'. These are **compact devices with an electric engine that you can take with you** and that allow you to travel for several kilometers. Some examples of such devices are Segway, electric step, solowheel and hoverboard (see pictures).

Note that electric bicycles are **NOT** considered part of this category of transport modes.

The following figures are examples of e-assisted transport modes.

 1) Segway	 2) Electric step
 3) Solowheel	 4) Hoverboard

Base: all respondents

Q32 **[S - dropdown box]**

How many e-assisted transport modes are available in your household which you could use?

We are interested in all vehicles that you could use for private purposes, including company vehicles

If you can use these outside of the work context

1. Segway: [dropdown box]
2. Electric step: [dropdown box]
3. Solowheel: [dropdown box]
4. Hoverboard: [dropdown box]
5. Other: [dropdown box] Scripter: needs to be specified [O] if not ‘0’

SCRIPTER: Dropdown boxes, with “0” as default value and numbers “1”, “2”, “3”, “4”, “5” and “More than 5”

Scripter: show image of Info6 (but smaller)

Base: if Q32=0 for all items

Q32a **[S]**

You indicated that none of these vehicles are available in your household for you to use.
Is this correct?

1. Yes
2. No   *Scripter: return to Q32 so that respondent can correct his answer*

Base: all respondents

Q33 **[S]**

Which of the following statements best describes you?

Include all the trips in which you used or would use an e-assisted transport modes. This also includes the trips in which you the e-assisted transport mode is used as before/after transport, e.g.: when you ride a solowheel to a public transport stop, and consequently use public transport. Please note that touring trips where you purely use the device for fun or exercise are excluded. The use of electric bicycles should NOT be considered here.

1. I have never thought about traveling by **an e-assisted transport mode**.
2. I have never travelled by **an e-assisted transport mode**, but sometimes I consider it
3. I sometimes travel by **an e-assisted transport mode**, but I am not really considering to do it more regularly
4. I sometimes travel by **an e-assisted transport mode**, and I am seriously thinking about doing so more regularly
5. Recently I started traveling more frequently by **an e-assisted transport mode**, and I am planning to keep on doing so in the future.
6. For some time now, I am traveling more frequently by **an e-assisted transport mode**.

Base: all respondents

Q34 **[S]**

In the past 12 months, how many times did you use **an e-assisted transport mode**, irrespective of the purpose of the trip?

1. Never
2. One to a few days a year
3. One to a few days per month
4. One to a few days per week
5. At least 5 days per week

Base: all respondents

Q35 **[SGRID – rolling grid]**

To what extent do you agree with the following statements?

For me, to take **an e-assisted transport mode** for my daily travel from my current place of residence would be …

Columns:

1. 1 - Strongly disagree
2. 2
3. 3
4. 4
5. 5
6. 6
7. 7 - Strongly agree

Rows (randomize):

1. Fast
2. Convenient
3. Fashionable/cool
4. Safe
5. Cheap
6. Pleasant/fun

Appendix 2: Categorical principal component analysis (CatPCA) of TPB variables

Attitudes

The Scree plot graphs the eigenvalue against the component number. After the second component, the line tapers, which implies that each successive component is accounting for increasingly smaller amounts of the total variance. Only principal components whose eigenvalues are greater than 1 are kept, which implies that two components are extracted. These two principal components explain 55.8% and 21.9% of the variance in the data, respectively (77.7% in total).

CatPCA yields component loadings for the analysed variables. A plot of the component loadings obtained for the attitude items displayed as vectors is shown in Figure 10. We see that the five attitude items related to walking are highly correlated because their vectors all have small angles between them and all have high loadings on the first dimension; the same applies to the five attitude items related to cycling which all have high loadings on the second dimension. As a result, the first component can be interpreted as a general 'walking attitude' factor, and the second as a general 'cycling attitude' factor.

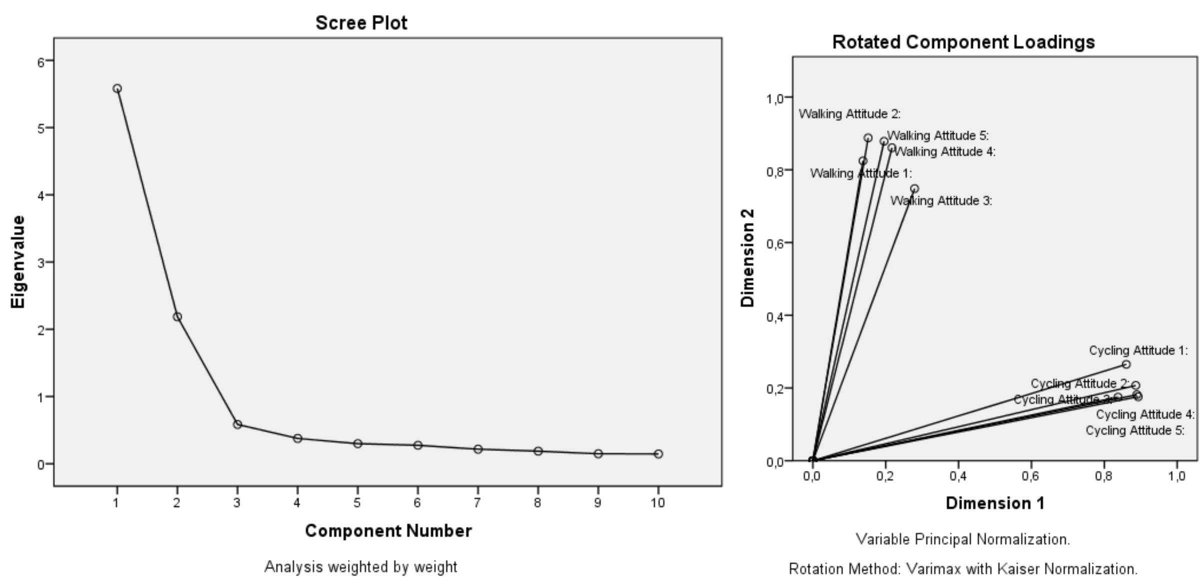

Figure 10: Scree plot attitudes.

Table 27: Eigenvalues attitudes.

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5,582	55,819	55,819	5,582	55,819	55,819	4,021	40,205	40,205
2	2,186	21,858	77,677	2,186	21,858	77,677	3,747	37,472	77,677
3	,584	5,842	83,519						
4	,376	3,765	87,284						
5	,299	2,993	90,277						
6	,274	2,743	93,020						
7	,216	2,163	95,183						
8	,187	1,874	97,057						
9	,149	1,485	98,542						
10	,146	1,458	100,000						

Extraction Method: Principal Component Analysis.

Table 28: Cronbach's Alpha attitudes.

Model Summary Rotation[a]

Dimension	Cronbach's Alpha	Variance Accounted For	
		Total (Eigenvalue)	% of Variance
1	,875	4,020	40,205
2	,863	3,747	37,472
Total	,968[b]	7,768	77,677

a. Rotation Method: Varimax with Kaiser Normalization.

b. Total Cronbach's Alpha is based on the total Eigenvalue.

Table 29: Rotated Component Matrix attitudes.

Rotated Component Matrix[a]

	Component	
	1	2
Cycling Attitude 1: For me to cycle for my daily travel from my current place of residence would be: Fast Quantification	,860	,265
Cycling Attitude 2: For me to cycle for my daily travel from my current place of residence would be: Convenient Quantification	,886	,207
Cycling Attitude 3: For me to cycle for my daily travel from my current place of residence would be: Safe Quantification	,837	,175
Cycling Attitude 4: For me to cycle for my daily travel from my current place of residence would be: Good Quantification	,893	,176
Cycling Attitude 5: For me to cycle for my daily travel from my current place of residence would be: Pleasant Quantification	,889	,182
Walking Attitude 1: For me, to walk for daily travel from my current place of residence would be: Fast Quantification	,138	,824
Walking Attitude 2: For me, to walk for daily travel from my current place of residence would be: Convenient Quantification	,152	,888
Walking Attitude 3: For me, to walk for daily travel from my current place of residence would be: Safe Quantification	,279	,748
Walking Attitude 4: For me, to walk for daily travel from my current place of residence would be: Good Quantification	,217	,861
Walking Attitude 5: For me, to walk for daily travel from my current place of residence would be: Pleasant Quantification	,195	,878

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.[a]

a. Rotation converged in 3 iterations.

Norms

The analysis found two distinct factors in the analysis of norms; factor 1 is the subjective norm, factor 2 combines the descriptive norm and the personal norm.

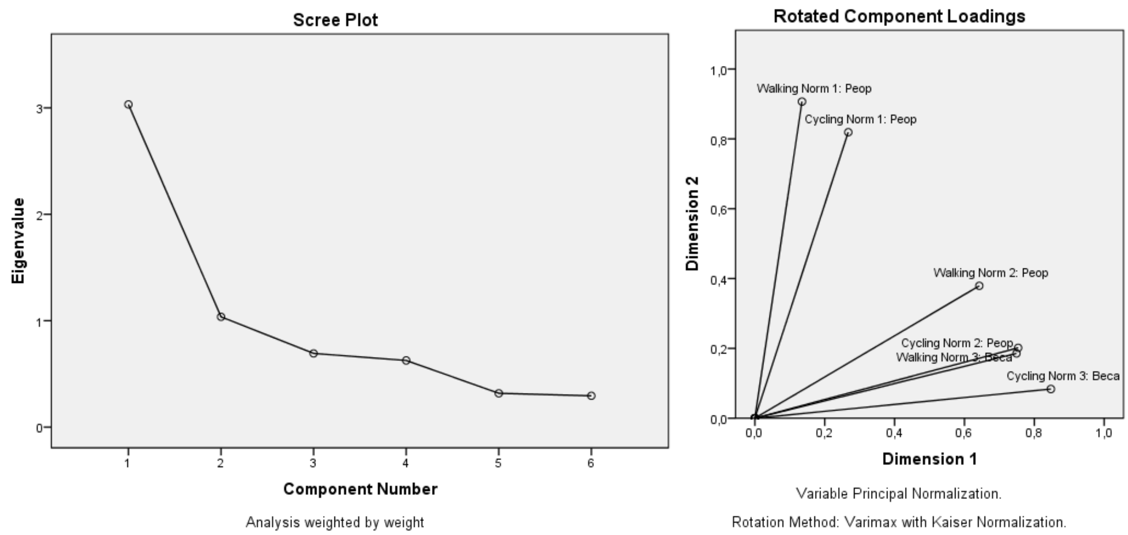

Figure 11: Scree plot norms.

Table 30: Eigenvalues norms.

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3,032	50,537	50,537	3,032	50,537	50,537	2,350	39,162	39,162
2	1,036	17,274	67,811	1,036	17,274	67,811	1,719	28,649	67,811
3	,693	11,544	79,355						
4	,626	10,442	89,797						
5	,318	5,298	95,095						
6	,294	4,905	100,000						

Extraction Method: Principal Component Analysis.

Table 31: Cronbach's Alpha norms.

Model Summary Rotation[a]

Dimension	Cronbach's Alpha	Variance Accounted For	
		Total (Eigenvalue)	% of Variance
1	,758	2,350	39,160
2	,660	1,719	28,651
Total	,905[b]	4,069	67,811

a. Rotation Method: Varimax with Kaiser Normalization.

b. Total Cronbach's Alpha is based on the total Eigenvalue.

Table 32: Rotated Component Matrix norms.

Rotated Component Matrix[a]

	Component 1	Component 2
Cycling Norm 1: People who are important to me think I should cycle more (injuctive norm) Quantification	,268	,819
Cycling Norm 2: People who are important to me cycle for their daily travel (descriptive norm) Quantification	,749	,185
Cycling Norm 3: Because of my own values/principles I feel an obligation to cycle instead of using the car for everyday Quantification	,847	,084
Walking Norm 1: People who are important to me think I should walk more (injuctive norm) Quantification	,135	,907
Walking Norm 2: People who are important to me walk for their daily travel (descriptive norm) Quantification	,643	,379
Walking Norm 3: Because of my own values/principles I feel an obligation to walk instead of using the car for everyday t Quantification	,753	,202

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.[a]

a. Rotation converged in 3 iterations.

Perceived behavioural control

Four factors are distinguished within the analysis of PBC, more specifically self-efficacy of walking (factor 1), self-efficacy of cycling (factor 2), inducive cycling and walking facilities (factor 3) and high-level slopes that hinder routine cycling and walking (factor 4).

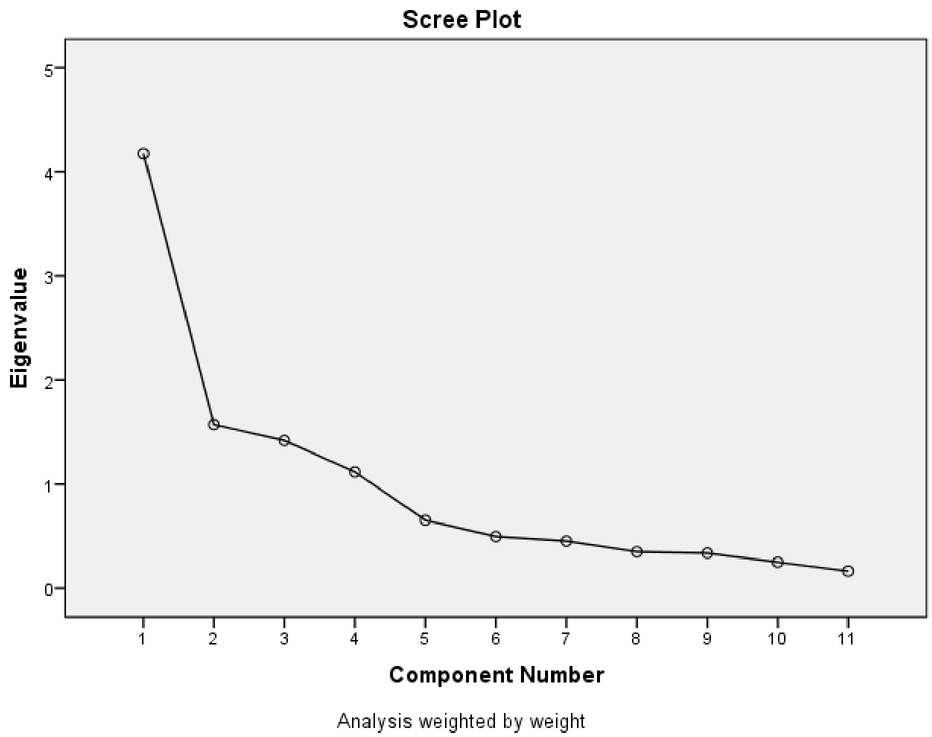

Figure 12: Scree plot perceived behavioural control.

Table 33: Eigenvalues perceived behavioural control.

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4,177	37,976	37,976	4,177	37,976	37,976	2,525	22,958	22,958
2	1,574	14,306	52,282	1,574	14,306	52,282	2,424	22,036	44,995
3	1,420	12,913	65,195	1,420	12,913	65,195	1,752	15,930	60,924
4	1,118	10,164	75,360	1,118	10,164	75,360	1,588	14,435	75,360
5	,654	5,947	81,307						
6	,497	4,520	85,827						
7	,454	4,126	89,953						
8	,351	3,195	93,148						
9	,338	3,075	96,224						
10	,250	2,275	98,498						
11	,165	1,502	100,000						

Extraction Method: Principal Component Analysis.

Table 34: Cronbach's Alpha perceived behavioural control.

Model Summary Rotation[a]

Dimension	Cronbach's Alpha	Variance Accounted For	
		Total (Eigenvalue)	% of Variance
1	,763	2,525	22,958
2	,759	2,424	22,037
3	,613	1,752	15,930
4	,530	1,588	14,435
Total	,967[b]	8,290	75,360

a. Rotation Method: Varimax with Kaiser Normalization.

b. Total Cronbach's Alpha is based on the total Eigenvalue.

Table 35: Rotated Component Matrix perceived behavioural control.

Rotated Component Matrix[a]

	Component			
	1	2	3	4
Cycling PBC - Controllability 1: In my city, the existing infrastructure makes it easier for me to cycle Quantification	-,079	,280	,794	,124
Cycling PBC - Controllability 2: In my city, I could/can park my bicycle securely Quantification	,031	,215	,748	,009
Cycling PBC - Controllability 3: In my city, there are hills, changes in level and slopes which hinder routine cycling (Quantification	-,069	,179	,081	,898
Waling PBC - Controllability 1: In my city, the existing infrastructure makes it easier for me to walk Quantification	,422	-,149	,674	,129
Waling PBC - Controllability 2: In my city, there are hills, changes in level and slopes which hinder routine walking (r Quantification	,308	-,035	,109	,842
Cycling PBC - Self-efficacy 1: I am capable of riding my bicycle through traffic Quantification	,153	,830	,211	,093
Cycling PBC - Self-efficacy 2: I am capable of going uphill or over rough terrain on a bicycle Quantification	,254	,851	,127	,015
Cycling PBC - Self-efficacy 3: I am capable of riding my bicycle for at least 30 minutes Quantification	,379	,785	,115	,102
Walking PBC - Self-efficacy 1: I am capable of crossing a street as a pedestrian with dense traffic Quantification	,792	,178	,109	,118
Walking PBC - Self-efficacy 2: I am capable of walking uphill or over rough terrain Quantification	,803	,354	,018	,029
Walking PBC - Self-efficacy 3: I am capable of walking for at least 30 minutes Quantification	,858	,243	,044	,079

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.[a]

a. Rotation converged in 5 iterations.

Intention

The analysis distinguishes between two factors of intention, namely walking intention and cycling intention.

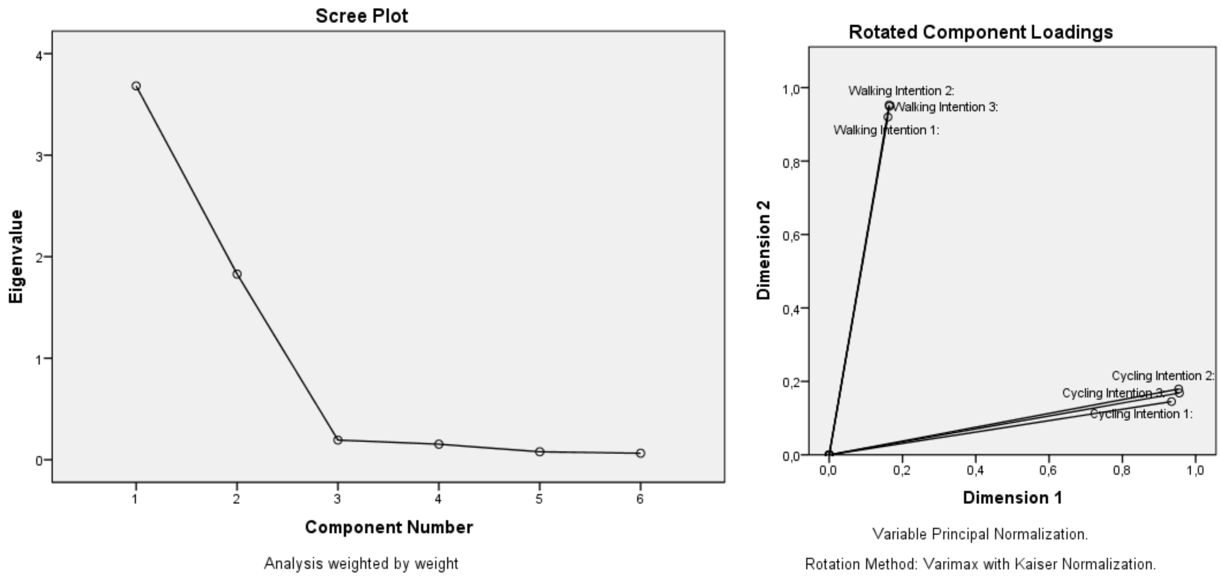

Figure 13: Scree plot intention.

Table 36: Eigenvalues intention.

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3,682	61,369	61,369	3,682	61,369	61,369	2,774	46,231	46,231
2	1,829	30,481	91,850	1,829	30,481	91,850	2,737	45,619	91,850
3	,194	3,229	95,080						
4	,153	2,548	97,628						
5	,078	1,307	98,934						
6	,064	1,066	100,000						

Extraction Method: Principal Component Analysis.

Table 37: Cronbach's Alpha intention.

Model Summary Rotation[a]

Dimension	Cronbach's Alpha	Variance Accounted For	
		Total (Eigenvalue)	% of Variance
1	,810	2,774	46,231
2	,808	2,737	45,619
Total	,982[b]	5,511	91,850

a. Rotation Method: Varimax with Kaiser Normalization.

b. Total Cronbach's Alpha is based on the total Eigenvalue.

Table 38: Rotated Component Matrix intention.

Rotated Component Matrix[a]

	Component	
	1	2
Cycling Intention 1: My intention to cycle instead of using the car in the next few weeks for everyday trips is Quantification	,934	,145
Cycling Intention 2: How likely is it, that in the next weeks you will cycle instead of using the car for everyday route Quantification	,954	,179
Cycling Intention 3: I intend to cycle instead of using the car in the next few weeks for everyday trips in my city Quantification	,955	,168
Walking Intention 1: My intention to walk instead of using the car in the next few weeks for everyday trips is Quantification	,160	,920
Walking Intention 2: How likely is it, that in the next weeks you will walk instead of using the car for everyday routes Quantification	,164	,953
Walking Intention 3: I intend to walk instead of using the car in the next few weeks for everyday trips in my city Quantification	,164	,949

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.[a]

a. Rotation converged in 3 iterations.

Habit

In the analysis of habit, we will deviate from the cut-off of 1 that has been applied so far. The reason is that the value drops only marginally under 1 for the second component (0,969), and from the rotated component loadings it becomes clear that it is more logic to distinguish between two factors instead of one; namely shopping and leisure (factor 1) and work/school (factor 2).

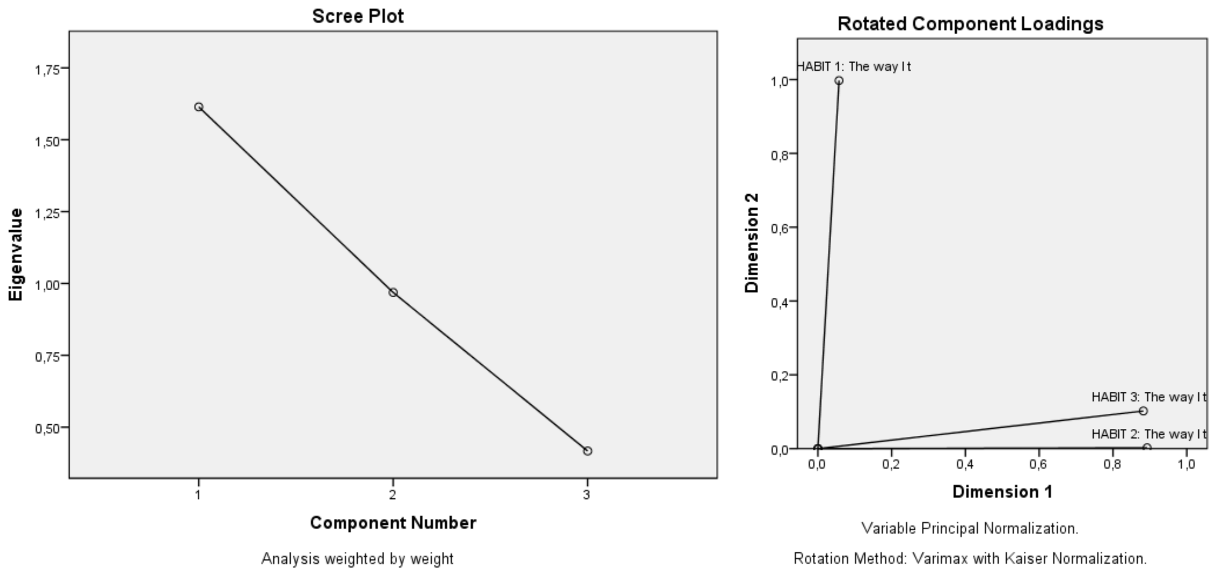

Figure 14: Scree plot habit.

Table 39: Eigenvalues habit

Total Variance Explained

Component	Initial Eigenvalues Total	Initial Eigenvalues % of Variance	Initial Eigenvalues Cumulative %	Extraction Sums of Squared Loadings Total	Extraction Sums of Squared Loadings % of Variance	Extraction Sums of Squared Loadings Cumulative %	Rotation Sums of Squared Loadings Total	Rotation Sums of Squared Loadings % of Variance	Rotation Sums of Squared Loadings Cumulative %
1	1,614	53,813	53,813	1,614	53,813	53,813	1,578	52,600	52,600
2	,969	32,288	86,102	,969	32,288	86,102	1,005	33,501	86,102
3	,417	13,898	100,000						

Extraction Method: Principal Component Analysis.

Table 40: Cronbach's Alpha habit.

Model Summary Rotation[a]

Dimension	Cronbach's Alpha	Variance Accounted For Total (Eigenvalue)	Variance Accounted For % of Variance
1	,566	1,578	52,600
2	,071	1,005	33,501
Total	,919[b]	2,583	86,101

a. Rotation Method: Varimax with Kaiser Normalization.

b. Total Cronbach's Alpha is based on the total Eigenvalue.

Table 41: Rotated Component Matrix habit.

Rotated Component Matrix[a]

	Component 1	Component 2
HABIT 1: The way I travel to work/school is an ingrained routine Quantification	,057	,997
HABIT 2: The way I travel to shopping locations is an ingrained routine Quantification	,892	,002
HABIT 3: The way I travel to leisure locations is an ingrained routine Quantification	,882	,102

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.[a]

a. Rotation converged in 3 iterations.

Behaviour

In terms of behaviour, two factors can be clearly distinguished, namely walking behaviour (factor 1) and cycling behaviour (factor 2).

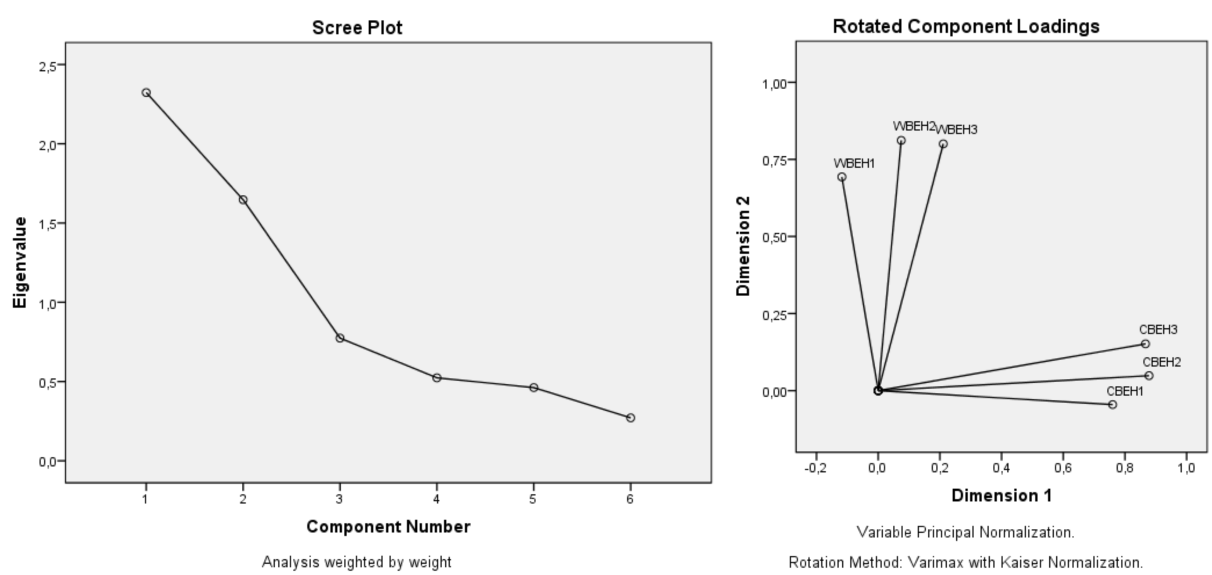

Figure 15: Scree plot behaviour.

Table 42: Eigenvalues behaviour.

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2,323	38,723	38,723	2,323	38,723	38,723	2,163	36,057	36,057
2	1,647	27,452	66,174	1,647	27,452	66,174	1,807	30,117	66,174
3	,774	12,896	79,070						
4	,523	8,725	87,795						
5	,462	7,694	95,488						
6	,271	4,512	100,000						

Extraction Method: Principal Component Analysis.

Table 43: Cronbach's Alpha behaviour.

Model Summary Rotation[a]

Dimension	Cronbach's Alpha	Variance Accounted For	
		Total (Eigenvalue)	% of Variance
1	,640	2,163	36,057
2	,543	1,807	30,118
Total	,898[b]	3,970	66,174

a. Rotation Method: Varimax with Kaiser Normalization.

b. Total Cronbach's Alpha is based on the total Eigenvalue.

Table 44: Rotated Component Matrix behaviour.

Rotated Component Matrix[a]

	Component	
	1	2
Cycling Behavior 1: # trips the past 30 days you made by bicycle: to work/school (Monotone transformed variable)	,760	-,045
Cycling Behavior 2: # trips the past 30 days you made by bicycle: to do shopping and errands	,878	,048
Cycling Behavior 3: # trips the past 30 days you made by bicycle: to participate in leisure activities	,867	,152
Walking Behavior 1: # trips the past 30 days you walk: to work/school	-,118	,693
Walking Behavior 2: # trips the past 30 days you walk: to do shopping and errands	,075	,812
Walking Behavior 3: # trips the past 30 days you walk: to participate in leisure activities	,211	,800

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.[a]

a. Rotation converged in 3 iterations.

Appendix 3: Stage models – output

Appendix 3.1: Stage model cycling

Table 45: Variables omitted in backwards elimination of stage model cycling.

Summary of Backward Elimination						
Step	Effect Removed	DF	Number In	Wald Chi-Square	Pr > ChiSq	Variable Label
1	AboPT	4	18	0.5285	0.9707	Season ticket for using public transportation
2	Degree	4	17	2.8342	0.5859	Highest qualification or educational certificate obtained
3	PARTNER	4	16	2.6601	0.6162	
4	CHILD	4	15	2.3572	0.6704	
5	CarShare	4	14	3.3306	0.5041	Subscription to a car sharing system
6	PETPOS	4	13	7.6410	0.1057	

Table 46: Type 3 Analysis of Effects stage model cycling.

Type 3 Analysis of Effects			
Effect	DF	Wald Chi-Square	Pr > ChiSq
CBEH	4	124.8909	<.0001
CINT	4	192.6215	<.0001
CATT	4	16.0665	0.0029
CNORM	4	24.3873	<.0001
CPBC	4	41.6903	<.0001
HAB	4	18.0230	0.0012
NEPS	4	12.0091	0.0173
Agecat	4	28.7871	<.0001
BICYCLEPOS	4	63.6165	<.0001
CARPOS	4	14.4793	0.0059

Type 3 Analysis of Effects			
Effect	**DF**	**Wald Chi-Square**	**Pr > ChiSq**
COBST	4	21.8741	0.0002
BikeShare	4	28.5643	<.0001
DrivLic	4	10.6741	0.0305

Table 47: Stage model cycling.

Analysis of Maximum Likelihood Estimates							
Parameter		**C_STAGE**	**DF**	**Estimate**	**Standard Error**	**Wald Chi-Square**	**Pr > ChiSq**
Intercept		**2) Contemplation**	1	-4.7777	0.8447	31.9874	<.0001
Intercept		**3) Preparation**	1	-7.3696	1.0628	48.0801	<.0001
Intercept		**4) Action**	1	-14.2830	1.5408	85.9295	<.0001
Intercept		**5) Maintenance**	1	-11.9747	1.2920	85.9002	<.0001
CBEH		**2) Contemplation**	1	0.0128	0.0444	0.0837	0.7723
CBEH		**3) Preparation**	1	0.0650	0.0472	1.8961	0.1685
CBEH		**4) Action**	1	0.1573	0.0491	10.2474	0.0014
CBEH		**5) Maintenance**	1	0.2432	0.0476	26.0661	<.0001
CINT		**2) Contemplation**	1	0.3767	0.0907	17.2461	<.0001
CINT		**3) Preparation**	1	0.7672	0.0999	58.9372	<.0001
CINT		**4) Action**	1	1.1902	0.1298	84.1271	<.0001
CINT		**5) Maintenance**	1	1.4509	0.1212	143.3829	<.0001
CATT		**2) Contemplation**	1	0.2542	0.0673	14.2826	0.0002
CATT		**3) Preparation**	1	0.2455	0.0866	8.0342	0.0046
CATT		**4) Action**	1	0.3174	0.1280	6.1537	0.0131
CATT		**5) Maintenance**	1	0.3423	0.1111	9.4983	0.0021
CNORM		**2) Contemplation**	1	0.2597	0.0762	11.6146	0.0007
CNORM		**3) Preparation**	1	0.4430	0.0914	23.4671	<.0001

Analysis of Maximum Likelihood Estimates							
Parameter		C_STAGE	DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
CNORM		4) Action	1	0.4392	0.1177	13.9308	0.0002
CNORM		5) Maintenance	1	0.3672	0.1057	12.0666	0.0005
CPBC		2) Contemplation	1	0.1831	0.0662	7.6547	0.0057
CPBC		3) Preparation	1	0.4578	0.0909	25.3494	<.0001
CPBC		4) Action	1	0.4973	0.1367	13.2354	0.0003
CPBC		5) Maintenance	1	0.7406	0.1224	36.6061	<.0001
HAB		2) Contemplation	1	0.0470	0.0576	0.6663	0.4144
HAB		3) Preparation	1	-0.1305	0.0756	2.9816	0.0842
HAB		4) Action	1	-0.3077	0.1075	8.1995	0.0042
HAB		5) Maintenance	1	-0.2294	0.0949	5.8496	0.0156
NEPS		2) Contemplation	1	0.0714	0.0705	1.0266	0.3110
NEPS		3) Preparation	1	0.1779	0.0925	3.7018	0.0544
NEPS		4) Action	1	0.0544	0.1272	0.1827	0.6691
NEPS		5) Maintenance	1	-0.1056	0.1131	0.8730	0.3501
Agecat	18-54	2) Contemplation	1	0.5018	0.1747	8.2456	0.0041
Agecat	18-54	3) Preparation	1	0.5469	0.2247	5.9235	0.0149
Agecat	18-54	4) Action	1	0.7553	0.3177	5.6510	0.0174
Agecat	18-54	5) Maintenance	1	-0.2013	0.2671	0.5680	0.4511
BICYCLEPOS		2) Contemplation	1	1.0601	0.1739	37.1782	<.0001
BICYCLEPOS		3) Preparation	1	1.7337	0.2560	45.8605	<.0001
BICYCLEPOS		4) Action	1	2.9821	0.7141	17.4403	<.0001
BICYCLEPOS		5) Maintenance	1	1.9099	0.3914	23.8063	<.0001
CARPOS		2) Contemplation	1	0.0745	0.2114	0.1243	0.7244
CARPOS		3) Preparation	1	0.6242	0.2717	5.2778	0.0216
CARPOS		4) Action	1	0.9000	0.3610	6.2172	0.0127
CARPOS		5) Maintenance	1	0.1941	0.3096	0.3933	0.5306
COBST		2) Contemplation	1	-0.0226	0.0628	0.1290	0.7194

Analysis of Maximum Likelihood Estimates							
Parameter		C_STAGE	DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
COBST		3) Preparation	1	-0.0579	0.0814	0.5064	0.4767
COBST		4) Action	1	0.0660	0.1038	0.4036	0.5252
COBST		5) Maintenance	1	-0.2542	0.0935	7.3927	0.0065
BikeShare		2) Contemplation	1	0.6355	0.2663	5.6935	0.0170
BikeShare		3) Preparation	1	-0.0197	0.3197	0.0038	0.9509
BikeShare		4) Action	1	1.0678	0.3716	8.2557	0.0041
BikeShare		5) Maintenance	1	0.9355	0.3518	7.0717	0.0078
DrivLic		2) Contemplation	1	-0.3907	0.2512	2.4184	0.1199
DrivLic		3) Preparation	1	-0.9246	0.3120	8.7810	0.0030
DrivLic		4) Action	1	-0.6622	0.4130	2.5700	0.1089
DrivLic		5) Maintenance	1	-0.9680	0.3602	7.2247	0.0072

Table 48: Odds ratios stage model cycling.

Odds Ratio Estimates				
Effect	C_STAGE	Point Estimate	95% Wald Confidence Limits	
CBEH	2) Contemplation	1.013	0.929	1.105
CBEH	3) Preparation	1.067	0.973	1.171
CBEH	4) Action	1.170	1.063	1.289
CBEH	5) Maintenance	1.275	1.162	1.400
CINT	2) Contemplation	1.457	1.220	1.741
CINT	3) Preparation	2.154	1.771	2.620
CINT	4) Action	3.288	2.550	4.240
CINT	5) Maintenance	4.267	3.365	5.411
CATT	2) Contemplation	1.289	1.130	1.471
CATT	3) Preparation	1.278	1.079	1.515
CATT	4) Action	1.374	1.069	1.765

Odds Ratio Estimates				
Effect	C_STAGE	Point Estimate	95% Wald Confidence Limits	
CATT	5) Maintenance	1.408	1.133	1.751
CNORM	2) Contemplation	1.297	1.117	1.505
CNORM	3) Preparation	1.557	1.302	1.863
CNORM	4) Action	1.551	1.232	1.954
CNORM	5) Maintenance	1.444	1.174	1.776
CPBC	2) Contemplation	1.201	1.055	1.367
CPBC	3) Preparation	1.581	1.323	1.889
CPBC	4) Action	1.644	1.258	2.150
CPBC	5) Maintenance	2.097	1.650	2.666
HAB	2) Contemplation	1.048	0.936	1.173
HAB	3) Preparation	0.878	0.757	1.018
HAB	4) Action	0.735	0.595	0.907
HAB	5) Maintenance	0.795	0.660	0.957
NEPS	2) Contemplation	1.074	0.935	1.233
NEPS	3) Preparation	1.195	0.997	1.432
NEPS	4) Action	1.056	0.823	1.355
NEPS	5) Maintenance	0.900	0.721	1.123
Agecat 18-54 vs 55+	2) Contemplation	1.652	1.173	2.326
Agecat 18-54 vs 55+	3) Preparation	1.728	1.112	2.684
Agecat 18-54 vs 55+	4) Action	2.128	1.142	3.967
Agecat 18-54 vs 55+	5) Maintenance	0.818	0.484	1.380
BICYCLEPOS	2) Contemplation	2.887	2.053	4.059
BICYCLEPOS	3) Preparation	5.662	3.428	9.351
BICYCLEPOS	4) Action	19.729	4.867	79.971
BICYCLEPOS	5) Maintenance	6.753	3.135	14.544
CARPOS	2) Contemplation	1.077	0.712	1.631
CARPOS	3) Preparation	1.867	1.096	3.180

Odds Ratio Estimates				
Effect	**C_STAGE**	**Point Estimate**	**95% Wald Confidence Limits**	
CARPOS	**4) Action**	2.460	1.212	4.990
CARPOS	**5) Maintenance**	1.214	0.662	2.227
COBST	**2) Contemplation**	0.978	0.864	1.106
COBST	**3) Preparation**	0.944	0.805	1.107
COBST	**4) Action**	1.068	0.871	1.309
COBST	**5) Maintenance**	0.776	0.646	0.931
BikeShare	**2) Contemplation**	1.888	1.120	3.182
BikeShare	**3) Preparation**	0.981	0.524	1.835
BikeShare	**4) Action**	2.909	1.404	6.027
BikeShare	**5) Maintenance**	2.548	1.279	5.078
DrivLic	**2) Contemplation**	0.677	0.413	1.107
DrivLic	**3) Preparation**	0.397	0.215	0.731
DrivLic	**4) Action**	0.516	0.230	1.159
DrivLic	**5) Maintenance**	0.380	0.188	0.769

Appendix 3.2: Stage model walking

Table 49: Variables omitted in backwards elimination of stage model walking.

Summary of Backward Elimination						
Step	Effect Removed	DF	Number In	Wald Chi-Square	Pr > ChiSq	Variable Label
1	Degree	4	18	2.3613	0.6696	Highest qualification or educational certificate obtained
2	HAB	4	17	2.8774	0.5785	
3	BikeShare	4	16	4.1893	0.3810	Subscription to a bicycle sharing system
4	CHILD	4	15	4.5300	0.3390	
5	Agecat	4	14	6.5512	0.1616	Age groups (sample stratification)
6	WPBC	4	13	5.8817	0.2082	
7	PETPOS	4	12	7.8710	0.0964	
8	PARTNER	4	11	8.4601	0.0761	
9	NEPS	4	10	9.0933	0.0588	

Table 50: Type 3 Analysis of Effects stage model walking.

Type 3 Analysis of Effects			
Effect	DF	Wald Chi-Square	Pr > ChiSq
WBEH	4	96.3266	<.0001
WINT	4	192.4887	<.0001
WATT	4	39.0752	<.0001
WNORM	4	60.8893	<.0001
BICYCLEPOS	4	25.7521	<.0001
CARPOS	4	15.5901	0.0036
WOBST	4	48.0572	<.0001
CarShare	4	11.7218	0.0195

Type 3 Analysis of Effects			
Effect	DF	Wald Chi-Square	Pr > ChiSq
DrivLic	4	21.3458	0.0003
AboPT	4	10.7282	0.0298

Table 51: Stage model walking.

Analysis of Maximum Likelihood Estimates						
Parameter	W_STAGE	DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Intercept	2) Contemplation	1	-1.6632	0.9514	3.0561	0.0804
Intercept	3) Preparation	1	-3.7126	1.0362	12.8377	0.0003
Intercept	4) Action	1	-6.3380	1.1303	31.4428	<.0001
Intercept	5) Maintenance	1	-6.2235	1.0592	34.5230	<.0001
WBEH	2) Contemplation	1	0.0644	0.0346	3.4695	0.0625
WBEH	3) Preparation	1	0.0695	0.0356	3.8057	0.0511
WBEH	4) Action	1	0.1139	0.0363	9.8677	0.0017
WBEH	5) Maintenance	1	0.1702	0.0352	23.4187	<.0001
WINT	2) Contemplation	1	0.2663	0.0949	7.8773	0.0050
WINT	3) Preparation	1	0.4864	0.0996	23.8406	<.0001
WINT	4) Action	1	0.6839	0.1085	39.7004	<.0001
WINT	5) Maintenance	1	0.9761	0.1020	91.5164	<.0001
WATT	2) Contemplation	1	-0.1385	0.0799	3.0065	0.0829
WATT	3) Preparation	1	0.1011	0.0891	1.2879	0.2564
WATT	4) Action	1	0.0248	0.1020	0.0591	0.8079
WATT	5) Maintenance	1	0.2336	0.0927	6.3488	0.0117
WNORM	2) Contemplation	1	0.4583	0.1073	18.2451	<.0001
WNORM	3) Preparation	1	0.6972	0.1136	37.6285	<.0001
WNORM	4) Action	1	0.8581	0.1223	49.2062	<.0001

Analysis of Maximum Likelihood Estimates						
Parameter	W_STAGE	DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
WNORM	5) Maintenance	1	0.6283	0.1144	30.1746	<.0001
BICYCLEPOS	2) Contemplation	1	0.9275	0.2289	16.4227	<.0001
BICYCLEPOS	3) Preparation	1	0.3764	0.2491	2.2826	0.1308
BICYCLEPOS	4) Action	1	0.7857	0.2872	7.4862	0.0062
BICYCLEPOS	5) Maintenance	1	0.8541	0.2607	10.7334	0.0011
CARPOS	2) Contemplation	1	-0.3095	0.3567	0.7529	0.3856
CARPOS	3) Preparation	1	0.4534	0.3826	1.4044	0.2360
CARPOS	4) Action	1	0.1537	0.3986	0.1488	0.6997
CARPOS	5) Maintenance	1	-0.0745	0.3748	0.0396	0.8424
WOBST	2) Contemplation	1	0.0643	0.0836	0.5921	0.4416
WOBST	3) Preparation	1	0.0797	0.0905	0.7746	0.3788
WOBST	4) Action	1	-0.0258	0.0983	0.0689	0.7930
WOBST	5) Maintenance	1	-0.2369	0.0925	6.5638	0.0104
CarShare	2) Contemplation	1	0.3478	0.3390	1.0526	0.3049
CarShare	3) Preparation	1	-0.1531	0.3628	0.1781	0.6730
CarShare	4) Action	1	0.3218	0.3864	0.6939	0.4049
CarShare	5) Maintenance	1	0.4462	0.3676	1.4733	0.2248
DrivLic	2) Contemplation	1	0.4062	0.4551	0.7967	0.3721
DrivLic	3) Preparation	1	0.0617	0.4764	0.0168	0.8970
DrivLic	4) Action	1	-0.0393	0.4927	0.0064	0.9364
DrivLic	5) Maintenance	1	-0.5496	0.4646	1.3997	0.2368
AboPT	2) Contemplation	1	0.3634	0.2759	1.7352	0.1878
AboPT	3) Preparation	1	0.5300	0.2905	3.3277	0.0681
AboPT	4) Action	1	0.7678	0.3091	6.1700	0.0130
AboPT	5) Maintenance	1	0.7352	0.2926	6.3136	0.0120

Table 52: Odds ratios stage model walking.

Odds Ratio Estimates				
Effect	W_STAGE	Point Estimate	95% Wald Confidence Limits	
WBEH	2) Contemplation	1.066	0.997	1.141
WBEH	3) Preparation	1.072	1.000	1.150
WBEH	4) Action	1.121	1.044	1.203
WBEH	5) Maintenance	1.186	1.107	1.270
WINT	2) Contemplation	1.305	1.084	1.572
WINT	3) Preparation	1.626	1.338	1.977
WINT	4) Action	1.982	1.602	2.451
WINT	5) Maintenance	2.654	2.173	3.242
WATT	2) Contemplation	0.871	0.744	1.018
WATT	3) Preparation	1.106	0.929	1.317
WATT	4) Action	1.025	0.839	1.252
WATT	5) Maintenance	1.263	1.053	1.515
WNORM	2) Contemplation	1.581	1.281	1.951
WNORM	3) Preparation	2.008	1.607	2.509
WNORM	4) Action	2.359	1.856	2.998
WNORM	5) Maintenance	1.875	1.498	2.346
BICYCLEPOS	2) Contemplation	2.528	1.614	3.960
BICYCLEPOS	3) Preparation	1.457	0.894	2.374
BICYCLEPOS	4) Action	2.194	1.250	3.852
BICYCLEPOS	5) Maintenance	2.349	1.409	3.916
CARPOS	2) Contemplation	0.734	0.365	1.476
CARPOS	3) Preparation	1.574	0.743	3.331
CARPOS	4) Action	1.166	0.534	2.547
CARPOS	5) Maintenance	0.928	0.445	1.935
WOBST	2) Contemplation	1.066	0.905	1.256
WOBST	3) Preparation	1.083	0.907	1.293

Odds Ratio Estimates				
Effect	W_STAGE	Point Estimate	95% Wald Confidence Limits	
WOBST	4) Action	0.975	0.804	1.182
WOBST	5) Maintenance	0.789	0.658	0.946
CarShare	2) Contemplation	1.416	0.729	2.752
CarShare	3) Preparation	0.858	0.421	1.747
CarShare	4) Action	1.380	0.647	2.942
CarShare	5) Maintenance	1.562	0.760	3.211
DrivLic	2) Contemplation	1.501	0.615	3.662
DrivLic	3) Preparation	1.064	0.418	2.706
DrivLic	4) Action	0.961	0.366	2.525
DrivLic	5) Maintenance	0.577	0.232	1.435
AboPT	2) Contemplation	1.438	0.838	2.470
AboPT	3) Preparation	1.699	0.961	3.002
AboPT	4) Action	2.155	1.176	3.950
AboPT	5) Maintenance	2.086	1.176	3.701

Appendix 3.3: Stage model Personal e-Transporters

Table 53: Variables omitted in backwards elimination of stage model PeTs.

Summary of Backward Elimination						
Step	Effect Removed	DF	Number In	Wald Chi-Square	Pr > ChiSq	Variable Label
1	WINT	2	24	0.5059	0.7765	
2	CHILD	2	23	0.7773	0.6780	
3	AboPT	2	22	1.2211	0.5430	Season ticket for using public transportation
4	DrivLic	2	21	1.2225	0.5427	Car driving license or permit
5	CARPOS	2	20	0.6843	0.7103	
6	PARTNER	2	19	1.7838	0.4099	
7	Degree	2	18	1.7910	0.4084	Highest qualification or educational certificate obtained
8	CarShare	2	17	1.8813	0.3904	Subscription to a car sharing system
9	WOBST	2	16	1.9056	0.3857	
10	BICYCLEPOS	2	15	1.9738	0.3727	
11	Agecat	2	14	2.7898	0.2479	Age groups (sample stratification)
12	WPBC	2	13	3.6501	0.1612	
13	CBEH	2	12	4.0985	0.1288	
14	CINT	2	11	3.3164	0.1905	
15	CATT	2	10	3.9160	0.1411	
16	CPBC	2	9	5.3008	0.0706	
17	WNORM	2	8	4.7855	0.0914	

Table 54: Type 3 Analysis of Effects stage model PeTs.

Type 3 Analysis of Effects			
Effect	DF	Wald Chi-Square	Pr > ChiSq
CNORM	2	41.9650	<.0001
WBEH	2	28.3991	<.0001
WATT	2	28.2769	<.0001

Type 3 Analysis of Effects			
Effect	DF	Wald Chi-Square	Pr > ChiSq
HAB	2	7.4943	0.0236
NEPS	2	11.0698	0.0039
PETPOS	2	78.2632	<.0001
COBST	2	19.3752	<.0001
BikeShare	2	13.0794	0.0014

Table 55: Stage model PeTs.

Analysis of Maximum Likelihood Estimates						
Parameter	EAM_STAGE	DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Intercept	2) Contemplation	1	-1.4464	0.5244	7.6085	0.0058
Intercept	3) Preparation/action/maint	1	0.1289	1.0275	0.0157	0.9001
CNORM	2) Contemplation	1	0.2081	0.0403	26.6656	<.0001
CNORM	3) Preparation/action/maint	1	0.4640	0.1005	21.3244	<.0001
WBEH	2) Contemplation	1	0.0324	0.00791	16.7769	<.0001
WBEH	3) Preparation/action/maint	1	0.0644	0.0148	18.8443	<.0001
WATT	2) Contemplation	1	-0.1905	0.0416	20.9554	<.0001
WATT	3) Preparation/action/maint	1	-0.3418	0.1009	11.4834	0.0007
HAB	2) Contemplation	1	-0.0928	0.0429	4.6800	0.0305
HAB	3) Preparation/action/maint	1	-0.2064	0.1063	3.7707	0.0522
NEPS	2) Contemplation	1	0.1099	0.0534	4.2423	0.0394
NEPS	3) Preparation/action/maint	1	-0.2843	0.1237	5.2877	0.0215
PETPOS	2) Contemplation	1	0.8577	0.2227	14.8268	0.0001
PETPOS	3) Preparation/action/maint	1	2.6198	0.2973	77.6324	<.0001
COBST	2) Contemplation	1	0.1759	0.0403	19.0807	<.0001
COBST	3) Preparation/action/maint	1	0.1151	0.0963	1.4273	0.2322

Analysis of Maximum Likelihood Estimates						
Parameter	EAM_STAGE	DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
BikeShare	2) Contemplation	1	-0.2880	0.1613	3.1866	0.0742
BikeShare	3) Preparation/action/maint	1	-1.0323	0.2953	12.2233	0.0005

Table 56: Odds ratios stage model PeTs.

Odds Ratio Estimates				
Effect	EAM_STAGE	Point Estimate	95% Wald Confidence Limits	
CNORM	2) Contemplation	1.231	1.138	1.333
CNORM	3) Preparation/action/maint	1.590	1.306	1.937
WBEH	2) Contemplation	1.033	1.017	1.049
WBEH	3) Preparation/action/maint	1.066	1.036	1.098
WATT	2) Contemplation	0.827	0.762	0.897
WATT	3) Preparation/action/maint	0.710	0.583	0.866
HAB	2) Contemplation	0.911	0.838	0.991
HAB	3) Preparation/action/maint	0.813	0.660	1.002
NEPS	2) Contemplation	1.116	1.005	1.239
NEPS	3) Preparation/action/maint	0.753	0.591	0.959
PETPOS	2) Contemplation	2.358	1.524	3.648
PETPOS	3) Preparation/action/maint	13.733	7.668	24.595
COBST	2) Contemplation	1.192	1.102	1.290
COBST	3) Preparation/action/maint	1.122	0.929	1.355
BikeShare	2) Contemplation	0.750	0.547	1.029
BikeShare	3) Preparation/action/maint	0.356	0.200	0.635