Moving on to the Active Modes

A RESEARCH ON THE POTENTIAL OF SPEED PEDELECS BECOMING A MAJOR MODE IN COMMUTER TRAFFIC

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A RESEARCH ON THE POTENTIAL OF SPEED PEDELECS BECOMING A MAJOR MODE IN TRAFFIC

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PREFACE

March 2017, Nijmegen

Dear reader,

In front of you a masterpiece is presented, at least it is in my opinion. Factually, it is a masterpiece as it represents the grand closure of my master Local and Regional Planning in the Netherlands. To me, it is a masterpiece regarding the effort, time and joy that has been put in. During the initial phase of this thesis in January 2016, my focus was on how the number of cycling commuters could be multiplied in a daily urban system. This line of thought was an attempt to address both mobility and spatial issues. In contemporary spatial planning the interplay between the two concepts cannot be denied. New born concepts enter the world of mobility and accessibility which should be given a chance in our struggle to a more sustainable living environment while simultaneously keeping everyone in motion. If one would ask me, I would suggest that the Speed Pedelec is an answer to accessibility issues on the inter-urban scale. At least if it is embedded properly in law and regulations, and if infrastructure provides for varying velocities.

I would like to thank Fariya Sharmeen as my helpful and patient supervisor. She was willing to help me attaining my goals: doing at least one internship and move my thesis to the next college year. With her patience she taught me a great deal on how to properly write a thesis, struggle through analysis and find joy in puzzling your way through research. Also my two supervisors at the Province of Gelderland should not be forgotten: Jessica van Hees and Johan Leferink were good advice and showed me around the world of civil servants. The regional playfield of the Province appeared to be an interesting area to move in.

This thesis discusses the speed pedelec's possibilities and limits in commuter traffic in a search to find the key to attracting more commuters to cycle to work. Be aware, it is not a psychological research. It is a spatial planner caring for the urban landscape of the Netherlands and trying to at least stress the importance of moving to sustainable modalities.

Babet Hendriks

SUMMARY

This research is drawn from the urgent need to move towards a sustainable mobility system whereby reduction of CO_2 emission is attained and accessibility remains warranted. Studies on sustainable mobility have predominantly focussed on cars due to the development of hybrid and autonomous vehicle technologies. However, not all signs point out the continuing importance of automobiles since the bicycle is still gaining territory in the Dutch urban environment. This is among others, triggered by the advent of electrically supported bicycles which expands the scope of active modes. First of all, there is a powered bicycle which is supporting the rider to a speed limit of 25 km/h, known as the e-bike. Secondly, there is a powered assisted bicycle known as the speed pedelec, which may attain 45 km/h.

Due to the provision of power assistance, the speed pedelec has a great potential in expanding the role of the bicycle in urban transport, specifically commuter traffic. It is calculated that the e-bike's operational distance is 1.5 times larger than a conventional bicycle. In a country with a strongly embedded cycling culture and infrastructure, the emerging challenge is to extend cycling beyond short-term intra-city trips. Besides enabling opportunities to develop a sustainable urban environment, the arrival of the speed pedelec has created challenges. Primarily because of its theoretical speed limit of 45 km/h, people question its safety. From 1st of January this theoretical speed limit of 45 km/h has led to the regulation whereby a speed pedelec is regarded equally as a moped. This all raises questions such as if using the speed pedelec remains attractive, will user numbers keep growing and how can people be still stimulated to use the speed pedelec in order to attain a sustainable mobility system. In order to investigate this, the following research aim has been formulated:

'The aim of this research is to contribute to the expansion of the role of speed pedelecs in commuter traffic in daily urban systems through gaining insights in behavioural intentions of riding a speed pedelec and the perceived needs to successfully ride a speed pedelec.'

This goal will be accomplished through answering the following research question:

'How can the role of speed pedelecs in commuter traffic be expanded in daily urban systems through discovering the users' behavioural intentions and needs to ride a speed pedelec and how can this knowledge be used in formulating strategies?'

Before illustrating the remainder of the research, it is wise to elaborate on the speed pedelec's features. The advent of the speed pedelec has created a conflict in the Dutch urban landscape. On the one hand it may encourage a shift to sustainable alternatives in commuter traffic as it is a convenient transport mode on a distance of 10 – 30 kilometre at considerable speed. On the other hand its distinction with the moped has become unclear as its speed limit is 45 km/h and safety issues have arisen. With the new law from the 1st of January similar rules apply to the speed pedelec as to the moped. First, the cyclist should ride on car tracks within the built environment in case of absence of a cycling / moped lane. Secondly, the cyclist is obliged to wear an especially designed helmet. Moreover, one should have a moped driving license and thus be older than sixteen years. At last, it became mandatory to have a yellow license plate accompanied by paying road tax and insurance. However, a speed pedelec remains a bicycle considering appearance and mass. Therefore, it has been argued that the speed pedelec should belong to the *cycle family.* Besides legal issues, the speed pedelec's attractiveness is confined by its purchase costs which range from €2300 - €4500. This all questions the speed pedelec's potential as a contributor to a sustainable mobility system.

To assure that all relevant literature and theory related to mobility and mode choice is covered, a theoretical frame has been composed on the leading behavioural and transport theories. The theoretical frame has been embedded into the greatest incentive of exploring new modes of transport: the sustainable discourse that prevails in contemporary science and policy developments. Sustainable mobility can be viewed as an outcome of sustainability of the built environment which concerns both enhancing liveability of buildings and urban infrastructures and the built environment's efficiency.

The main theory that has been applied in order to assess a commuter's choice for a certain transport mode has been distracted from social psychology: the theory of planned behaviour. It argues that an individual's intention to execute a behaviour is determined by his attitude toward the behaviour, his subjective norm and his perceived behavioural control. The latter comprising the individual's assessment if he thinks he is able to carry out the behaviour. The larger the intention is to carry out that behaviour, the larger the chance is that he will actually perform the behaviour. To put this theory in the context of commuter's mode choice preference the theoretical frame also incorporates mathematical approaches to transport mode choice. One of these is the maximization utility theory which assumes that humans choose the most efficient

option to complete an activity and therefore choose the mode with the highest utility. Performing behaviour conforming the subjective norm costs less as one can copy another individual's behaviour and therefore gains more utility. Besides utility related to one's decision support system, utility on individual scale has also been contemplated. Here, a distinction is made between mobility and travel attributes. The first category referring to long term decisions such as purchase and the second group compromising short term decisions as route, frequency and destination. All the aspects from the mathematical approaches have functioned as input of operationalising the three dimensions of the theory of planned behaviour.

As became apparent from the introductory and theoretical frame, the interplay between the built environment and mobility might contribute to the development of a sustainable mobility system. Therefore the geographical concept of daily urban system has been integrated into the theoretical frame. This compromises urban cores and their relational sphere by determining the commuters travelling back and forth to this centre. Putting the research in such a frame emphasises on which scale the developments of the speed pedelec are relevant and how it might be related to infrastructural enhancement.

The theoretical frame has been followed by a methodological section in which choices for strategy and method were illustrated. This has been based on the preferred research philosophy. For this research's purpose a positivist perspective has been chosen. This implies that it is assumed that there is one common truth to be identified among speed pedelec users. Moreover, the researcher has maintained a 'disinterested' position towards the subject in order to draw objective conclusions that have led to advising policy makers. Following from this research philosophy, a survey has been chosen as research strategy. This has enabled collecting a large data set which allowed easy comparison between and within the groups. The particular method that has been employed is an online questionnaire to portray the speed pedelec users' motivations and experiences and the potential group's behavioural intention. Two comparable questionnaires have been composed to collect data among current speed pedelec commuters and potential speed pedelec commuters. The questionnaires have been structured by means of the dimensions that have been incorporated in the conceptual frame to guarantee full coverage.

After the collection of surveys had closed, 222 responses appeared to be valid among current speed pedelecers. In the potential user set 243 appeared to be valid. Figure 1 and 2 that have

been incorporated summarise the results of the groups' relevant descriptive data and which indicators appeared to be relevant for estimating the latent constructs. For example, the separate indicators of subjective norm could not be used to estimate subjective norm for the speed pedelecer. In the contrary, in the potential user dataset it is shown that the indicators together estimate for subjective norm of which colleagues is the strongest determinant. After this, a structural equation model has been calculated to determine which dimension is most influencing the mode choice preference. It appeared that attitude was the strongest determinant. Perceived behavioural control also had substantial influence on mode choice preference compared to subjective norm, which was only a minor contributor.

The tables below and the structural equation model have provided insight in the gap between intention to ride a speed pedelec and performing the behaviour. A literature research has been carried out to overcome the gap between behavioural intention and actually performing the behaviour. The most appealing evidence from established research in relation to this thesis is the

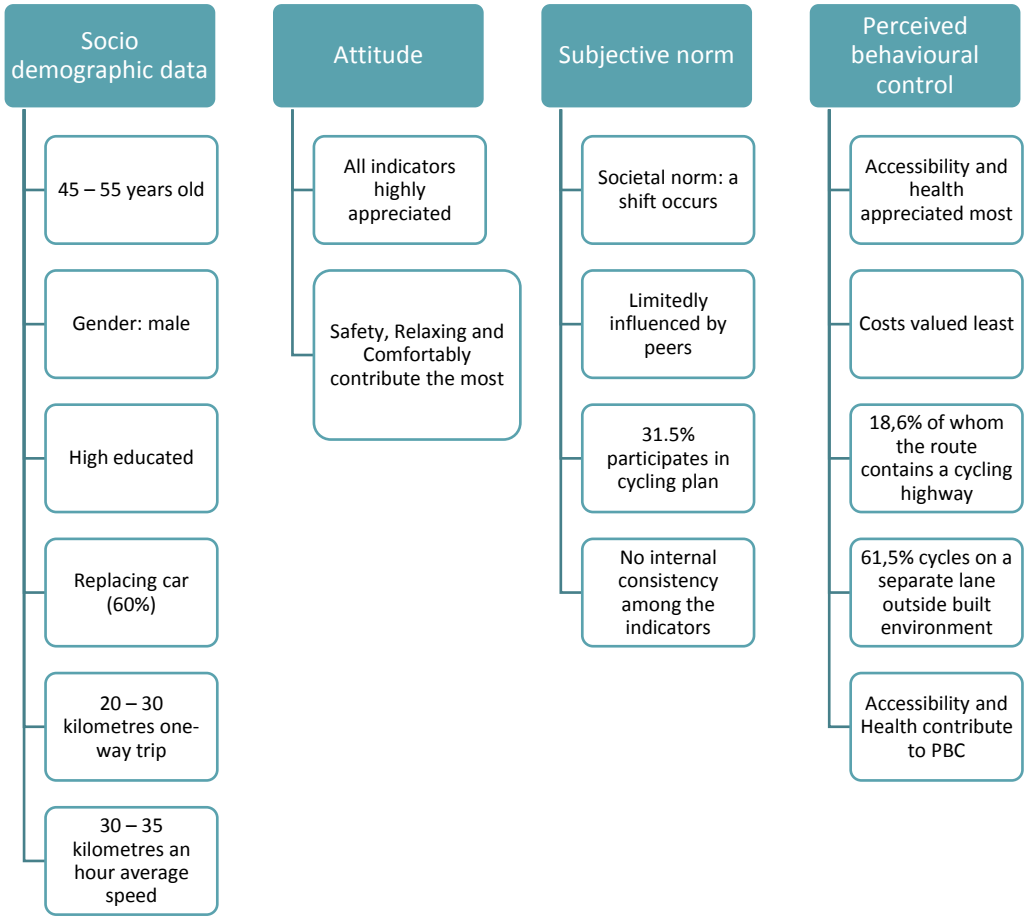

FIGURE 1 RESULTS CURRENT SPEED PEDELECER IN COMMUTER TRAFFIC

suggestion that life changing events offer a window of opportunity to change habitual behaviour. In other words, the knowledge that may be derived from this research on speed pedelecer's motivations and experiences should be shared with the potential commuter whenever he is experiencing a life changing event.

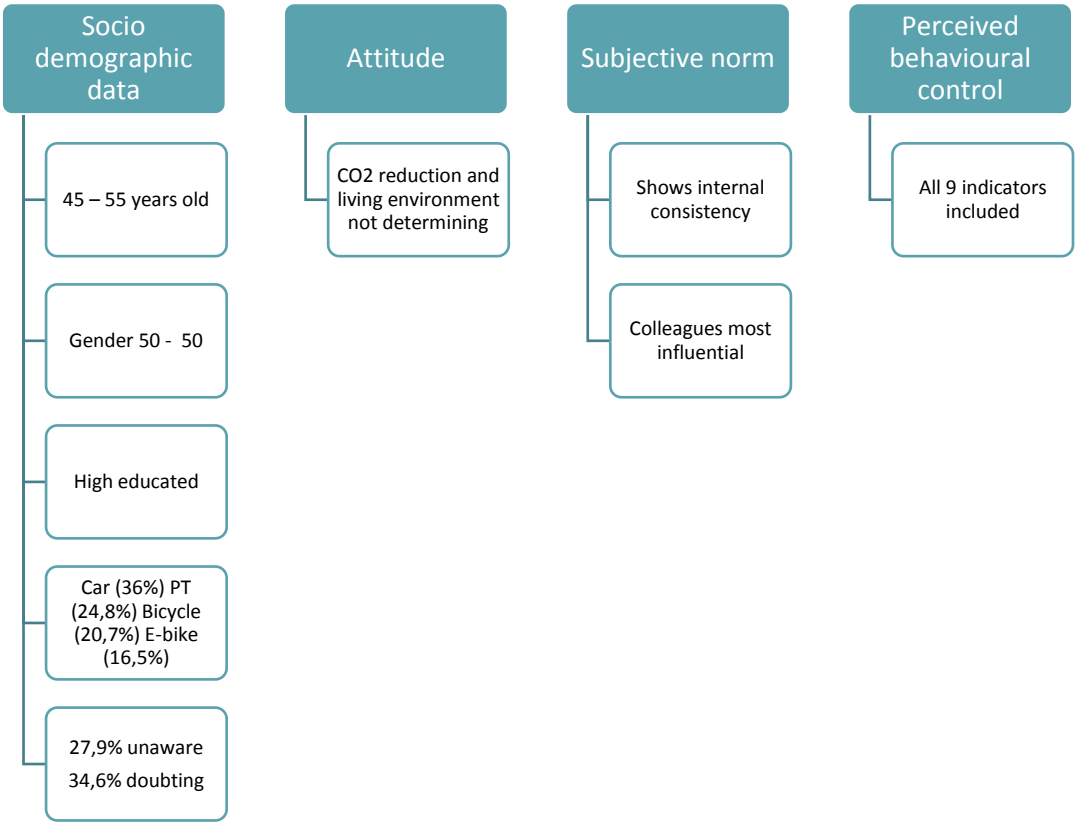

FIGURE 2 RESULTS POTENTIAL SPEED PEDELECER IN COMMUTER TRAFFIC

To concretise the directives for policy strategy, a segmentation of the potential commuter group has been executed to identify what particular indicators are valued most by which group. This segmentation (shown in table 1) has been done by estimating the Chi square to extract deviating values. This has led to an overview of core values per mode of transport category to present how they currently assess their own transport mode and where an advance can be reached in respect of riding a speed pedelec. It for example shows that car drivers might respond to the health and living environment argument that speed pedelecers put forward. It is suggested in this thesis that the directives for stimulating speed pedelec use in commuter traffic could be integrated in the 'Gedragshuis' approach. This is a broadly supported and widely developed technique for stimulating programs which focusses on behaviour change in mobility.

TABLE 1 SEGMENTATION PER COMMUTER GROUP

	Speed pedelec user	Potential user			
		Car user	PT user	Conventional cyclist	E-bike user
Attitude	Flexible Comfortably Relaxing Safety Travel time	Flexible Comfortable	Regard for environment	Flexible Regard for environment	Flexible Regard for environment
Subjective norm	Not significantly contributing to intention	Colleagues	Colleagues	Colleagues	Colleagues
PBC own transport mode			Costs	Costs Accessibility Health Living environment	Costs Accessibility Health Living environment
PBC Speed pedelec	Accessibility Health Living environment	Health Living environment	Travel time	Travel time	Travel time

To stimulate speed pedelec use for commuting, policy makers should guarantee that the speed pedelec may be considered as a convenient and comfortable mode of transport by putting effort in certain regulations. This does not entail large scale infrastructure investments but requires specified stimulation programs which may result in enhanced accessibility and improved commuter's health. In other words, if the government would make it financially attractive and communicate on all the opportunities a speed pedelec offers, moving on to the active modes would be encouraged and a shift towards a sustainable mobility system will be accomplished.

1. INTRODUCTION TO THE RESEARCH

This first chapter introduces the research problem on speed pedelecs and why it might function as potential to move on to the active modes in commuter traffic. First, the research frame will be given. This will then lead to a research aim and question that will be central throughout the remainder of the thesis. After this, the research problem will be related to contemporary societal and scientific trends that are relevant for the speed pedelec and mobility issues.

1.1 RESEARCH FRAME

This research is drawn from the urgent need to move towards a sustainable mobility system. Studies on sustainable mobility have predominantly focussed on cars due to the development of hybrid and autonomous vehicle technologies (Lauwers, 2015; Rietveld, 2000). However, not all signs point out the continuing importance of cars. In developed countries, we see a trend of young people delaying the purchase of a car, known as 'peak car' (Vishwanath, Gan, Winter & Mareels, 2015, p.38; PBL, 2016). This development has been the consequence of increasing operational expenditures related to owning a car, such as the costs for fuel, maintenance and parking (Vishwanath, Gan, Winter & Mareels, 2015). Moreover, an ongoing increase of car use has been putting pressure on the main road network's capacity more than ever. In 2015 the travel time loss had increased with 22% compared to 2014 (Knowledge Institute for Mobility, 2016). All in all, many researchers are concentrating on the car and its relevance in transportation systems (Lauwers, 2015; Rietveld, 2000) and not fully acknowledge the importance of active modes and its possibilities.

Despite innovations in mobility systems focussing on cars the bicycle is gaining territory in the Dutch urban environment. This is among others, triggered by the advent of electrically supported bicycles (KiM, 2016) which expands the scope of active modes. It is important to distinguish two types of electrically supported bicycles. First of all, there is a powered bicycle which is supporting the rider to a speed limit of 25 km/h. This is commonly known as the e-bike. Secondly, there is a powered assisted bicycle only supporting the rider when he is pedalling along, known as the speed pedelec, which may attain 45 km/h (De Bruijne, 2016; Rose, 2012). Due to the provision of power assistance to the rider, the speed pedelec has a great potential in expanding the role of the bicycle in urban transport (Rose, 2012). Such bicycles also respond to the perception of increase in physical activity and personal well-being (Jones, Harms and Heinen, 2016). The Dutch

Knowledge Institute for Mobility reports that the partition of our travels by cycle remains about 25% throughout the years (KiM, 2015). However, the growth in number of travelled kilometres by bicycle among the Dutch population is significant. This has risen with nine percent compared to 2004 (KiM, 2015). Related to this is the growth of ownership of the electric bicycles (Rose, 2012). Especially among elderly in the Netherlands the increase of pedelec ownership is significant. This particular group mainly uses such electrically supported bicycles for recreational trips. Yet, in 2016 the KIM reported that the number of e-bike users also increases among working people for commuting and shopping purposes (KiM, 2016). While the KIM reports that the regular pedelec is only 0,6 kilometre per hour faster than a common bicycle, the average distance travelled is two kilometres longer (KiM, 2015). In the subsequent research of 2016 it is calculated that the e-bike's operational distance is 1.5 larger than a conventional bicycle (KiM, 2016). In a country with a strongly embedded cycling culture and infrastructure, the emerging challenge is to extend cycling beyond short-term intra-city trips. This might be possible certainly since the scope has expanded with the previously mentioned advent of pedelecs. Commuters riding a conventional bicycle to work, on average bridge a distance of 7.5 kilometres (KiM, 2015). This emphasises why the speed pedelec may be a valuable potential for commuters: it enables the commuter to bridge longer distances and therefore create intercity movements. Up to now, intercity trips, exceeding a distance of 7.5 kilometres, are primarily executed by car. This is shown by the augmentation of cars primarily on the main road network (KiM, 2016).

This distinction between the types of pedelecs is also visible in Dutch law from January 1st 2017 onwards. The e-bike is allowed to reach a speed of 25 km/h, a helmet is not obligatory and they should use the designated cycling lanes. They are classified as light mopeds. Other rules apply to speed pedelecs since January 1st 2017. They are judged equally as mopeds (RAI vereniging, 2016), implying that they should drive on car tracks within the built environment in case of absence of a cycling/moped lane. The law determines a maximum speed of 45 km/h on car tracks and 40 km/h on the designated cycling and moped lanes (ANWB, 2016). Research has pointed out that it is unfavourable to put speed pedelecs on car tracks as the average speed is 35 km/h, in contrary to the supposed 45 km/h speed limit (De Bruijne, 2016). This raises questions such as if using the speed pedelec remains attractive, will user numbers keep growing and how can people be still stimulated to use the speed pedelec.

Even though advantages of power assisted bikes have been recognised, not everyone welcomes the cycling trend with great joy. Remarks are made such as: 'Help! The bicycle is a success' (Immers & Weststrate, 11 December 2015). This exclamation seems to suggest that the phenomenon is growing out of proportion and is producing negative external effects. Immers and Weststrate point at the growing pressure on a cycling path's capacity, safety and comfortable use due to the growing number and variety in users. It is still unclear how the speed pedelec should be fit in more properly in the urban transport system since its effects on mobility remain unsure (Rose, 2012). As the Knowledge Institute for Mobility (2015) states, there is more necessary than solely providing hardware related to bicycles to stimulate the use of bicycles and pedelecs. Also, orgware and software are essential elements in evoking an increase in cyclists and ensuring safety. For conventional cycles and e-bikes many stimulating programs have been developed and evaluated (Tertoolen, de Vree, Ruijs & Stelling, 2016). For speed pedelecs only explorative studies have been carried out to define the target group and behaviour in relation to safety as in De Bruijne (2016). Another research consists of interviews with speed pedelecs users to identify the influence of the physical environment on the cycling experience (Westerweele, 2016).

Remarks such as 'help, the bicycle is a success', despite negative connotations, hold tons of opportunities to develop a sustainable urban environment. Such as an environment in which mobility is organized in a way that carbon dioxide is drastically reduced, lifestyles turn out to be healthier and the urban environment is organized more compactly (Rose, 2012). An augmentation of commuters riding a pedelec requires two policy areas, spatial planning and infrastructure, to be synchronized carefully. According to Bertolini, le Clerq & Kapoen (2005); Hamers, Hornis and Snellen (2013); Platform 31 (2013) spatial planning and infrastructure are often insufficiently synchronized to each other. While integrating those policy areas effectively, could result in achieving sustainable development (Bertolini, le Clerq & Kapoen, 2005). A daily urban system is a concept which brings the policy areas together. It entails an urban employment centre surrounded by its commuter hinterland (Coombes, Dixon, Goddard, Openshaw & Taylor, 1978). These commuting movements are relevant since Engelmoer (2012) and Fietsberaad (2013) notice possibilities for the pedelec to become of major importance in commuter travelling. The willingness for transitioning towards a mobility system with the speed pedelec as substantial part is there. However, regional governments as the Province of Gelderland should know if travellers are up for this, how they can be motivated and what their needs are considering infrastructure,

laws and experience. Moreover, encouraging cycling is not only a task of employers or independent suppliers of mobility. Tertoolen, de Vree, Ruijs and Stelling (2015) also point to regional governments: encouraging of cycling may be incorporated in policy on regional scale in terms of integrated area agenda's, accessibility goals, sustainability goals and goals related to the quality of life.

1.2 RESEARCH AIM AND QUESTIONS

Referring to the last paragraph a research aim can be drawn from the described research problem. The research aim that will be central during the research can be formulated as follows:

The aim of this research is to contribute to the expansion of the role of speed pedelecs in commuter traffic in daily urban systems through gaining insights in behavioural intentions of riding a speed pedelec and the perceived needs to successfully ride a speed pedelec.

The research aim shows a practical oriented research (Verschuren & Doorewaard, 2007). They distinguish five directions within practical research. This research aim is focused on both *diagnosing* commuter's behaviour and *designing* a solution in attracting more commuters to the speed pedelec. This is also indicated in the twofold representation of the research aim. Through analysing the users and potential users of speed pedelecs one can understand what they consider to be the speed pedelecs' opportunities and strengths which then might be used in providing directions of where policy should focus on for stimulating potential users. Following from the research aim a research question can be designed to obtain the goal:

How can the role of speed pedelecs in commuter traffic be expanded in daily urban systems through discovering the users' behavioural intentions and needs to ride a speed pedelec and how can this knowledge be used in formulating strategies?

The answer to this question will be formulated in policy strategies which can be applied by regional governments to influence potential new speed pedelecs users' travel behaviour. To obtain the research question several sub questions have to be answered.

A. ***What kind of commuters use the speed pedelecs for travelling in the daily urban systems of the Netherlands?***

B. *What do the behavioural intentions of the speed pedelec users currently consist of?*
C. *What do the behavioural intentions of the potential users currently consist of?*
D. *What are the determinants of actual commute mode choice behaviour in the Daily Urban System?*
E. *How can we bridge the gap between behavioural intention and actual behaviour to address potential users to use the speed pedelec?*

1.3 SCIENTIFIC RELEVANCE

As stated before, the bicycle has often been put aside in scientific research. Rietveld (2000) has argued that the primary reason of this is that walking and cycling are usually produced by households themselves and are not a product of demand and supply. Moreover, those 'transport modes are low-tech and imply low investments so that producers of the necessary equipment are of minor importance for the national economy' (Rietveld, 2000, p. 31). Up to now, few researches have focussed exclusively on the speed pedelec. Only De Bruijne (2016) has carried out a descriptive research on speed pedelec users. Earlier the ministry of Infrastructure and Environment (2014) has done a study on the effects of possible rules in behaviour for speed pedelecs.

Research whereby the bicycle or e-bike is involved is research on the 'last mile'. This refers to the issue of connecting railway and bus stations to the travellers' destination. Several researchers have been investigating how the bicycle or pedelec could complete this last mile (Lauwers, 2015; Martens, 2007; Rose, 2012; Vishwanath, Gan, Winter & Mareels, 2015). Only Engelmoer (2012) has put the e-bike forward as potential mode for commuting a full distance. Therefore, exploring the commuters' motivations for speed pedelec usage would imply extending current research.

The Dutch research institute Platform31 (2013) is cautious on changing mobility patterns towards a more sustainable approach. They acknowledge that the Dutch planning system in which auto mobility is preferred over slower modes will not change overnight. Nonetheless, extensive research on potential benefits of sustainable approaches might enforce a change in politics. Focussing on speed pedelecs is a start in this. There already have been investigations on pedelecs but it is mostly related to the key ratios of users, distances travelled and how many users there are (CROW-fietsberaad, 2014).

At last, many programmes have already been developed to stimulate use of cycles and pedelecs. In the 'cycling is cool' report (Tertoolen et al., 2016) fifteen projects within the national 'Beter Benutten' program are evaluated to see what elements contribute to successful stimulation programs. None of them have specialised in speed pedelecs (Tertoolen et al., 2016; Dijksterhuis & Van Baren, n.d.). While it is suggested that a new target group has arisen from speed pedelec usage (De Bruijne, 2006), and therefore programs and policy tools might have to be revised. Many programs related to e-bike stimulation consist of testing a vehicle for a certain period of time (Tertoolen et al., 2016). This research also offers opportunities to find new directions in stimulation programmes.

1.4 SOCIETAL RELEVANCE

An important argument for researching the use of speed pedelecs is the trend of peak car in the developed world. As pointed out in paragraph 1.1 a trend can be noticed among young adults who to an increasingly extent delay the purchase of a car. At the same time an augmentation of pedelec ownership is recognised. Those two facts may be combined to further utilise the pedelec's potentials. As Martens (2007) points out the Netherlands have the highest rate in cycling trips in the industrialized world. Yet, this rate can still increase when considering the – speed – pedelec's possibilities on inter-city scale. This could imply a decrease in 'transport poverty', which refers to the incapability for people to participate in certain activities (KiM, 2015).

Moreover, the KiM (2015, p.6) has stated that the employees' absence through illness decreases as the frequency of riding a bicycle to work increases and the travelled distance is longer. Litman (2010, p.3) has described that 'walking and cycling are inexpensive for users and reduce costs such as congestion, parking subsidies, energy consumption and pollution emissions.' Rose (2012) has been more careful considering these improvements when stating that environmental benefits are only generated when one is choosing the car over a pedelec, not when one is choosing a pedelec over a conventional bicycle.

A replacement of cars by active modes such as the pedelec or speed pedelec could also support strategic land use objectives. Communities that have been oriented on those active or non-motorised modes are compact, connected and designed at a human scale (Litman, 2010). Here the synchronization between infrastructure and spatial planning has been a precondition for

facilitating a sustainable mobility approach. There are multiple calls for a 'smarter design' to facilitate the active modes.

In discovering the route to a low-carbon mobility society Schwanen, Banister and Anable (2012, p.527) have emphasised that 'carbon-intensive travel habits are more likely to be displaced if the behaviour change agenda is accompanied by, and embedded in, systemic change in which the socio-technical system of auto mobility – the conglomerate of technologies, infrastructures, regulations, knowledges, user practices, cultural preferences that has developed around the car.' The Province of Gelderland has recognised that not all parts of this system are there. User practices have been somewhat unclear, cultural preferences should be pointed to the speed pedelec and regulations still have been under development. Therefore, the Province of Gelderland is still discovering how the speed pedelec should be fit in mobility policy. The cycling highways that have been constructed in the past years, intended for cyclists at high speed, are partially prohibited for mopeds. This implies that with the new law being implemented from 1st January 2017, speed pedelecs cannot profit from the continuity of cycling highways any longer. This has raised questions of how speed pedelecs should be incorporated in traffic. At the same the Province of Gelderland has concluded that the cycling highways are not optimally used by travellers (CROW – fietsberaad, 2016). In other words, there has been a demand for improving the understanding of travellers.

2. THE SPEED PEDELEC

To understand the impact of the speed pedelecs as a mode of transport in commuter traffic, this chapter will provide insight into the opportunities and threats a speed pedelec offers and must deal with. This will be done through assessing its technical features and the rule of law that applies to the speed pedelec. This will be incorporated in the legal, safety, economic, and social issues that are inherent to the speed pedelec.

FIGURE 3 SPEED PEDELEC (ELEKTRABIKES, 2015)

Despite the speed pedelec poses potential solutions to accessibility and sustainability issues, problems have arisen with its arrival in the Dutch urban landscape. As this bicycle may reach 45 kilometres an hour, its distinction with mopeds has become unclear. Cycling lanes have to deal with varying speeds: conventional cycles, children, cargo bikes, race cycles, e-bikes and speed pedelecs. As a response to this issue the ministry of Infrastructure and Environment has determined that the speed pedelec will be regarded equally to a moped, these regulations will be illustrated in detail in the following paragraph. The implemented law which directs speed pedelecers to car tracks results in arguments between speed pedelecers and car drivers, shown by the Dutch tv program 'Kassa' on 21st of January, 2017. Not all participants in traffic are aware of the speed pedelec and its place on the road. On top of this, the speed pedelec has the appearance of a regular bicycle. The regulations are a response to safety and social issues which have been evolving the past years in the Dutch cycling landscape, with the arrival of new types of bicycles. Yet, redirecting the speed pedelecer to car tracks causes new questions and problems. Those challenges have not been present before in the Dutch urban landscape considering cycling.

2.1 LEGAL ISSUES

Riding and owning a speed pedelec (example in figure 3) is confined through both European and Dutch law. In the European model various vehicle categories are distinguished based on number of wheels, motor capabilities, size and weight. A speed pedelec belongs to the L1e category as it supported by an electrical motor. This includes all light motorised vehicles on two wheels (De Bruijne, 2016). According to European law it is allowed to build speed pedelecs with batteries that can deliver an output of 2000 watt. Yet, the speed pedelec will always only multiply the cyclists' effort four times. This implies that the cyclist would have to put in 500-watt himself to exploit the batteries' capabilities. A threat to the rule of law is the relatively easiness for a cyclist to tune his cycle to reach higher speeds. The limit of 45 km/h can be increased manually. Besides electronic tuning it also possible to change the limits mechanically (Ministry of I&E, 2014). It is difficult to maintain the current speed limit as tuned pedelecs will not be visible.

In the Netherlands, the law on speed pedelecs has changed from the 1st of January 2017, hereby following the European law that was settled in 2013 on electrically supported bikes. This law implies that the speed pedelec is regarded to be equal to the moped. One of the consequences is that the speed pedelec users are now obliged to wear a helmet. Initially this would be the regular moped helmet. However, various parties have lobbied to design a new type of helmet. This norm has been published in august 2016, determined under the NTA 8776 norm. The helmet has the appearance of a regular cyclist helmet but is designed for higher falling velocities. On top of this, it covers the temples and back of your head.

Its juridicial place on the road is now also equal to that of a moped. The following rules are forced upon the speed pedelec (Rijksoverheid, n.d.):

1) *The maximum speed on a regular track is 45 km/h.*
2) *On a cycling/moped lane outside the built environment the designed speed is 40 km/h.*
3) *On a cycling/moped lane within the built environment the designed speed is 30 km/h.*

In other words, the speed pedelec is redirected to the regular track and is forced to mix with car traffic in case of absence of a cycling/moped lane. This while their average speed is not comparable to that of a car (De Bruijne, 2016).

2.2 SAFETY ISSUES

The speed pedelec has the appearance of a conventional bicycle due to the narrow frame. Almost equal to a regular bicycle, it weighs 23 kilograms. Yet, there is a reasonable difference compared to the bicycle because a speed pedelec has a powered assisted system. This means that the cyclist must pedal to move forward but his effort is multiplied through the electrically supported motor. The speed pedelec supports the cyclist up to 45 kilometres per hour. In other words, this is the maximum speed a cyclist can reach. Research shows that this maximum speed is hardly obtained. The average recorded speed is 30,3 km/h. The operating speed, which is the speed a cyclist tries to reach when there are no obstructions such as traffic lights or crossings, is 35,2 km/h on average (De Bruijne, 2016). The theoretical limit of 45 km/h is therefore hardly reached in traffic.

Figure 4 illustrates the technical capabilities of a speed pedelec. The input of the cyclist is always multiplied by four. Only when the cyclist delivers 200 watts, the minimum of 1000 watts is attained to cycle 45 km/h (Ministry I&E, 2014). De Bruijne (2016) expects that the development of the pedelecs' battery will not exponentially grow in the coming years. The batteries are expensive and take up more space when they are enlarged. However, it should be noted that the upgrade to stronger batteries is permitted by European law.

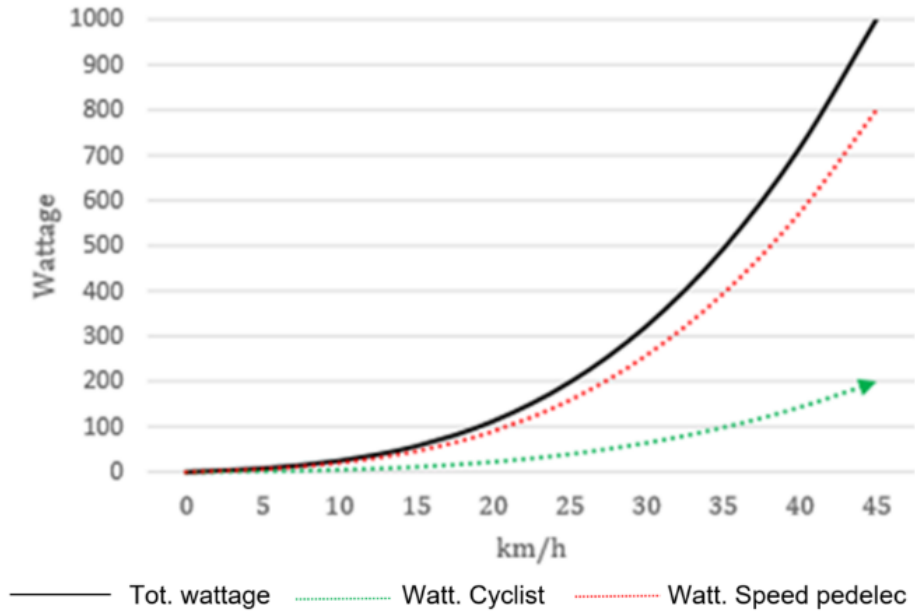

FIGURE 4 VELOCITY WITH MAXIMUM SUPPORT UNDER OPTIMAL CONDITIONS: NO WIND AND SLOPES (DE BRUIJNE, 2016, P.11)

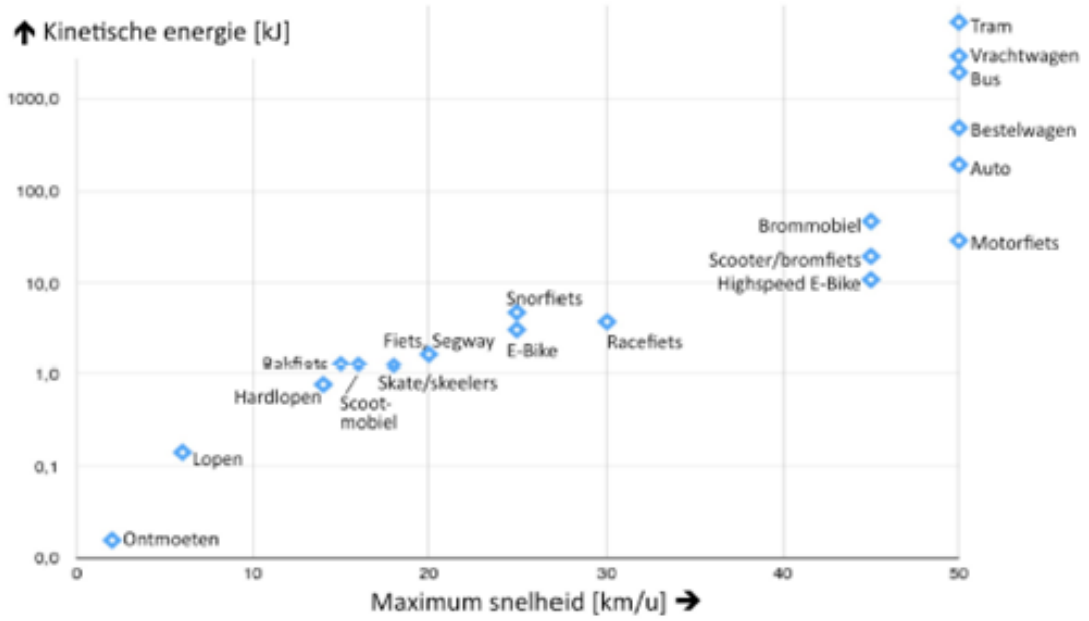

FIGURE 5 KINETIC ENERGY DELIVERED BY VEHICLES IN THE CITY AT THEIR 'USUAL' MAXIMUMSPEED (IMMERS ET AL., 2016, P.18)

The speed pedelec has the appearance of a bicycle but manages to attain a moped's velocity. This questions its place on the road, an ongoing discussion that has not been finished when finishing this thesis. The Royal Dutch Touring Club (ANWB, 2015) has approached this issue through composing an innovative design approach for public space in urban areas. Essential in this is the categorisation of modes of transport. A component of this approach is assessing kinetic energy (mass * velocity^2). The outcomes are displayed in figure 5. It appears that the speed pedelec produces substantially less kinetic energy than a moped and slightly less than a light moped. Consequently, the ANWB has chosen to categorise the speed pedelec (high speed e-bike in the graphic) as part of the bicycle family. Moreover, this methodology has utilised the 'theoretical' speed of 45 km/h during calculation while the average speed is lower. Generally, the delivered kinetic energy is expected to be lower than the graph shows. This line of argumentation is in conflict with the national law as earlier described. Also from accident analysis research support can be drawn to integrate the speed pedelec in the bicycle family. Schepers, Fishman, den Hartog, Wolt and Schwab (2014) have concluded that among victims of an accident that are treated at an emergency department, electrically supported and conventional cyclists are about equally likely to be admitted to the hospital. Yet, this research only comprises e-bike users whose bicycle does not exceed 25 km/h.

Despite such explanations, Schepers, de Jager and Hulshof (2016) have argued that the speed pedelec's appropriate place on the road is a car track. Car drivers would not expect cyclists to cross a road with 30 km/h (Schepers, de Jager & Hulshof, 2016). Moreover, the risk for one-sided accidents is argued to be higher on a speed pedelec than on a classic bicycle as cycling lanes are traditionally designed for 20 to 30 km/h instead of the 45 km/h (Schepers, de Jager & Hulshof, 2016). The car track would therefore be more appropriate.

2.3 ECONOMIC ISSUES

A speed pedelec costs considerably more money than a conventional bicycle and therefore is attractive to a limited number of travellers. Prices range from €2300 - €4500, depending on battery capacity and operating range. De Bruijne (2016) explained that the purchase price is viewed as one of the speed pedelec's disadvantages. Regular e-bikes are less expensive with a price category of €700,- to €2500-,. However, second-hand speed pedelecs are instituting a new market. The purchase costs may be perceived as boundary to invest in a speed pedelec. Therefore, a lobby arises from the cycling industry to make a pedelec fiscally attractive (Van den Eerenbeemt, 17 January 2017). Currently, when making a lease contract on a speed pedelec, a person should pay income tax over this. Whereas an electric car is stimulated through attractive contracts. 'Leasing a speed pedelec that costs €3500,-, results in €120,- – €150,- additional income over which tax must be paid. This is twice as much as with an electrical car' (Van den Eerenbeemt, 17 January 2017). All in all, other modes of transport are favoured by national policy considering financial support.

2.4 SOCIAL ISSUES

There has been social agitation on this matter as well. Not all associated parties have agreed with the ministry's decision to regard the speed pedelec as a moped given the – supposedly negative – consequences. This has created uncertainty for the speed pedelecer on how to act in traffic. The national cyclist federation has reported to agree with the ministry's decision to move the speed pedelec to regular car tracks. They consider the cycling lanes to be too full and unsafe due to a great variety in velocity of the road users (Stikkelorum, 21 November 2016). Previous research executed by consultancy Grontmij suggests that the main reasons on which the minister's resolution is built, are not valid. As mentioned before, the average speed is not the theoretical speed limit of 45 km/h but 30 km/h (De Bruijne, 2016). Other traffic experts suggest that speed pedelecers should be confined by regulations in order to guarantee safe traffic

situations (Van der Aa, January 11th 2017). Also, questions have been raised if safety risks and augmenting CO_2 emissions negate health benefits. For example, multiple researches have shown that health benefits because of an upturn in cycling outweigh the effects of exposure to pollution during cycling, especially on the long-term (Tainio et al, 2016, p.233). Even though a speed pedelec is driven with help of electrical support, it is plausible that the health benefits are maintained since human effort still should be put in to gain speed.

3. THEORETICAL FRAME

In this chapter a critical review of the literature and current policy context provide insight in the issue on sustainable urban mobility and travel behaviour. This initiates delineation of the conceptual frame. The concepts central in this frame will then be operationalised in the last paragraph.

3.1 LITERATURE REVIEW

3.1.1 URBAN SUSTAINABILITY

The greatest incentive of exploring new modes of transport is the sustainability discourse prevailing research in contemporary science and policy developments. Therefore, it is chosen here as embedding of the remaining theoretical frame. The concept has been dominant in urban studies since the 1970s in formulating policies about the interchange between population, environment and industrial development (Gottdiener, Budd & Lehtovuori, 2016). The primary thought of sustainability is to ensure 'economic growth while employing science and technology to produce and consume more cleanly and efficiently' (Alexander, 2012, p.356). In relation to the initial three components of sustainability, i.e. environmental, socio-cultural and economic (Gottdiener, Budd & Lethovuori, 2016), the concept is mostly relevant in urban context. As Gottdiener, Budd & Lehtovuori (2016, p.143) describe: 'urban areas are the prime engines of population movements and economic performance. Simultaneously, they are central in solving social and environmental problems of a global scale.' Urban areas may be viewed as the gateways to sustainable development. Allen (2009) argues that there are more components to sustainability in an urban context than the three mentioned earlier. She distinguishes five dimensions which are projected in figure 6. Sustainable mobility or transport is not mentioned in this figure but it can be distracted from those five dimensions.

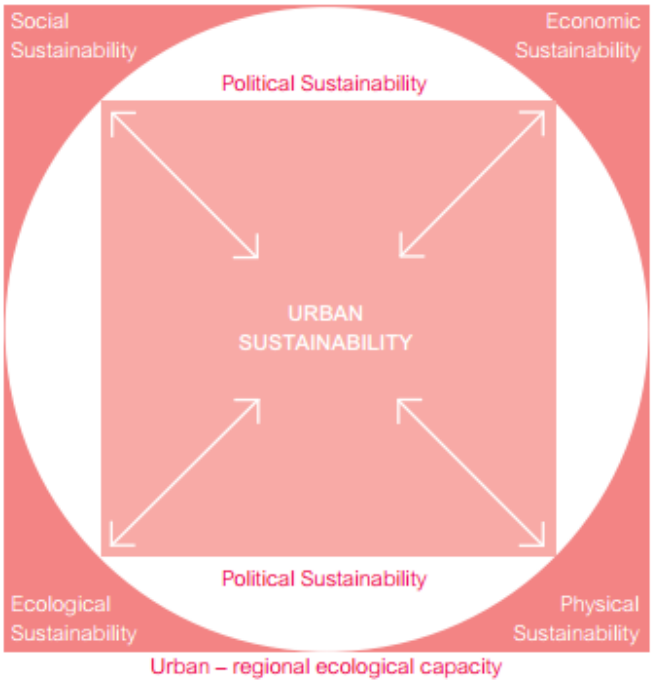

FIGURE 6 DIMENSIONS OF SUSTAINABILITY (ALLEN, 2009)

Primarily regarding sustainability of the built environment which concerns both enhancing liveability of buildings and urban infrastructures and the efficiency of the built environment (Allen, 2009). Here, the interdependence between infrastructure and spatial planning is also apparent. At a local scale, the city should 'consist of sub-units developed at pedestrian/bicycle scale […] to permit multi-purpose trips' (Hall in Gottdiener, Budd & Lethovuori, 2016, p. 144). Another form of mobility may be facilitated and encouraged when land use planning is focused on higher densities and mixed land uses (Allen & You, 2002). Therefore, any research focussing on mobility patterns should be connected to the urban and built environment where the patterns occur. Therefore, paragraph 3.1.5 discusses the concept of daily urban system.

3.1.2 Behaviour in Social Psychology

The research's objective is to influence commuter's travel behaviour and stimulate the use of speed pedelecs in commuter traffic. In doing so, understanding of behaviour is mandatory. In this paragraph, behavioural theories from social psychology will be put forward. According to many contemporary researches, mobility choices are determined through and influenced by individuals' preferences and attitudes on the various modes of transport (Olde Kalter, Harms & Geurs, 2015). One of the leading theories on behaviour, comprising the concept of attitude, is the theory of planned behaviour (from now on referred to as TPB) (Ajzen, 1991; Ajzen, 2002).

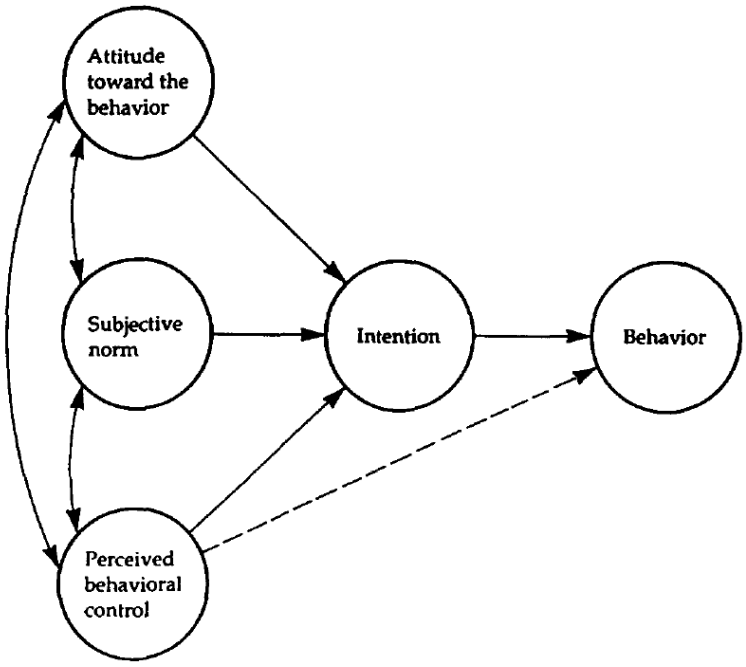

Figure 7 The theory of planned behaviour (Ajzen, 1991, p.182)

This theory, which is an extension of the theory of reasoned action, presents multiple aspects

that lead to a certain behaviour. Similar to the theory of reasoned action, Ajzen (1991) defines a causal relation between intention and behaviour as depicted in figure 7. Ajzen (1991) describes intention as the indication of how hard people are willing to try to perform the behaviour. This is determined through three components: attitude, subjective norm and the perceived behavioural control (Ajzen, 1991; Anable, 2005; Madden, Scholder Ellen & Ajzen, 1992; Olde-Kalter, Harms & Geurs, 2015; Verplanken, Aarts, van Knippenberg & Moonen, 1998).

Thus, the relation between attitude and behaviour appears to be more complicated than many people think. The two concepts are interrelated (Ajzen, 1991; Ajzen, 2002; Anable, 2005; Gilovich, Keltner & Nisbett, 2011). Attitude is understood to be 'the degree to which a person has a favourable or unfavourable evaluation or appraisal of the behaviour in question' (Han, Hsu & Sheu, 2010, p.326). Multiple researches have pointed out that the influence of behaviour on attitudes is much stronger than it is in the reversed way (Ajzen, 1991; Gilovich, Keltner & Nisbett, 2011). In other words, when one succeeds in changing a person's behaviour, that person's attitude towards that particular behaviour changes subsequently. The main reason why attitude on its own is not an accurate predictor of behaviour is because the various components of attitude may not coincide (Gilovich, Keltner & Nisbett, 2011). The components that are shown in figure 8 might even be contradictory. A limitation on measuring attitude is the issue of valuing short term advantages more over long-term advantages (Olde Kalter, Harms & Geurs, 2015). Indicators of attitude according to Olde Kalter, Harms and Geurs (2015) are comfort, relaxing, travel time, safety, flexibility and pleasure.

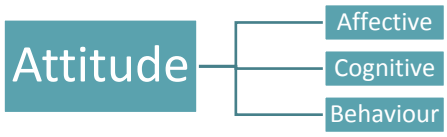

FIGURE 8 THE COMPONENTS OF ATTITUDE (GILOVICH, KELTNER & NISBETT, 2011)

The second component influencing one's intention is the subjective norm. Ajzen (1991, p.188) states that this refers to 'the perceived social pressure to perform or not to perform the behaviour.' This reflects how others assess a certain behaviour. Many people decide based on other person's behaviour or how they think that others behave (Rli, 2014). This also occurs in mobility decisions as they are made within a social context (Abou-Zeid, Schmöcker, Belgiawan and Fujii, 2013). Problematic in measuring the subjective norm is the fact that individuals

overestimate their relatives' norms. Olde Kalter, Harms and Geurs (2015) state that the subjective norm resembles much of one's own norm, when asking for it. The influence of the social context will be elaborated further on extensively in paragraph 3.1.3.

The third component that influences behavioural intention is perceived behavioural control (from now on referred to as PBC). Supplementing this aspect to the framework is the key difference between the theory of reasoned action and the TPB (Madden, Scholder Ellen & Ajzen, 1992). Anable (2005) explains it as the judgement of the presence of factors that either facilitate or impede performing the behaviour. The general premise that may be distracted from this theory, as displayed in figure 7, is that when 'behaviours pose no serious problems of control, they can be predicted from intentions with a certain accuracy' (Ajzen, 1991, p.186).

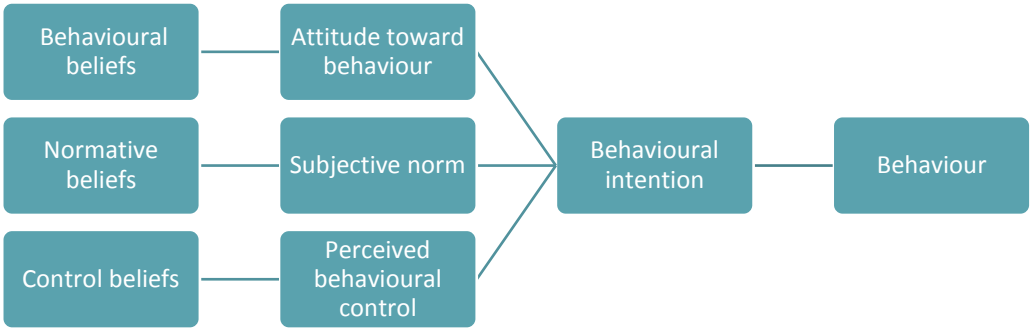

FIGURE 9 OVERVIEW THEORY OF PLANNED BEHAVIOUR

Ajzen (1991; 2002) refers to the three kinds of considerations that truly explain human behaviour. Those are the antecedents of attitudes, subjective norms and behavioural control that together determine behavioural intention. The beliefs, in relation to the three components of behavioural intention, are displayed in figure 9. For example, behavioural beliefs can be explained as 'the perceived consequences of the behaviour and his/her evaluation of the significance of the consequences' (Han, Hsu & Sheu, 2010, p.326).

This theory deems to consider all aspects of behaviour, yet habits are not explicitly discussed despite research postulates that habit is a strong predictor of behaviour and contributes significantly more than behavioural intention and perceived control (Verplanken, et al., 1998).

The main reason why it is not included is because the TPB accounts for new behaviour, where choices are consciously made (Ajzen, 1991; Verplanken, et al., 1998) and this does not apply to habitual behaviour where acts are done repetitively and become automatic responses to situations (Verplanken, et al., 1998). Nonetheless, the concept of habit may be distracted from the last-mentioned component of perceived behavioural control. Ajzen (1991) described it as the perceived ease or difficulty to execute the behaviour and reflections of past experiences performing the behaviour. This is an arbitrary explanation because it captures the definition of habits, yet habitual behaviour has lost its reasoned character through the repeatedly and satisfactorily executed actions (Verplanken, et al., 1998). Multiple researchers therefore suggest habit to be an addition to the traditional TPB (Smith, Manstead, Terry & Louis, 2007). There exist multiple views on habits. The plainest explanation refers to habit as 'automatically elicited behaviour, whereby the presence of particular cues in the performance context automatically triggers the behaviour in question' (Schwanen, Banister & Anable, 2012, p.523). Yet, it can be argued that habit is more complex than a routine process and opposed to this notion of routine habits do initiate reflectivity (Schwanen, Banister & Anable, 2012). This is labelled as 'the general law of habit' constructed by Ravaisson. On the one hand the chance of undergoing change decreases with each repetition but simultaneously the chance of spontaneity increases as the habit takes less effort (Schwanen, Banister & Anable, 2012). All in all, the essence of habitual behaviour is not repetition of past acts but enabling new acts (Schwanen, Banister & Anable, 2012). Relating this to cycling on a speed pedelec, one could argue that commuters already used to daily cycling to work, are more likely to switch to the use of a speed pedelecs than commuters who rely on their cars.

All in all, the TPB is appropriate here as new behaviour is likely to be under the control of the constructs that are described in the theory (Verplanken, et al., 1998). The aim of this research is to stimulate commuters to use the speed pedelec through identifying the behavioural intention of current users. The potential speed pedelecers will be predominantly unknown with the phenomenon or unsure about its strengths and weaknesses. This means that the components of behavioural intention can be controlled. Anable (2005, p.65) explains that the 'factors affecting travel choice will differ in distinct ways for distinct groups of people'. The research will therefore contemplate individuals' travel history to assess if there are significant deviations between former car, public transport or cycle users. Moreover, TPB does not only function as a tool for explaining human behaviour, it also enables influencing human behaviour systematically

(Bamberg & Schmidt, 2001). At last, there are recent examples of applying this theory in similar ways as meant in this research. For example, the Dutch Council of Environment and Infrastructure (Raad voor Leefomgeving en Infrastructuur, 2014) introduced the TPB in their tool to write effective environmental policy. Also, the 'Beter Benutten' programme introduced TPB in their framework of regional actions to change travel behaviour (Tertoolen & Stelling, 2014). The ISM model applied by the Scottish government to influence behaviour demonstrates similarities to TPB. It can be viewed as an extended framework as it considers behavioural theories from multiple disciplines and tries to move beyond the individual addressing groups in society (Darnton & Horne, 2013). The three categories that are included: the individual, the social and the material show parallels to an individual's attitude, subjective norm and perceived behavioural control as pointed out in TPB. A main dispute between the ISM model and TPB relates to the perceived behavioural control. Within the ISM model this is captured in indicators such as agency and skills in the individual dimension (Darnton & Horne, 2013). The third dimension, material, is not about perceived facilities and capabilities but actual facilities and restrictions present (Darnton & Horne, 2013). As the TPB has more academic support than the ISM model and takes an individual into consideration, the ISM model is not further contemplated.

3.1.3 Travel Behaviour

Besides understanding general behavioural theories, comprehension of why travellers choose a particular mode of transport is essential. Therefore, literature on travelling behaviour in specific will be considered. A first significant finding is that the three elements that influence behavioural intentions resemble much of what theories in travel behaviour say determine travel decisions. A travel decision is driven by the interaction of opportunity, obligation and inclination (Anable, 2005; Stradling, Meadows, Beatty, 2005). Inclination here can be linked to one's attitudes, obligation to subjective norms and opportunity to perceived behavioural control. This close connection can be explored further with other perspectives on travel behaviour.

DECISION SUPPORT SYSTEM

A disaggregate modelling approach has been dominating the quantitatively embedded researches in urban transportation since the 1970s. This means that the models are calibrated on individual or household level data (Ben-Akiva, Bowman & Gopinath, 1996). These will be reviewed here since such models 'explicitly take into account the choice processes the individual or household undergoes that lead to activity and its related travel behaviour' (Ben-Akiva,

Bowman & Gopinath, 1996, p.243). An example of such a model appears in Golob and Beckmann (1970) their appliance of maximization utility theory in travel behaviour. This model represents one of the basic assumptions in travel behaviour that humans choose the most efficient option to complete an activity and therefore choose the mode with the highest utility (Schlich & Axhausen, 2003). Considering utility theory here, as applied by Golob and Beckmann (1970), is relevant since their understanding of the maximization utility theory uses an abstract mode approach, which means it is applicable to new or modified modes. This is the case considering the entrance of pedelecs in commuter systems.

Maximization utility theory is a mathematical approach to reality. As this study has been primarily based on the TPB, the models have not been considered in contrary to the underlying premises have. Those might be a relevant addition to the TPB. One important notion within the maximisation utility theory is that a transport mode is chosen by means of the 'perceived level of a finite set of modal attributes' (Golob & Beckmann, 1970, p.80). This implies that values such as the perception of speed pedelecs' attributes, are necessary to understand its utility. This can be linked to the perceived behavioural control from the TPB. Chances of riding a speed pedelec will increase when its attributes and related facets are perceived to be in control of the traveller. More importantly, the perceived attributes of a speed pedelec might be influenced by the social reference group. Through mathematical argumentation Golob and Beckmann (1970) explain how one strives for the least costs and the highest utility, which is the greatest benefit in achieving activities. It is argued that as generalized transportation costs decrease, more purposes can be achieved and/or accommodated (Golob & Beckmann, 1970). This can be here linked to what Van Nes (2002, p.40) explains as the travellers' optimum, displayed in figure 10. A traveller would prefer direct connection between any origin and destination and at any time (Van Nes, 2002). The pedelec might realise this as its flexibility is substantially higher than travelling by car or public transport: it can be taken anywhere at any time when it is privately owned. What should be taken into account here, are the strong interrelations between travel behaviour and the transport network (Van Nes, 2002). The

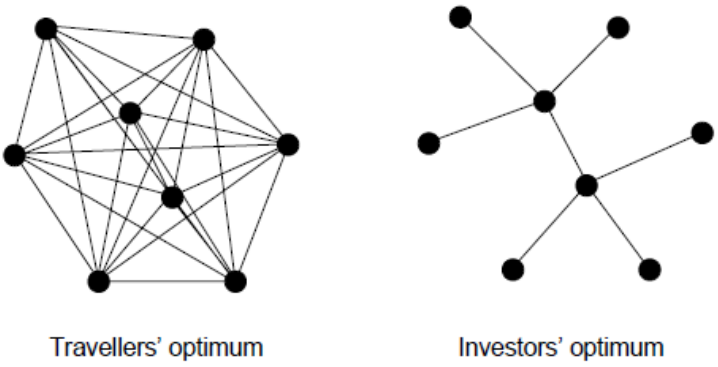

FIGURE 10 OPTIMAL NETWORK STRUCTURES (VAN NES, 2002, P.40)

infrastructure supplied should facilitate these transport modes as the traveller wishes. It would moderate the speed pedelecs' implementation in the commuter system. Likewise, a strong relation between mobility patterns and the built environment is apparent.

PEER INFLUENCE

Subjective norm, the second component determining behaviour in Ajzen his model, has also been accentuated in travel behaviour. Multiple researchers argue that it is the most influential component predicting behaviour (Abou-Zied, et al., 2013). The concept was defined earlier as the social pressure one perceives to carry out a certain behaviour. More specifically it could be referred to as 'herd behaviour, peer effects, conformity or fashion' (Abou-Zeid et al., 2013, p.115). This topic has been explored extensively throughout the decades. An example of this is Festinger (1954) his social comparison process theory. He illustrated the process individuals experience when trying to conform to the social context. There are multiple reasons why people use others as exemplars to decide. First, following other's behaviour is less costly than collecting new behaviour in new or emergency situations. Secondly, it could reduce the cognitive effort to decide and at last persons may feel the need to conform in situations to identify with a group (Abou-Zeid et al, 2013). Yet, despite individuals recognize that they should change their behaviour, either due to conformation with others or another objective, an individual experiences non-social restraints that may complicate changing one's behaviour (Festinger, 1954). Peer influence cogitates peer groups that are familiar to the individual whereas subjective norm is here understood at an abstract level where society's values are addressed. This distinction is relevant in the remainder of the research. In the empirical research the difference is important as it might affect the conclusions and formulating policy strategies.

Goetzke and Weinberger (2012) have carefully researched peer influence in predicting car ownership. They distinguish contextual and endogenous effects in peer effects. The contextual effects refer to the characteristics of a social reference group and endogenous effect to the actual behaviour of the social reference group (Goetzke & Weinberger, 2012). It appears that the endogenous effect is highly significant (Abou-Zeid et al., 2013; Goetzke & Weinberger, 2012). This implies that the social reference group's travel behaviour affects an individual's travel behaviour when there is a discrepancy between the two groups.

3.1.4 INDIVIDUAL UTILITY

One of the premises prevailing in quantitatively oriented travel behaviour is that humans choose the most efficient option in travelling and therefore choose the mode with the highest utility (Schlich & Axhausen, 2003). This will be helpful in generating ideas on why travellers could prefer the speed pedelec. It appears to be difficult to distract one clear list of attributes of a mode's utility from literature. Therefore, a literature review will here propose some attributes. First, in addressing a mode's attributes a distinction can be made between mobility decisions and travel decisions (Rose, 2012). The first one concerns long term decisions for example deciding about the purchase of a car. The second contains decisions on the level of an individual trip such as mode, route, frequency and destination (Rose, 2012). This last category is closely intertwined with the supplied infrastructure. It is assumable that also the utility of a speed pedelec can be divided into those two categories.

MOBILITY ATTRIBUTES

The first aspect through which an individual attributes utility to a mode of transport is ***social costs***. A mode's utility might be considered from a social dilemma's point of view. A social dilemma is a 'situation in which private interests are at odds with collective interests' (Van Vught, Van Lange & Meertens, 1996, p.374). This dilemma can also be derived from the earlier noted maximising utility theory. As a traveller wants to create the least costs - or the greatest benefit – personal interest is thought of in relation to pro-social concerns (Van Vught, Van Lange & Meertens, 1996). It is interesting to consider this in delineating a speed pedelec's attributes. The interest that comes up often in such a social dilemma are the environmental consequences. This dilemma can be connected to the already discussed notion of subjective norm. If the subjective norm imposes more sustainable transport, the social dilemma will be in favour of the collective interests: limiting environmental negative effects. Subsequently, if one can contribute to lower social costs this might result in more utility for that mode.

Secondly, as Rose (2012) describes, the decision to purchase a particular mode of transport is part of mobility decisions. A motive to buy a pedelec are the lower costs of travelling by bike than by car (Crow-fietsberaad, 2014). Another motive which reflects purchase costs is choosing a pedelec over a second car (Crow-fietsberaad, 2014). ***Purchase costs*** can therefore be perceived as a motive in buying a – speed – pedelec or not.

It can be argued that motivations for choosing a certain mode can also be derived from its ***health and safety impacts.*** Rose (2012) puts these impacts forward as an outcome of using a specific mode. Reasoning this from the traveller's perspective it might also be taken into consideration when choosing a mode. As noted in the societal relevance before, riding a speed pedelec is beneficial for one's health.

TRAVEL ATTRIBUTES

There are some obvious facets of a mode's utility that are considered in choosing a mode of transport before starting a trip. The most important in this is ***travel time*** (Van Vught, Van Lange & Meertens, 1996; Fietsberaad-crow, 2014). However, this travel time can differ per day. This implicates that reliability is another important attribute or, in other words, ***time uncertainty*** (Van Vught, Van Lange & Meertens, 1996).

Another relevant concept in assessing speed pedelecs' utility could be ***accessibility***. It is put forward here with figure 10 in mind, a speed pedelec might contribute to enlarging accessibility. This, of course, depends on how accessibility is regarded since it is a concept subject to discussion and various researchers define it differently. The multiple approaches to accessibility vary from putting the traveller's effort at focus to the built environment and its infrastructure enabling traveller's to reach their activity (Knowledge Institute for Mobility, 2011). This continuum can be divided into three main categories dividing the various meanings given to accessibility: infrastructure-related, activity-oriented and mixed approaches (Van Wee, Hagoort en Annema, 2001). Especially this first category is related closely to the question of what route to take, part of the travel decision as stated by Rose (2012). Here a relation can also be drawn to the provided infrastructure and possible barriers to not choose the speed pedelec.

Related to infrastructural accessibility is ***travel distance***. An augmentation in trip distance results in a decrease of cyclists (Heinen, van Wee, Maat, 2010). It can be argued that this rule might change in the future considering the technical opportunities speed pedelecs offer. Moreover, there is newly developed infrastructure that may diminish relative travel distance intended for cyclists whom cycle at higher speed: ***the cycling highway***. This may be understood as a regional cycling route that has been developed with high-quality designs to stimulate and encourage cycling over a longer distance (Crow, 2014). A route may be recognised as cycling highway if some requirements are met. First, it should connect destinations. This should be done in the most

direct route possible. The third condition relates to the attractiveness and how the cycling highway is embedded in its environment. Fourth, safety should be guaranteed by means of the fewest crossings with motorised traffic possible. At last, the route needs to be comfortable in the sense that the infrastructure is continue and complete (Crow, 2014).

The travel distance can also be determined through ***network layout.*** If a road network is dense, with a high connectivity, it will be more attractive for active modes such as the speed pedelec (Heinen, van Wee, Maat, 2010). A newly developed concept to facilitate cycling at higher speed is the cycling highway. These are a few examples of attributes but it is not an exhausting list.

3.1.5 Daily Urban System

Multiple reports and researches (De Bruijne, 2016; van der Hoeven, 2009) predict that the speed pedelec is a conceivably substitute of automobiles on a commuter distance of 10 – 30 kilometres. Moreover, it also appears that 90% of the current movements on a speed pedelec are made for commuter purposes (De Bruijne, 2016). To frame and emphasise the urgency of revealing commuters' preferences on speed pedelecs in this research, a concept has been chosen that parallels this idea.

Coombes et al. (1978) put forward a daily urban system to create a concept which captures an urban core and its relational sphere by determining the commuters travelling back and forth to this centre. This is akin to a definition proposed by Pacione (2009), pointing out an urban core plus metropolitan ring that together formed the daily urban system where the two parts are functionally related. As this research focuses on commuters, this concept will be taken into consideration. At the time of writing the article, Coombes et al. (1978) were already aware of their theory's limitations by realising that single urban-centred regions are difficult to realise. Contemporarily, 'the hierarchical structure is changing into a horizontal one' (Van der Laan, 1998, p.235). This then implies that urban centres more and more function as nodes in a complex network also understood as polycentric urban systems (Limtanakool, Schwanen & Dijst, 2009; Van der Laan, 1998). Thus, interaction among areas turns out to be more intense and relationships change from dependent to reciprocal (Limtanakool, Schwanen & Dijst, 2009). In other words, the daily urban system has been moving towards a regional scale. Simultaneously we witness a continuing increase of mobility. This means that the current mobility network is often lacking capacity (Rutten, 2012). Complementing the current road capacity with cycling

highways, as is already happening throughout the Netherlands, might bring new solutions to this issue. The intended user of the cycling highway is the cyclist willing to bridge longer distances, perhaps assisted by means of an electrical supported bicycle. All in all, the concept of daily urban system secures a strong frame in which commuter distances are included.

3.2 OPERATIONALISATION

The preceding theoretical framework will now be visualised in a conceptual frame to provide an overview of the research. Similar to the research aim, the research design is practically oriented because it aspires to formulate concrete advice for current policy to change travel behaviour (Verschuren & Doorewaard, 2007).

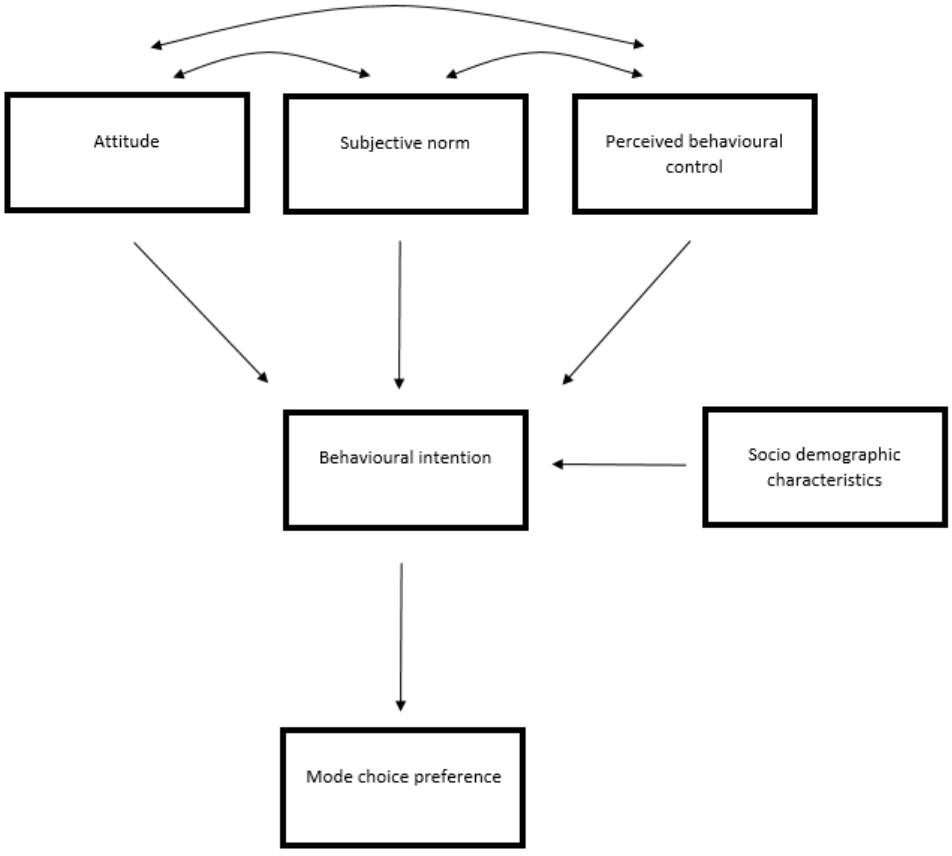

FIGURE 11 CONCEPTUAL FRAME

The basis of this framework is the theory of planned behaviour, represented through the five main constructs: attitude, subjective norm, perceived behavioural control, behavioural intention and behaviour that have been thoroughly explained in paragraph 3.1. To assess speed pedelecs commuters' current behaviour and why commuters choose the speed pedelec as mode of

transport, the research will provide insight in those five components. To test the dimensions of intention, indicators have been derived from traditional transport research which are mathematical embedded. This means that PBC has been extended with indicators on the gained utility. Additionally, this research is aiming to identify how potential users can be addressed in order to choose a speed pedelec. To realise this, the conceptual frame incorporates the concept mode choice preference instead of travel behaviour to assess what are the current determinants for commute choice. This might reveal the gap between the intention for speed pedelec and intention for other commuter modes.

In contrast to the original theory of planned behaviour as drawn by Ajzen (1991), the indirect effect between PBC and behaviour is left out. It is suggested that if one can control for attitude and subjective norm, PBC directly accounts for behaviour (Ajzen, 1991), as mentioned in paragraph 3.1.2. However, this research reviews all dimensions of intention to assess which is the most influential for mode choice preference. Moreover, it is not the purpose to control for attitude and subjective norm in an experiment setting, as will become apparent from chapter 5.

As an addition to the established literature and researches on the theory of planned behaviour, this framework includes socio-demographic characteristics. Actual mode choice preference should be controlled for socio-economic and demographic characteristics of the individual (Van Acker & Witlox, 2010). They make the following variables on this dimension explicit: age, gender, educational level, employment status and income. Their research relates to car travels. Since it also deals with travel behaviour, their point of view can be adapted here.

The results of the analysis should assist in developing strategies to influence potential speed pedelec users. Note that the conceptual frame is not meant to test if speed pedelecs users conform to a certain 'speed pedelecs behaviour'. In the contrary, it has an explorative goal to specify the speed pedelecs users' behaviour. Verschuren & Doorewaard (2007) explain that an explorative conceptual frame contains abstract and global concepts and is meant to be specified and refined through carrying out the research. From literature indicators have been distracted that could be incorporated in the various dimensions to explain mode choice preference. However, those are not all explicit beforehand and this exploratory research will assist in defining which indicators matter for preferring a speed pedelec in commuter traffic.

4. METHODOLOGY

This chapter will provide insight in the selected methodological approach. This will be denoted in a research philosophy, strategy and method. In the research method section the focus will be on data collection and analysis.

4.1 RESEARCH PHILOSOPHY

Determining the research strategy has been preceded by outlining the research philosophy. This defines what the researcher considers to be reality, how this can be identified and his or her position within the research (Guba & Lincoln, 1994). A distinction could be made between four leading paradigms on research philosophies that could be applied within both quantitative as qualitative research, ranging from a positivistic view to a constructivism perspective (Guba & Lincoln, 1994). One could argue that these are contradicting paradigms, however Newman & Benz (1998) have put them forward as a continuum and the best paradigm is the one that serves best to answer the specific research question. Therefore, the research question that was formulated in the introductory chapter has been taken into consideration again.

How can the role of speed pedelecs in commuter traffic be expanded in daily urban systems through discovering the users' behavioural intentions and needs to ride a speed pedelec and how can this knowledge be used in formulating strategies?

This question depicted that the aim of inquiry was to discover a common value among speed pedelec users and applying this knowledge in policy on stimulating potential speed pedelecers. This coincided with the positivist position that assumed a common objective reality across individuals (Newman & Benz, 1998). This reflected the positivist paradigm's ontological point of view: 'there is only one truth, an objective reality that exists independent of human perception' (Sale, Lohfeld & Brazil, 2002). However, the phrase 'independent of human perception' conflicted with the theoretical underpinnings of this research. The theoretical frame that has been illustrated in chapter three stated that behaviour is, among others, determined by an individual's perception if he or she is able to carry out the required behaviour. Nevertheless, it may be argued that within the speed pedelec group a shared set of attributes was experienced to successfully carry out the behaviour in question: riding a speed pedelec. This line of thought has also been applied to the potential commuter group: for every mode of transport a common set of attributes

may lead to preferring that mode of transport and carrying out the confirming behaviour. This research aimed to identify this set of attributes; hence a positivist assumption applies here.

Besides questioning what could be regarded as reality, one should ask what the nature is of the relation between the researcher and the researched subject. This has been known as the epistemological question (Guba & Lincoln, 1994; Sale, Lohfeld & Brazil, 2002). Within a positivist approach, the investigator and the investigated have been viewed as independent entities (Sale, Lohfeld & Brazil, 2002). On the opposite end of the spectrum was the constructivist assumption that has posed that the investigator and the investigated were linked and results came about as the research proceeded (Guba & Lincoln, 1994). This research did not have the intention to mingle with respondents, by which the researcher would have shown behaviour similarly to a speed pedelec commuter. An objective role towards reality has assured profound and constructive findings to advice on policy strategies. When the researcher had participated in the investigated, drawing an objective conclusion would have been out of question. As this research is conducted in commission of the Province of Gelderland, the aim was to inform the Province on this new mode of transport, its implications and necessity to stimulate the mode. Therefore, a positivist approach by a '*disinterested scientist'* to serve policy makers has suited as per Guba & Lincoln (1994).

4.2 RESEARCH STRATEGY

This paragraph on the research strategy has been built on the previous section which has advocated for a positivist research philosophy as fundament for the choice of a strategy and method, considered in relation to the research question and aim. There are multiple strategies that could have served to attain the research question such as: experiment, survey, case study and action research (Saunders, Lewis & Thornhill, 2009).

Both the research question and aim have induced a two-step approach. To begin with, the research has been aimed at collecting knowledge concerning speed pedelec users' behaviour and experiences. After, the focus has been on gathering knowledge on barriers and thoughts on not riding a speed pedelec. This would lead to formulation of strategies to address the right target group with the right motives and stimulations. The first section has required an exploratory technique as it wanted to gain new insights concerning use of speed pedelecs and how this was experienced (Saunders, Lewis & Thornhill, 2009). Baarda (2014) has distinguished qualitative and

quantitative exploring research. The first focusing on coherence among variables and working to a theory while the quantitative approach is answering questions that have been designed in advance. As established theories in behavioural science were available, a quantitative approach has been applied to investigate behavioural intentions of speed pedelec users. Moreover, this related best to the suggested philosophy in which this paragraph is embedded. Quantitative research has been based on positivism in which phenomena could be reduced to empirical factors that represented the truth (Sale, Lohfeld & Brazil, 2002). In this case, it was the phenomenon of riding a speed pedelec of which one needed to conceive a clear overview. A survey appeared to be the most suitable strategy here. It has been commonly used for exploratory and descriptive research and allowed easy comparison between or within a group (Korzilius, 2008; Saunders, Lewis & Thornhill, 2009; Verschuren & Doorewaard, 2008). An experiment also would have tended to serve exploratory investigations (Saunders, Lewis & Thornhill, 2009). Nonetheless, it has been mostly deployed to assess if respondents were sensitive for certain incentives and investigations on causal relations. Here, the research's purpose was to gain insight in the current users' behaviour, motivations and experiences without any specified stimulations from work or home environment.

4.3 RESEARCH METHOD

There were multiple methods available within a survey strategy such as structured observations, structured interviews and questionnaires (Saunders, Lewis & Thornhill, 2009). Structured observations could have served a quantitative purpose by means of recording what participants do and say (Saunders, Lewis & Thornhill, 2009). Yet, it would not have provided understanding in the reasons why participants were carrying out the behaviour. Observations would have produced too superficial data considering the research question. To generate a profound overview of the population's key numbers structured interviews or questionnaires would have achieved the goal. In spite of this, structured interviews were out of question as the respondents were unknown beforehand and it would have been too time consuming to physically conduct all the surveys (Saunders, Lewis & Thornhill, 2009). Therefore, questionnaires have served the purpose best to portray the speed pedelecs users' motivations and experiences and the potential group's behavioural intention.

4.3.1 QUESTIONNAIRE DESIGN

The twofold approach has demanded two separate questionnaires: a speed pedelec user and a potential user survey. To assure that all mandatory data was gathered, the questionnaires have been based on the theory's three determining dimensions: attitude, subjective norm and perceived behavioural control. This may have contributed to ensuring content validity, meaning that the questions cover the research question sufficiently (Saunders, Lewis & Thornhill, 2009). The internal validity, referring to if the questionnaire has measured what you intended to measure (Saunders, Lewis & Thornhill, 2009), is persecuted through applying indicators and questions of existing and established researches. For example, Olde Kalter, Harms and Geurs (2015) have employed six indicators to measure attitude: comfortably, relaxing, travel time, safety, flexibility, pleasure. Complementary to these indicators, the questionnaires in this research have also assessed if one would like to attain fewer CO_2 reduction and contribute to a better living environment. This related to the social dilemma as discussed in paragraph 3.1.4. The latent constructs have all been measured by means of lickert-scale items to allow internal comparison. All indicators belonging to one dimension have been incorporated in a matrix outline (Saunders, Lewis & Thornhill, 2009). Moreover, as will be explained in paragraph 4.3.3, the indicators have been estimated on the Cronbach's alpha to estimate internal consistency. This has played a role in the reliability of the questionnaire's outcome (Saunders, Lewis & Thornhill, 2009). A question on behavioural intention has not been integrated within the speed pedelec user survey because the respondent has past the stadium of intention and was already executing the given behaviour. A question on the intention to ride a speed pedelec has been included for the potential commuter, in contrast to current speed pedelecer. The questionnaires have been designed with help of the online Qualtrics tool provided by the Radboud University and can be found in appendix A and B.

4.3.2 DATA COLLECTION

As the population's size of speed pedelec users was unknown and it was unclear who they were beforehand, it was not possible to take a sample at random from the larger population (Korzilius, 2008; Saunders, Lewis & Thornhill, 2009). It was therefore obligatory to execute a non-probability sample. A distinction could be made between an available sample and a quota sample. Specific population' characteristics should be represented according to the researcher when drawing a quota sample (Korzilius, 2008). Here, the research has depended on the available sample: any speed pedelec user who has crossed the survey might have become a respondent. Relying on an

available non-probability sample has implied that the conclusions may not be generalised to the complete population (Korzilius, 2008). This argumentation has also applied to the potential group since there is not one database of employees' travel distance to work.

A questionnaire could be disseminated via various channels such as the internet, post and telephone (Saunders, Lewis & Thornhill, 2009). Since the speed pedelec group was complex to identify, approaching and convincing them to participate has taken much effort. An introductory e-mail with a link to the survey has been spread via social media such as Facebook and LinkedIn. Additionally, several organisations as the Province of Gelderland, *Fietscommunity,* Dutch Cycling Embassy and RadboudUMC have shared the link internally to establish acquaintance on the research. Because the link to the survey has been dispersed via internet, it was difficult to warrant external validity. This concept stands for the extent to which the results have attributed to what the researched intended to measure (Korzilius, 2008; Saunders, Lewis & Thornhill, 2009). The respondent could not receive additional explanation when he doubted on how to interpret a question, since it was an online survey. Consequently, a question may have been answered based on different interpretations.

4.3.3 Data Analysis

Selecting the right method for analysing the data has been done through contemplating literature on the theory of planned behaviour and other similar behavioural approaches in transport research. The theory and the conceptual frame, as ascertained in chapter 3, have induced complex causal relations between both manifest and latent structures. An appropriate method to test those proposed relations could be structural equation modelling (Bamberg & Schmidt, 2001; Olde-Kalter, Harms & Geurs, 2015; Scheiner & Holz-Rau, 2007). As stated by Scheiner and Holz-Rau (2007, p.495) 'structural equation models are frequently applied in mobility psychology, particularly in applications of the theory of planned behaviour.' Such models have facilitated investigation of multistage interrelations between variables. SEM, as its abbreviation calls, has been applied in travel behaviour research since the 1980s (Golob, 2013). This technique could be regarded as a combination of factor analysis and regression modelling (Van Acker & Witlox, 2010).

SEM consisted of a measurement (sub) model for the endogenous and/or exogenous variables, and a structural model. A measurement model is usually included when latent variables are part

of the model (Golob, 2013), meaning that there are unobserved constructs. This has also emphasised the need of structural equation modelling over multivariate analysis: the dimensions of behavioural intention were latent and ought to be measured by means of measurement models. The factor analysis aspect has become present since measurement models have been included (Van Acker & Witlox, 2010). Within such a model the relationship between a latent variable and its indicators is defined (Van Acker & Witlox, 2010). This has been done through modelling on which manifest indicators the latent structure is based. Before composing the measurement model, Cronbach's alpha has been applied to see for internal reliability among the items. Building on those measurement models, a structural model has been constituted. There have been distinguished a few essential steps towards estimating the structural equation model (Scheiner & Holz-rau, 2007):

1. Calculate the covariance matrix between the variables;
2. Calculate the parameters in the path diagram to reproduce the covariance matrix;
3. Test significance difference estimated and empirical model;
4. Assess the model fit;
5. Assess significance of separate parameters by means of maximum-likelihood approach.

FIGURE 12 ACTION PLAN ON STRUCTURAL EQUATION MODEL

This technique has been effective for sub question d and e, whereby was asked for the determinants of mode choice preference. For sub question a to c this technique was too complex. Those questions have been primarily answered through depicting descriptive data. Those have included percentages to assess deviations within the dataset and means to enable a quick overview of the speed pedelec user. Also, the Chi square has provided insight in the existence of distinctive groups. Moreover, measurement models have been constructed for each dataset to identify which variables are relevant for each dimension for the two groups in order to answer sub question a to c. The approach for measurement models will be illustrated in detail in chapter 5 and 6.

5. THE SPEED PEDELEC USER

Within this chapter an answer will be given to the first two sub questions: what kind of commuters use the speed pedelec and what do their behavioural intentions consist of? To outline the speed pedelec user's profile descriptive data will be put forward. The behavioural intention of the speed pedelec user will be investigated by means of measurement models.

5.1 SAMPLE SIZE

In total 649 cases have been collected with help of the electronic Qualtrics tool. Not every response has been used for analysis. First, multiple surveys were already identified as incomplete during the collection process. Respondents were not obliged to finish the survey and this led to 120 surveys that were completed for only 3 to 50%. These have been excluded from analysis as it was unsure if the respondent owned a speed pedelec or was simply curious to fill in the survey. Secondly, it appeared that some respondents originated from Belgium by the time collection was closed and responses were checked. These responses have been considered to be invalid as this research explicitly concerned Dutch urban environment, law and regulations. For example, a cycle highway as we recognise it has different requirements in Belgium than in the Netherlands. Moreover, habit of cycling is reasonably less in Belgium. The bicycle share in the modal split is 8% in Belgium compared to 26% on average in the Netherlands (Fietsberaad, 2010). These factors might have influenced indicators for perceived behavioural control that were delineated in the conceptual frame. At last, there was one respondent who explicitly stated not to employ the speed pedelec in commuter traffic. However, the research has exclusively focused on commuter traffic and therefore this response was not valid for this purpose. The second survey included two selecting questions to guarantee participation from non-speed pedelec commuters whom bridged a distance between 10 and 30 kilometres during a one-way trip. Through this selecting questions 55 respondents appeared to be not in the target group, those have been directly excluded from analysis.

TABLE 2 SAMPLE OVERVIEW

Cases	#
Total collected cases	649
Invalid cases (incomplete surveys)	120
Invalid cases (not in the target group)	64
Valid cases in total	465
Valid cases among speed pedelec users	222
Valid cases among non-users of speed pedelec	243

The surveys which have been analysed were not always entirely completed. This may be caused by respondents who were not willing to answer a specific question or not knowing what their opinion was on a certain matter. Where relevant, the share of missing values has been provided. In this survey for speed pedelec users an 'I don't know' category was only provided twice and has been mentioned explicitly in the tables. The proportions that have been displayed to survey's questions in the tables refer to the valid percent number that was calculated.

5.2 WHO ARE THE SPEED PEDELEC USERS?

In table 3, socio demographic data on the speed pedelec user has been summarised. The presented variables are age, gender, education, driving license, availability of a car and previous travel behaviour. It appears that the largest group (42,3%) is between 46 and 55 years old. The average age among the respondents is 48,52. Moreover, earlier research is confirmed when considering the share of men on speed pedelec is four times larger than women (De Bruijne, 2016). This is remarkable as research shows that women are inclined to commute more often by bike and men by car (Van Acker & Witlox, 2010). Riding a speed pedelec is primarily an activity for higher educated people. 69,8% of the respondents has completed university of applied sciences or university. A speed pedelec, with considerably high prices, might be more appealing to higher income groups which are presumably higher educated people (Van Acker & Witlox, 2010).

TABLE 3 SAMPLE 1 CHARACTERISTICS

Observed variables	Description	Mean or proportion (%)
Age < = 35	Age up to or equal to 35 years	9,0%
Age 36 – 45	Age between 36 and 45 years	24,8%
Age 46 – 55	Age between 46 and 55 years	42,3%
Age 56 – 65	Age between 56 and 65 years	23,4%
Age 66 = >	Age equal to or above 66 years	0,5%
Male	Share of male respondents	81,1%
Female	Share of female respondents	18,9%
Primary school	Highest completed education is primary school	1,4%
Secondary school	Highest completed education is secondary school	10,8%
Vocational	Highest completed education is vocational school	18,0%
University of applied sciences	Highest completed education is university of applied sciences	43,7%
University	Highest completed education is university	26,1%
Driving license	Having a driving license	97,7%
Availability car	Having a car available to drive to work	95,0%
Car (driving alone)	Former primary transport mode in commuting: car	58,4%
Car (carpooling)	Former primary transport mode in commuting: carpooling	1,8%

Public transport	Former primary transport mode in commuting: PT	13,1%
Moped or light moped	Former primary transport mode in commuting: moped or light moped	3,6%
Bicycle	Former primary transport mode in commuting: bicycle	10,9%
Electrical bicycle	Former primary transport mode in commuting: e-bike	12,2%
Age	Mean age	48,52

5.3 HOW DOES THE SPEED PEDELEC USER TRAVEL?

Before focussing on the respondents' behavioural intention, the general travel behaviour when riding a speed pedelec will be enlightened. This will be done through demonstrating their average speed, travel distance, multimodality, frequency of cycling to commute and previous mode of transport. As previous research has shown, not every speed pedelec user reaches the speed limit of 45 km/h (De Bruijne, 2016). This is confirmed through this data set. Almost halve of the respondents (48,6%) estimate their average speed to be between 31 and 35 km/h. What can be derived from the table below is that the share of speed pedelecers in commuter traffic grows as the distance augments.

Moreover, the full commuting distance is covered by 82,9% of the speed pedelecers. This means that it potentially fully substitutes other modes of transport. Table 3 shows that 58,4% used to drive their car to work. In other words, for almost 60% of the current users the speed pedelec has replaced the car. On average the speed pedelec is used for 76,07% of the working days. This is limiting the notion of car replacement. Apparently, approximately 25% of the speed pedelec users still rely on other modalities. An argument that can be put forward is that those respondents have the opportunity to tele work or are expected to sometimes work from an office outside the range of their speed pedelec.

TABLE 4 GENERAL TRAVEL BEHAVIOUR

Observed variables	Description	Mean or proportion (%)
Speed		
< 25 km/h	Average speed under 25 km/h	2,3%
26 – 30 km/h	Average speed between 26 – 30 km/h	17,1%
31 – 35 km/h	Average speed between 31 – 35 km/h	48,6%
36 – 40 km/h	Average speed between 36 – 40 km/h	24,8%
41 – 45 km/h	Average speed between 41 – 45 km/h	7,2%
Distance travelled		
<= 10 km	Working distance home to work is under 10 kilometres	8,2%
11 – 15 km	Working distance home to work is 11 – 15 kilometres	17,7%

16 – 20 km	Working distance home to work is 16 – 20 kilometres	21,4%
21 – 25 km	Working distance home to work is 21 – 25 kilometres	20,5%
26 => km	Working distance home to work is 26 kilometres or more	32,3%
Multimodality		
Travelling also by car	The respondent combines speed pedelec and car when travelling to work.	12,6%
Travelling also by public transport	The respondent combines speed pedelec and public transport when travelling to work.	4,5%
Travelling solitary by speed pedelec	The respondent only uses the speed pedelec when travelling to work	82,9%
Other purposes	The share of respondents that use the speed pedelec for other purposes than commuter travelling	70,6%
# working days	The number of days the respondents work	4,57
# days travelling by speed pedelec	The number of days the respondents are travelling by speed pedelec	3,47
Percentage of days travelling by speed pedelec	The share of working days the respondent travels by speed pedelec	76,07%

5.4 BEHAVIOURAL INTENTION

As depicted in the theoretical frame in chapter 3 behavioural intention may be determined through three dimensions. The first of these is attitude. In the survey this was measured through seven indicators where respondents could answer on a 5-point Likert scale. As will apply to all 5-point scale questions: one represents 'strongly disagreeing' and five represents 'strongly agreeing' with the statement.

TABLE 5 SAMPLE 1 INDICATORS OF ATTITUDE

Observed variables	Description	Mean	Missing values (%)
Flexibility	Respondent considers the SP to be a flexible transport mode	4,56	0,5%
Comfortable	Respondent considers the SP to be a comfortable transport mode	4,34	0,5%
Relaxing	Respondent considers the SP to be a relaxing transport mode	4,41	-
Safety	Respondent considers the SP to be a safe transport mode	3,90	1,4%
Travelling time	Respondent is content with travelling time on their SP	4,48	0,9%
Importance of electrical support	Respondent finds it important that the SP is electrically supported	4,68	1,4%
Living environment	Respondent thinks that the SP contributes to a better living environment	4,53	0,9%

The respondents are predominantly positive considering their attitude towards speed pedelecs. This is logical considering that the respondents are already executing the demanded behaviour. This is likely impelled by a positive attitude regarding the behaviour. Moreover, in paragraph 3.1.2 it was explained that behaviour also influences attitude, the concepts are iterative (Ajzen, 1991; Ajzen, 2002; Anable, 2005; Gilovich, Keltner & Nisbett, 2011). Thus, when one is satisfied in executing a specific behaviour, the attitude may develop to be even more positive. The lowest score within attitude is a 3,89 on the safety of speed pedelecs. On a five point scale this remains fairly sufficient. The fact that the speed pedelec is electrically supported appears to be very relevant for users.

TABLE 6 SAMPLE 1 INDICATORS OF SUBJECTIVE NORM

Observed variables	Description	Mean or proportion (%)	Missing values (%)
Care for Environment			
Conscious acting on environment	The extent to which respondents think that the average Dutch inhabitant cares for the environment but lacking to act on this.	71,6%	1,8%
Care for sustainable mobility	The extent to which respondents think that in the Netherlands a shift from conventional to sustainable mobility occurs.	50,0%	1,8%
Peer Influence			
Partner	Influence of partner on choice for speed pedelec	2,20	2,7%
Neighbours	Influence of neighbours on choice for speed pedelecs	1,18	2,7%
Family	Influence of family on choice for speed pedelecs	1,45	3,6%
Friends	Influence of friends on choice for speed pedelecs	1,67	2,3%
Colleagues	Influence of colleagues on choice for speed pedelec	2,10	0,9%
Work facilities			
Cycling plan available	Participation in employer's cycling or mobility plan	31,5%	5,4%
Cycling plan not participating	Not participating in employer's cycling or mobility plan	16,7%	
Cycling plan not available	The employer does not offer a cycling or mobility plan	46,4%	
Colleagues in cycling plan	In case of an organisational mobility plan, did any of the respondent's colleagues participate in the programme	56,1%	51,8%
Influence of participating colleagues	In case of participating colleagues, it influenced the respondent's choice for participating in the programme	23,3%	73%

The dimension of subjective norm consisted of peer influence and societal norms. Very remarkable in table 6 above is the limited impact of peers on the respondents' choice for speed pedelecs. All five types of peers score under a three, meaning that on average respondents disagree with the influence of those peers on their choice for a speed pedelec. A limited influence of peers may be caused by the earlier noted distinction between exogenous and endogenous effects. The first refers to the social characteristics of the peers and the endogenous captures the actual behaviour where Abou-Zeid et al. (2013) and Goetzke and Weinberger (2012) find that the endogenous effect is highly significant. In this dataset, the number of peers carrying out the behaviour is only 0,5195. This may elucidate the limited impact of relatives.

Considering societal norms 50,0% of the respondents have noted that there is a shift towards sustainable mobility. Yet, 45,4% thought that the focus in Dutch policy is too strongly on antiquated transport systems. Regarding awareness for environmental problems 71,6% of the respondents have indicated that Dutch inhabitants care for the environment but have been lacking to act on this. Their subjective norm, as the respondents primarily have presumed it, does not put forward sustainable modes of transport and strongly caring and acting for environmental problems. They have preceded society in using a sustainable mode of transport.

TABLE 7 SAMPLE 1 INDICATORS OF PERCEIVED BEHAVIOURAL CONTROL

Observed variables	Description	Mean or proportion (%)	Missing values (%)
Mode and travel attributes			
Purchase costs	Assessment of purchase cost of a speed pedelec	2,93	-
Maintenance costs	Assessment of maintenance cost of a speed pedelec	3,55	-
Road tax	Assessment of road tax of a speed pedelec	3,97	0,5%
Travel time	Assessment of travelling time of speed pedelecs	4,59	-
Accessibility working address	Assessment of accessibility working address	4,81	-
Accessibility home address	Assessment of accessibility home address	4,87	0,5%
Own physical health	Assessment of effects on own physical health	4,63	-
Own mental health	Assessment of effects on own mental health	4,75	0,9%
Living environment	Assessment of contribution to living environment	4,63	0,5%

Habit			
Habit of cycling	The share of respondents that already cycled often / always to school and work	59,7%	0,5%
Habit of sports	The share of respondents that sport once or more per week	37,1%	0,5%
Type of road			
Cycling highway	The share of respondents of whom their route contains a cycling highway and uses it	18,6%	0,9%
Separate cycling lane outside built environment	Mainly cycling on a separate cycling lane outside built environment	61,5%	0,5%
Separate cycling lane within the built environment	Mainly cycling on a separate cycling lane within the built environment	13,1%	
60 km/h speed limit outside the built environment	Mainly cycling on a 60 km/h speed limit track outside the built environment	18,6%	
50 km/h speed limit within the built environment	Mainly cycling on a 50 km/h speed limit track within the built environment	6,8%	
Capabilities			
Fit enough for cycling	To what extent did speed pedelecers considered themselves fit enough before using it	4,38	0,5%
Infrastructure	To what extent do speed pedelecers consider the infrastructure to be adequate for speed pedelec use	3,30	0,5%
Impeding or traffic light	To what extent is the route to work hindered by impeding or traffic light (very much = 1 – not so much = 5)	3,16	0,9%
Above average expensive	To what extent does the speed pedelec rider consider the speed pedelec to be above average expensive	2,45	0,5%

The last dimension has captured the perceived behavioural control which was operationalised here as habit and perceived mode and travel attributes. The indicators have been displayed in table 7 above. The degree of accessibility of the home and work address (respectively 4,81 and 4,87) has contributed most to enabling respondents to execute the behaviour. This relates to what van Nes (2002) described as travellers' optimum: a speed pedelec is flexible in connecting locations in and outside urban areas and thus enlarges utility. Yet, 76,4% of the respondents did not live in an area where a cycling highway was facilitated. Even, 5,0% of the respondents preferred avoiding a cycling highway. The largest share of the respondents mainly cycle outside the built environment. This is logical considering the distances the respondents bridge.

5.5 EFFECTS OF THE NEW LAW

As this research has been written in a time of uncertainty concerning the effects of a newly implemented law, the respondents have been asked to point out where they think problems will occur. 75,7% of the respondents state that they realise the law on speed pedelecs has changed and understand what the implications are. This group of 168 respondents have reviewed the impacts of the new law on the following indicators. Here, again the items have been scored from one to five. The new helmet, despite not feeling very comfortable with the new design, is welcomed. Nonetheless, the speed pedelec users do not expect to feel safe among car traffic.

TABLE 8 IMPACTS OF NEW LAW AS PERCEIVED BY CURRENT USERS

Observed variables	Description	Mean
Helmet	The extent to which speed pedelecers feel comfortable with the newly designed helmet	2,95
Place on the road	The extent to which it is clear for speed pedelecers where they are allowed to cycle from 1st of January 2017	3,48
Mixing with traffic	The extent to which speed pedelecers feel safe in case of mixing with car traffic on a track with a 50 km/h speed limit	1,68
Carrying new helmet	The extent to which the speed pedelecers plan to wear the newly designed helmet	3,59
Yellow license plate	The extent to which the speed pedelecers consider the obligatory yellow license plate to be a restraint for potential users to purchase a speed pedelec	2,16
Cyclists on cycling lane	The extent to which the speed pedelecers think that other cyclists experience hinder because of the increasing number of speed pedelecers	3,32
Increasing costs	The extent to which the speed pedelecers consider the increasing costs (insurance and road tax) to be a restraint for potential users to purchase a speed pedelec	2,16

5.6 COMPARING GROUPS

In order to fully answer the first two sub questions, tests have been carried out if to find distinctive groups within the speed pedelec user dataset. To find deviating mean values, groups have been compared on their mean values. The hypotheses that are presented in table 8, have been formulated to properly carry out the analysis. H_a has been accepted whenever the two-sided significance level of the Chi square did not exceed 0.05. The hypotheses have been formulated in such a way that it has enabled comparing groups considering their behaviour. Similar to paragraph 5.3 multiple indicators have been used to determine a speed pedelec users' behaviour: average speed, travel distance, type of road and former mode of transport. Groups have been differentiated based on the social demographic questions that have been included in

the survey. Those are age, gender, education, working days and percentage of days using a speed pedelec.

There have been some remarking results. First, it has appeared that there are significant differences between gender and the speed they achieve during cycling. Contemplating the data, it appeared that men reach a significant higher speed than women. Moreover, it has been found that there is a significant difference between the former transport mode respondents used to have and the current distance they cycle as shown. This relates to the fact that almost 60% of the respondents used to drive their car to work and now completes the same distance by speed pedelec. Moreover, the respondents are mainly male and higher educated indicating that they primarily drive a car to work and bridge longer distances (Van Acker & Witlox, 2010). From rejecting hypothesis 8 one could conclude that there has been a significant difference between the groups based on the type of road they mainly cycle considering the average distance they cycle. Remarkable is the fact that there is a significant deviance has been found between the level of education and the distances respondents cycle. Van Acker and Witlox (2010) their research confirms this relation through explaining that higher educated people find their jobs in highly concentrated urban areas which occurs in fewer places and therefore find theirs jobs further away from home. Regarding the type of road, groups have also been distinguished for cycling on a cycling highway or not. It appeared that cycling on a cycling highway has been contributing to a higher average speed. This has confirmed that the cycling highway has been accomplishing its initial purpose. Groups that have been differentiated on if their route mainly is outside or within the built environment show that cycling mainly outside the built environment, implies bridging longer distances. This makes sense as regional connections mainly are outside built environment. The last striking outcome has been the significant deviation between groups based on the number of days they work considering the distance they cycle.

TABLE 9 HYPOTHESIS TESTING

Hypothesis	Description	Valid cases	Pearson Chi-Square	Sig.	Accepted or rejected
1	There is a difference between groups based on gender considering the distance they cycle	220	3,418	0,490	Rejected
2	**There is a difference between groups based on gender and average speed they reach**	**222**	**18,647**	**0,001**	**Accepted**

3	**There is a difference between groups based on their former transport modes and current distance respondents cycle**	**219**	**35,329**	**0,018**	**Accepted**
4	There is a difference between groups based on former transport modes and current speed	221	20,324	0,438	Rejected
5	There is a difference between age groups considering the current distance the respondents cycle	220	18,133	0,316	Rejected
6	There is a difference between age groups considering the speed the respondents reach	222	22,716	0,122	Rejected
7	There is a difference between groups based on cycling distance considering if their trip is multimodal	220	13,023	0,111	Rejected
8	**There is a difference between groups based on the type of road they mainly cycle considering the average distance they cycle**	**220**	**29,909**	**0,003**	**Accepted**
9	**There is a difference between groups based on highest acquired education and distances they cycle**	**220**	**32,764**	**0,008**	**Accepted**
10	There is a difference between groups based on highest acquired education considering the speed respondents reach	222	18,803	0,279	Rejected
11	There is a difference between groups based on the percentage of working days that respondents cycle considering the velocity they reach	220	19,452	0,246	Rejected
12	**There is a difference between groups based on the percentage of working days that respondents cycle considering the distance they cycle**	**218**	**48,074**	**0,000**	**Accepted**
13	There is a difference between groups based on if they cycle on a cycling highway and the speed they reach	222	11,625	0,169	Rejected
14	There is a difference between groups based on if they cycle on a cycling highway and the distance they cycle	220	6,830	0,555	Rejected
15	**There is a difference between groups based on if they cycle within or outside the built environment and the distance they cycle**	**220**	**23,883**	**0,000**	**Accepted**
16	**There is a difference between groups based on if they cycle within or outside the built environment and the speed they reach**	**222**	**14,026**	**0,081**	**Accepted**
17	There is a difference between groups based on if they cycle on a separate cycling lane and the distance they cycle	220	3,436	0,488	Rejected
18	There is a difference between groups based on if they cycle on a separate cycling lane and the velocity they reach	222	8,531	0,383	Rejected

19	There is a difference between groups based on gender considering the frequency they use the speed pedelec	222	3,999	0,406	Rejected
20	There is a difference between age groups considering the frequency they use the speed pedelec	222	11,244	0,794	Rejected
21	**There is a difference between groups based on speed considering the distance they cycle**	**220**	**47,140**	**0,000**	**Accepted**

*Significance is here determined two-sided
** Hypothesis is rejected when significance does not exceed 0,05

5.7 MEASUREMENT MODELS

Before constructing the large structural model, measurement models have been set up. In such a model, solely continuous variables could be included. Therefore, indicators of the latent constructs only comprise questions that have been answered on a 5 point Likert-scale. To determine which indicators may be used for measuring the latent construct, Cronbach's alpha has been applied to test for internal reliability among the indicators. Internal reliability describes the extent to which all the items in a test measure the same concept or construct and thus addresses the inter-relatedness of the items (Tavakol & Dennick, 2011). Acceptable scores for Cronbach's alpha range from 0,7 to 0,95 (Tavakol & Dennick, 2011). It should be emphasised that Cronbach's alpha does not guarantee anything on unidimensionality of the items (Gefen, Straub & Boudreau, 2000). A satisfying Cronbach's alpha does not ensure that the items only measure for this dimension. In table 10, the measurement models are included for the speed pedelec user's latent constructs. The three corresponding hypotheses have been tested here.

H1 The indicators for attitude all have a positive influence on attitude

The seven indicators that have been used in the survey scored a 0,760 on Cronbach's Alpha. This is a very satisfying score on internal reliability. Therefore, the measurement model was constructed with all these indicators. To identify the latent construct, one regression should be fixed beforehand. Otherwise, no outcome would be realised. As a result, flexibility has a parameter estimate of exactly 1,00. All other indicators have a positive influence on Attitude, thus H1 can be accepted. Safety has the strongest influence on attitude with a parameter estimate of 1,59. Environmental related indicators have a relatively weaker impact on attitude.

H2 The indicators of subjective norm all have a positive influence on subjective norm

In the table below, the latent construct of subjective norm is left out. From the Cronbach's alpha test, it appeared that there was limited internal consistency among the indicators. Up to now,

one cannot draw any conclusions for this second hypothesis. Yet, a positive influence on subjective norm for riding a speed pedelec is crucial. If the social environment has a negative norm towards speed pedelecs, it is very difficult to change others behaviour as people comply with their subjective norm (Rli, 2014).

H3 The indicators of perceived behavioural control all have a positive influence on perceived behavioural control

For the third dimension, five indicators remained after testing for Cronbach's alpha. Also, a regression had to be fixed to prevent under identification of the latent construct. This hypothesis also should be accepted as all indicators have shown a positive value considering the parameter estimate. The two indicators on health have been influencing PBC the strongest. Accessibility to work and home address score fairly low and appear to be less important than other indicators. This is contradictory to what Rose (2012) argues: travel attributes are appreciated more by pedelec users than mode attributes. In other words, it was expected that short term decisions as route (related to accessibility) would have contributed more to PBC than long term decisions as impact on health.

TABLE 10 MEASUREMENT MODELS FOR SPEED PEDELEC USERS

	Indicator variable	Latent Variable	Parameter estimate
Variables measuring Attitude of speed pedelec user	Flexibility	Attitude	1,00
	Comfortably	Attitude	1,59
	Relaxing	Attitude	1,57
	Safety	Attitude	1,71
	Travel time	Attitude	1,30
	Importance electrical support	Attitude	0,82
	Living environment	Attitude	0,83
Variables measuring perceived behavioural control of speed pedelec user	Accessibility work address	Perceived behavioural control	0,51
	Accessibility home address	Perceived behavioural control	0,46
	Own physical health	Perceived behavioural control	1,51
	Own mental health	Perceived behavioural control	1,41
	Living environment	Perceived behavioural control	1,00
*** p < 0.1 for all the coefficients** **** Cronbach's alpha values: 0.760, 0.702 respectively from the top**			

6. THE POTENTIAL USER

As a follow up of exploring the current user's behavioural intention in chapter 5, this chapter will provide an answer to sub question c through mapping the potential user's behavioural intention. The potential group comprises people whom do not own nor use a speed pedelec for commuting purposes. In addition, the potential user has been selected on the criterion of a one-way commute trip between 10 and 30 kilometres. From the first survey's outcome it appeared that the largest group mainly covered this distance. Moreover, this distance relates to the daily urban system in the Netherlands which in contemporary geographies captures the notion of network cities instead of an urban region with solely one urban core (Van Eck et al, 2006).

In total 243 valid responses have been collected among potential speed pedelec commuters, as illustrated in chapter 5.1. Comparable to the previous chapter, the tables in this chapter include a missing value column when relevant. The survey as spread among the potential users included an 'I don't know' category to many questions. Where these were available, this number will be provided. Otherwise, the share of missing values will be stated.

6.1 WHO IS THE POTENTIAL GROUP?

The distribution among age groups has been comparable to the first dataset except for the youngest age category below 35 years old. In this dataset, this group captures 18,6% of the respondents as shown in table 11. Consequently, the mean age is almost two years lower than in the speed pedelec group. In this dataset, the division between men and women is more equal with 60,1% men against 39,9% women. Contemplating the highest acquired education of non-users, the distribution is comparable to the first dataset with the majority being highly educated.

Roughly, sample two consisted of commuters divided over four transport modes. Respondents driving their car to work was the largest share in the sample, resembling 36,0% of the dataset. The second largest group equals 24,8%, used public transport. Then 20,7% currently cycles on a conventional bicycle to work and the last group, 16,5% cycles on a regular e-bike to work.

TABLE 11 SAMPLE 2 CHARACTERISTICS

Observed variables	Description	Mean or proportion (%)
Age < = 35	Age up to or equal to 35 years	18,6%
Age 36 – 45	Age between 36 and 45 years	21,1%

Age 46 – 55	Age between 46 and 55 years	34,7%
Age 56 – 65	Age between 56 and 65 years	25,6%
Male	Share of male respondents	60,1%
Female	Share of female respondents	39,9%
Secondary school	Highest completed education is secondary school	3,7%
Vocational	Highest completed education is vocational school	19,8%
University of applied sciences	Highest completed education is university of applied sciences	41,2%
University	Highest completed education is university	35,4%
Nationality	Respondents whom are native Dutch	94,7%
Nationality	Respondents whom are naturalised Dutch	3,3%
Driving license	Having a driving license	97,1%
Availability car	Having a car available to drive to work	81,9%
Availability e-bike	Having an e-bike available to drive to work	25,9%
Car (driving alone)	Primary transport mode in commuting: car	36,0%
Car (carpooling)	primary transport mode in commuting: carpooling	1,2%
Public transport	Primary transport mode in commuting: PT	24,8%
Walking	Primary transport mode in commuting: walking	0,4
Bicycle	Primary transport mode in commuting: bicycle	20,7%
Electrical bicycle	Primary transport mode in commuting: e-bike	16,5%
Age	Mean age	46,62

6.2 WHAT IS THEIR CURRENT GENERAL TRAVEL BEHAVIOUR?

Similar to the first dataset, this group has been questioned on their general travel behaviour. In contrast to the group speed pedelec users, the number of commuter decreases as distance augments. 41,6% of the dataset is covering 10 – 15 kilometres and only 14,8% is covering 26 – 30 kilometres. The respondents were asked if they have considered to use the speed pedelec before. It appeared that almost 30% was unaware of the possibility and existence of the speed pedelec. 34,6% was aware of the speed pedelec as mode of transport but had not yet decided whether they should try it. The speed pedelec user had indicated that they use the speed pedelec for 76% of the working days. A non-speed pedelec user states that they use their transport mode for 89,43% of the time.

TABLE 12 SAMPLE 2 GENERAL TRAVEL BEHAVIOUR

Observed variables	Description	Mean or proportion (%)
Speed		
< 25 km/h	Average speed under 25 km/h	34,4%
26 – 30 km/h	Average speed between 26 – 30 km/h	10,0%
31 – 35 km/h	Average speed between 31 – 35 km/h	2,5%
36 – 40 km/h	Average speed between 36 – 40 km/h	1,2%
41 – 45 km/h	Average speed between 41 – 45 km/h	4,1%
> 45 km/h	Average speed travelled over 45 km/h	34,4%
Unknown	Respondent was not able to estimate the average speed	13,3%

Distance travelled		
11 – 15 km	Working distance home to work is 10 – 15 kilometres	41,6%
16 – 20 km	Working distance home to work is 16 – 20 kilometres	24,3%
21 – 25 km	Working distance home to work is 21 – 25 kilometres	19,3%
26 – 30 km	Working distance home to work is 26 – 30 kilometres	14,8%
Multimodality		
Active mode + public transport	The share of respondents that combine active modes and public transport.	28,9
Car + public transport	The share of respondents that combine car with public transport	5,8
Active mode + car	The share of respondents that combine active modes with the car	16,1
Unimodal	The share of respondents that only use one mode of transport in commuting	49,2
Consideration		
Unaware	Respondents who were unaware of the possibility to ride a speed pedelec to work	27,9%
Conscious	Respondents who were conscious of the possibility but have not decided yet if they want to try it	34,6%
Considered	Respondents who have considered to try a speed pedelec but decided not to	29,6%
Tested and doubting	Respondents who have tested a speed pedelec and are doubting to purchase a speed pedelec	3,3%
Tested and choose not to	Respondents who have tested a speed pedelec and decided not to purchase a speed pedelec	4,6%
# working days	The number of days the respondents work	4,41
# days travelling by primary mode of transport	The number of days the respondents are travelling by speed pedelec	3,94
Percentage of days travelling by main transport mode	The share of working days the respondent travels by their main transport mode	89,43%

6.3 WHAT DOES THEIR BEHAVIOURAL INTENTION CONSIST OF?

Also, the potential speed pedelecer has been asked for their behavioural intention consisting of attitude, peer influence and perceived behavioural control as explained in chapter 3.1.2. To map the respondent's attitude, they have been asked to score their current transport mode on the seven indicators of attitude. A remarkable difference is that the potential speed pedelec user does not attribute much of importance to the reduction of his CO_2 footprint or contribution to a better living environment as the speed pedelec user does. Except for the safety indicator, every indicator of attitude has been more moderated for potential speed pedelec users than current speed pedelec users.

TABLE 13 SAMPLE 2 INDICATORS OF ATTITUDE

Observed variables	Description	Mean	# I don't know
Flexibility	Respondent considers their transport mode to be a flexible transport mode	4,30	2
Comfortable	Respondent considers their transport mode to be a comfortable transport mode	4,33	4
Relaxing	Respondent considers their transport mode to be a relaxing transport mode	4,17	3
Safety	Respondent considers their transport mode to be a safe transport mode	4,28	5
Travelling time	Respondent is content with travelling time with their transport mode	4,13	4
Importance of electrical support	Respondent finds it important that their transport mode contributes to a reduction of their CO_2 footprint	3,16	5
Living environment	Respondent thinks that their transport mode contributes to a better living environment	3,23	8

Contemplating societal norms, 59% of the potential speed pedelec users judge the Dutch inhabitant as caring for the environment. This is 12% less than what the speed pedelec user had indicated. For speed pedelec use these conditions are less stimulating. Moreover, a potential speed pedelec user has indicated that he did not feel strongly influenced by any of the direct relatives considering his current travel mode. On top of this the number of potential users' peers carrying out the demanded behaviour of riding a speed pedelec is lower than for speed pedelec users. Respectively 0,3512 and 0,5195, however this difference is not significant with a significance level of 0,132 as estimated by the Chi-square.

The company facilities have been differently assessed by potential speed pedelec users compared to current speed pedelecers. The share of people participating in a cycling or mobility plan is 7,4% higher than among current speed pedelecers. This may be caused by the relative high share of e-bike users in this second dataset. Even more remarkable is the fact that 46,4% of the speed pedelecers has pointed out that there is not a cycling plan available, while this is only 21,8% among potential users of the speed pedelec. All in all, the subjective norm as perceived by potential speed pedelec users is less oriented on sustainable modes of transport and environmental conscious decisions.

TABLE 14 SAMPLE 2 INDICATORS OF PEER INFLUENCE

Observed variables	Description	Mean or proportion (%)	Missing values (%) or # I don't know
Care for environment			
Conscious acting on environment	The extent to which respondents think that the average Dutch inhabitant cares for the environment but lacking to act on this.	60,0%	1,2%
Care for sustainable mobility	The extent to which respondents think that in the Netherlands a shift from conventional to sustainable mobility occurs.	49,6%	1,2%
Peer Influence			
Partner	Influence of partner on choice for their mode of transport	2,05	3
Neighbours	Influence of neighbours on choice for their mode of transport	1,15	5
Family	Influence of family on choice for their mode of transport	1,25	4
Friends	Influence of friends on choice for their mode of transport	1,37	4
Colleagues	Influence of colleagues on choice for their mode of transport	1,65	4
Work facilities			
Cycling plan available and participating	Participation in employer's cycling or mobility plan	39,7%	0,4%
Cycling plan not participating	Not participating in employer's cycling or mobility plan	25,2%	
Cycling plan not available	The employer does not offer a cycling or mobility plan	20,7%	
Colleagues in cycling plan	In case of an organisational mobility plan, did any of the respondent's colleagues participate in the programme	58,6%	35,4%
Influence of participating colleagues	In case of participating colleagues, it influenced the respondent's choice for participating in the programme	16,3%	62,1%

Comparing PBC for the respondent's own transport mode and the speed pedelec reveals that their own transport mode has been valued higher than that of the speed pedelec on 5 out of 9 indicators. This implies that respondents have considered themselves to be less capable of riding a speed pedelec than travelling with their current transport mode. Golob and Beckmann (1970) comply with this argumentation as they explain that one strives for the least costs and the highest utility, therefore the respondents' appraisal for familiar behaviour over new behaviour was to be expected. Yet, the speed pedelec is assessed more positively on road tax, accessibility working

address, own physical health and the contribution to living environment. This last one may be caused by the relative high share of car users.

Considering respondent's habits the potential user group has shown a higher share of respondents whom have stated to be accustomed to cycling often or always for commuting purposes and have been more active in sports. This is striking but might be caused by the large share of cyclists and e-bike users who might be the habitual cyclists. The last four indicators that count for PBC have been, except for purchase costs, judged more positively by potential speed pedelecers than speed pedelec users. Preceding actually performing the behaviour, respondents consider their potential route to be stimulating for speed pedelec use. In other words, there are multiple important factors which are present according to potential users to successfully carry out the behaviour. Nevertheless, a large part of this group has stated to doubt about using a speed pedelec as shown in paragraph 6.2. Mobility related issues such as purchase costs are valued less than travel related matters such as accessibility and this might complicate the shift to speed pedelec utilisation. As Rose (2012) explains, mobility decisions are long term decisions and take more effort than short term travel decisions as frequency, route and timing.

A note should be made on the assessment of indicators related to the speed pedelec. Respondents were given the opportunity to answer 'I do not know' when they thought there were not capable of giving a proficient answer. The number of valid cases for the last category of questions (assessment of indicators of perceived behaviour control considering the speed pedelec) varied from 136 to 209.

TABLE 15 SAMPLE 2 INDICATORS OF PERCEIVED BEHAVIOURAL CONTROL

Observed variables	Description	Mean or proportion (%)	Missing values (%) or # I don't know
Mode and travel attributes for own transport mode			
Purchase costs	Assessment of purchase cost	3,38	19
Maintenance costs	Assessment of maintenance cost	3,56	28
Road tax	Assessment of road tax	3,76	36
Travel time	Assessment of travel time	4,20	5

Accessibility working address	Assessment of accessibility working address	4,38	5
Accessibility home address	Assessment of accessibility home address	4,67	5
Own physical health	Assessment of effects on own physical health	3,94	3
Own mental health	Assessment of effects on own mental health	4,29	5
Living environment	Assessment of contribution to living environment	4,00	6
Mode and travel attributes for the speed peed			
Purchase costs	Assessment of purchase cost of a speed pedelec	2,20	60
Maintenance costs	Assessment of maintenance cost of a speed pedelec	2,78	100
Road tax	Assessment of road tax of a speed pedelec	4,08	48
Travel time	Assessment of travel time of speed pedelecs	4,08	22
Accessibility working address	Assessment of accessibility working address	4,63	26
Accessibility home address	Assessment of accessibility home address	4,67	24
Own physical health	Assessment of effects on own physical health	4,12	27
Own mental health	Assessment of effects on own mental health	4,20	30
Living environment	Assessment of contribution to living environment	4,30	31
Habit			
Habit of cycling	The share of respondents that already cycled often / always to school and work	83,5%	2,5%
Habit of sports	The share of respondents that sport once or more per week	50,8%	2,1%
Type of road			
Cycling highway	The share of respondents whom know that their route contains a cycling highway	51,5%	0,8%
Capabilities			
Fit enough for cycling	To what extent do commuters consider themselves to be fit enough for cycling	4,45	13
Infrastructure	To what extent do commuters consider the infrastructure to be adequate for potential use of speed pedelec	3,58	21
Impeding or traffic lights	To what extent is the route to work hindered by impeding or traffic lights (very much = 1 – not so much = 5) for potential use of speed pedelec	3,21	24
Above average expensive	To what extent does a commuter consider the speed pedelec to be above average expensive	1,89	44

6.4 MEASUREMENT MODEL

The next step, similar to the chapter 5.6, captures the measurement models to map the latent structures. The data that is employed here includes all values again, also the missing values. To identify the relations between the indicators and the latent constructs four hypotheses have been tested again.

H1 The indicators of attitude have a positive influence on attitude

For the potential group five indicators appeared to determine attitude. Those are flexibility, comfortably, relaxing, safety and travel time. All parameters have shown positive impact on the latent construct so therefore this hypothesis should be accepted. The estimates have been fairly equally distributed among the indicators except for safety. The parameter estimate for safety contributes the fewest to attitude. This is remarkable as it was the strongest indicator in the measurement model for speed pedelec users.

H2 The indicators of subjective norm have a positive influence on subjective norm

In contrast to the speed pedelec group, the indicators for subjective norm show internal consistency. The indicators friends and colleagues very strongly influence subjective norm compared to neighbours and family. This may be also reflected by the endogenous effect (Goetzke & Weinberger, 2012) of peer influence: the numbers of friends and colleagues owning and riding a speed pedelec in the respondents' social environment. The mean numbers of friends and colleagues owning as speed pedelec (respectively 0,2603 and 1,2273) are higher than the means for the other peer influence categories.

H3 The indicators of perceived behavioural control considering the respondent's own transport mode have a positive influence on perceived behavioural control

The indicators for the latent construct of PBC all have been positively influencing the latent construct, thus H3 is accepted. However, the separate parameters' effects are not very strong. The estimates vary from 0,68 to 1,00. Strikingly, the indicators for PBC have been here related to the respondent's own transport mode. Perhaps indicators for PBC of a familiar behaviour are moderated as the respondent knows he is capable of carrying out the behaviour.

TABLE 16 MEASUREMENT MODEL FOR LATENT CONSTRUCTS

	Indicator variable	Latent Variable	Parameter estimate
Variables measuring attitude of potential speed pedelec user	Flexibility	Attitude	1,00
	Comfortably	Attitude	1,04
	Relaxing	Attitude	1,09
	Safety	Attitude	0,51
	Travel time	Attitude	1,02
Variables measuring subjective norm of potential speed pedelec user	Neighbours	Subjective norm	1,00
	Family	Subjective norm	1,48
	Friends	Subjective norm	2,36
	Colleagues	Subjective norm	2,64
Variables measuring perceived behavioural control of potential speed pedelec user	Purchase costs	PBC	1,00
	Maintenance costs	PBC	0,82
	Road Tax	PBC	0,68
	Travel time	PBC	0,77
	Accessibility work address	PBC	0,75
	Accessibility home address	PBC	0,74
	Own physical health	PBC	0,97
	Own mental health	PBC	0,94
	Living environment	PBC	0,89
*** p < 0.1 for all the coefficients** **** Cronbach's alpha values: 0,701, 0,756 and 0,754 respectively from the top**			

H4 The indicators of perceived behavioural control considering riding a speed pedelec have a positive influence on perceived behavioural control

The measurement constructs above all have been intended for identifying a respondent's behavioural intention for their current transport mode. This research has explicitly addressed the speed pedelec and therefore it has been decided to draw an extra measurement model for the latent construct of PBC considering the speed pedelec, as shown in table 17. Four extra indicators have been incorporated in this latent construct. However, it appears that those did not show strong influence on the latent construct. The other nine indicators are equally divided among the construct, not strongly affecting PBC. However, all indicators have shown a positive influencing on PBC therefore the fourth hypothesis should be accepted.

TABLE 17 MEASUREMENT MODELS FOR LATENT CONSTRUCT SPEED PEDELEC

	Indicator variable	Latent Variable	Parameter estimate
Variables measuring perceived behavioural control of riding a speed pedelec of a potential speed pedelec user	Purchase costs	PBC	1,00
	Maintenance costs	PBC	0,81
	Road Tax	PBC	0,67
	Travel time	PBC	0,76
	Accessibility work address	PBC	0,74
	Accessibility home address	PBC	0,73
	Own physical health	PBC	0,90
	Own mental health	PBC	0,88
	Living environment	PBC	0,83
	Fit enough	PBC	0,42
	Infrastructure	PBC	0,24
	Impeding	PBC	0,28
	Expensive	PBC	0,07
*** p < 0.1 for all the coefficients** **** Cronbach's alpha values: 0,846**			

7. BRIDGING THE GAP

The previous two chapters have provided insight in who the speed pedelec user is, who the potential user is and what their behavioural intentions consist of. In this chapter the generated knowledge will be taken a step further to answer sub question d and e. Those sub questions search for the determinants of actual commute mode choice behaviour and how the gap between intention and the actual determinants may be bridged.

7.1 THE DETERMINANTS

To formulate some points of departure for influencing the potential user group, structural equation modelling (SEM) will be applied as expounded on in chapter 4. This will provide insight in what factors of behavioural intention are determining for travel mode choice considering commuter distance 10 – 30 kilometres. To fully capture preferences for mode choice, both data on speed pedelec and potential users are included in the structural equation model. Van Acker & Witlox (2010) have stated that only an endogenous categorical variable is permitted and therefore the variable transport mode has been transformed into a dummy variable: non-motorised mode. The dummy non-motorised modes has integrated cyclists, e-bikers, speed

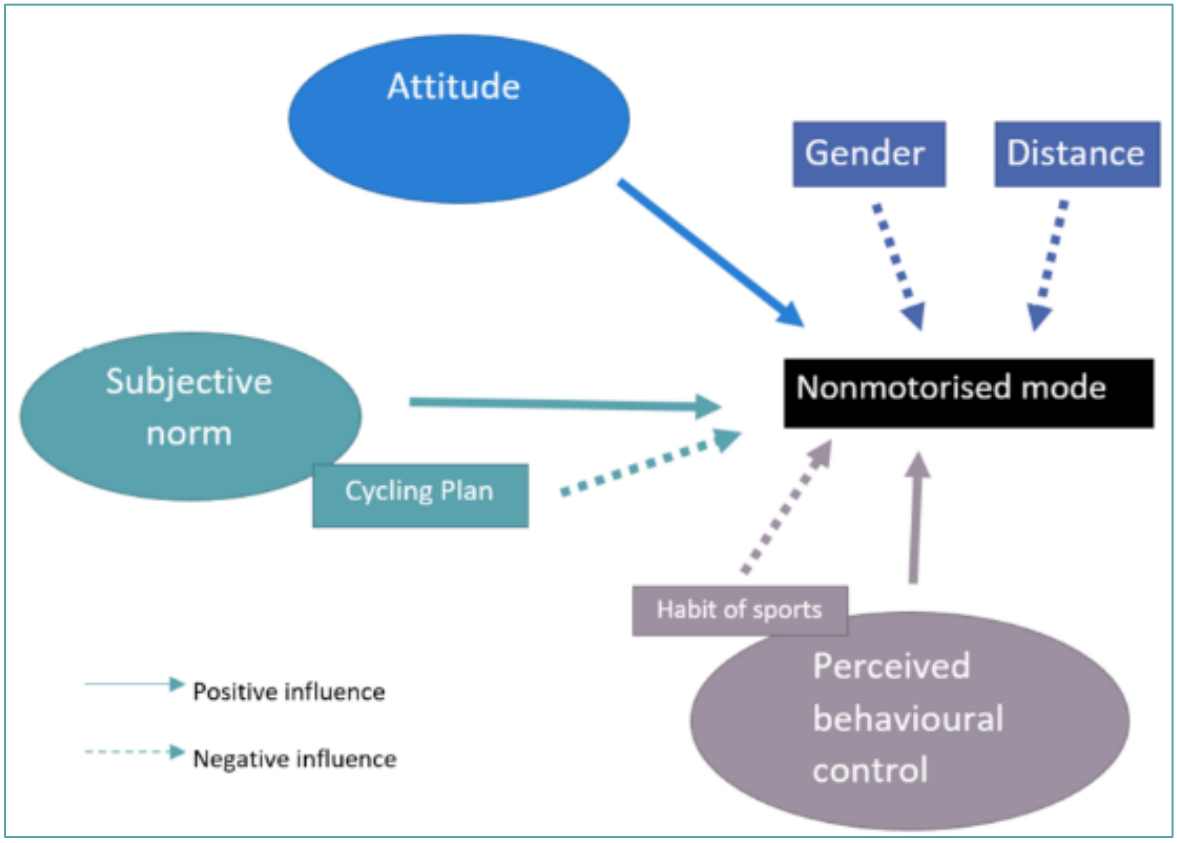

FIGURE 13 THE STRUCTURAL EQUATION MODEL ON NON-MOTORISED MODES

pedelec users and walking as reference category. All other modes of transport (i.e. car, carpooling, public transport, mopeds) have been included in the motorised modes category. This dummy diverges from the initial conceptual frame in chapter 3 where the dependent variable was depicted as mode choice preference. Nevertheless, a dummy had to be created to enable estimation of the SEM. This choice did not coincide with the main research question on the speed pedelec's behavioural intention as well. Yet, a large model on the speed pedelec's intention could not be estimated since the potential user's survey did not exclusively relate to speed pedelec. It primarily has questioned the attitude and PBC for one's own transport mode. Furthermore, halve of the total dataset consists of speed pedelecers and this would generate a distorted image as it deviates from reality. The final model which has been analysed here is depicted in figure 11. All presented relations turned out to be significant on a 0.05 level. The only exception is subjective norm which is a significant contributor on a 0.1 level.

7.1.1 TESTING HYPOTHESES

In the conceptual frame, it has been hypothesised that the three separate dimensions attitude, subjective norm and perceived behavioural control all have a positive influence on behavioural intention (Ajzen, 1991; Anable, 2005; Madden, Scholder Ellen & Ajzen, 1992). Before identifying the most important determinants for mode choice, three hypotheses will be tested to see if the general theoretical underpinning hold for the complete dataset. The conceptual frame illustrated behavioural intention and transport mode as two separate variables. Here, they will be regarded to be equal. Mainly because behaviour as discerned in this research is an observed action as opposed to a planned action that is central in the theory of planned behaviour (Ajzen, 1991). From the observed actions one cannot conclude that those actions were planned. Hence, intention thus can be regarded as redundant since the respondents are already carrying out the particular behaviour. However, it should be realised that one's attitude for the particular behaviour may not be expressed in actual performance of the behaviour as it may be constrained by external circumstances (Stradling, Meadows & Beatty, 2000). In other words, the dimensions of intention may be confined by other urgent circumstances such as physically not being capable of cycling which may be also referred to as *actual* control over the behaviour (Ajzen, 1991). Secondly, intention for all the separate transport modes has not been measured within the survey. Yet, applying the measurement model technique was not possible as identification of a latent construct cannot be done through three other latent constructs. Therefore, there has been

limited opportunity to measure intention of transport mode choice. Nevertheless, the research remains grounded to the theory of planned behaviour.

TABLE 18 MEASUREMENT MODEL FOR STRUCTURAL EQUATION MODEL

	Indicator variable	Latent Variable	Parameter estimate
Variables measuring attitude	Flexibility	Attitude	1,00
	Comfortably	Attitude	0,90
	Relaxing	Attitude	1,22
	Travel time	Attitude	1,09
	CO2 footprint	Attitude	0,77
	Regard for environment	Attitude	0,77
Variables measuring subjective norm	Neighbours	Subjective norm	1,00
	Family	Subjective norm	1,98
	Friends	Subjective norm	3,72
	Colleagues	Subjective norm	3,86
Variables measuring perceived behavioural control	Purchase costs	PBC	1,00
	Maintenance costs	PBC	1,36
	Road Tax	PBC	1,17
	Own physical health	PBC	0,11
	Own mental health	PBC	0,09
	Contribution to living environment	PBC	0,29
*** p < 0.01 for all the coefficients ** Cronbach's alpha values: 0,658, 0,664 and 0,736 respectively from the top**			

Before testing the hypotheses by means of a structural equation model, the latent constructs should be mapped again. A similar approach as in chapter 5 and 6 will be employed. The latent constructs need to be revised as it now concerns data of both the speed pedelecer and potential user. The latent construct of attitude has been measured through 6 indicators. The Cronbach's alpha score appeared to be higher without the safety indicator. Nonetheless, Cronbach's alpha is just below the satisfying norm of 0.7. Subjective norm is mainly determined by friends and colleagues, similar to when the data sets were separately reviewed. Here, Cronbach's alpha is 0,664 and therefore below the satisfying level. However, if the latent construct would have been excluded from the SEM, the model would not at all be significant. Therefore, 0,664 is accepted here. The third latent construct was perceived behavioural control. Only the indicators on costs, health and environmental contribution are included whereas indicators on costs appeared to be most influential.

H1 Attitude has a positive influence on behaviour

The dimension of attitude which consisted of six indicators according to the measurement model presented in table 18, shows a positive influence on transport mode. In the SEM one indicator (comfortably) appeared to be redundant as it did not significantly contribute to attitude. Therefore, it was excluded from the SEM. The attitude β is 0,99 with a p-value below 0.01 level. This would imply that attitude has significantly contributed to the model. This has been estimated by means of the maximum-likelihood approach in which every parameter is set to equal zero and the model is re-estimated to see if a significant different outcome would be realised (Scheiner & Holz-rau, 2007). Thus, H1 should be accepted since the influence of attitude is positive.

H2 Subjective norm has a positive influence on behaviour

The variable subjective norm, comprising four indicators resembling the measurement model depicted in table 18, shows a positive influence on behavioural intention. Its impact on preference for a non-motorised mode has appeared to be minor compared to attitude. A β of 0.15 (p-value < 0.1) compared to a β of 0.99. The results of this SEM emphasise that friends and colleagues are the most influencing on the subjective norm. All in all, H2 should be accepted.

Besides the three latent constructs, other variables have been included in estimating the SEM as they might be contributing to determining the likelihood of a behaviour. In the category of subjective norm, the availability of a cycling plan appeared to be a significant contributor. Remarkably, participating in a cycling plan, or having the opportunity, has resulted in less chance of commuting by means of an active mode. Presumably, this has been caused by the answering possibility 'I do not know' to this question, encoded as 9 and therefore clearly affecting the outcome. It can be argued that car drivers or public transport users are less aware of their work facilities considering cycling and therefore respond 'I don't know'.

H3 Perceived behavioural control has a positive influence on behaviour

The last dimension has captured the respondents' perceived ability to carry out a behaviour. The dimension has been confined to costs, health and living environment. H3 should be accepted as PBC shows a positive influence with an average impact on transport mode choice compared to the other dimensions as shown by a β equalling 0,49 (p-value < 0.05). In contrast to the measurement model, health and living environment provide for the largest impact on PBC.

Ajzen (1991) and Madden (1992) explained that according to the theory of planned behaviour, perceived behavioural control both has a direct effect on intention and indirect effect on actual behaviour. This assumption has been based on the thought that when people believe they have little control over carrying out the behaviour because of a lack of resources, intentions to perform the behaviour may be confined despite favourable attitude and subjective norm (Madden, 1992). Hence, it was expected that perceived behavioural control would have showed a stronger influence on the dependent variable.

Next to the latent construct, other variables have been added to the SEM to assess what other variables related to perceived behavioural control influences behaviour. Habit of sports showed a significant input as only variable. Though, with a β equalling -0.08, the impact is very limited. A negative relation suggests that if respondents claim to sport on a weekly basis or more, they are less likely to commute by means of an active mode. An explanation might be that the respondents driving their car to work compensate by taking up sports.

7.1.2 Evaluating the model

Besides drawing conclusions on the three hypotheses, the model can be evaluated on its validity for which measures are included in table 19. CMIN/*df* equals 5.328, this is just above the suggested maximum of 5 to conclude that it is a satisfying model. CMIN/*df* refers to the minimum of the discrepancy function between the sample and the model divided by degrees of freedom whereas a value approaching 1 refers to a good model (Scheiner & Holz-rau, 2007). The RMSEA equals 0,097, which is just below the critical level of 0.1 (Scheiner & Holz-Rau; Sharmeen, 2015). The RMSEA measures the amount of error of approximation per model degree of freedom, while controlling for sample size (Van Acker & Witlox, 2010). PCLOSE significance is 0.000 in the SEM but the desired value is above 0.05. This measure tells if the sample and the model significantly differ, which you not aim for since it is preferable that the data and the model coincide. From these three measures, it becomes apparent that the model is not significant despite all the incorporated parameters are.

Bearing in mind that the model has appeared to be insignificant, one can draw prudent conclusions on what are the determinants for transport mode choice. The strongest contributor is attitude which is primarily determined by the two environmental related indicators. Perceived behavioural control comes second and is mainly stipulated by health and again, regard of living environment.

TABLE 19 STRUCTURAL EQUATION MODEL ON TRANSPORT MODE

	Attitude	Subjective norm	Perceived behavioural control	Non-motorised modes
Flexible	1,00			
Relaxing	1,39*			
Travel time	1,01*			
CO2 footprint	3,14*			
Contribution living environment	4,14*			
Attitude				**0,99***
Neighbours		1,00		
Family		1,98*		
Friends		3,70*		
Colleagues		3,87*		
Subjective norm				**0,15*****
Availability cycling plan				**- 0,02***
Purchase costs			1,00	
Maintenance costs			1,55**	
Own physical health			5,08**	
Own mental health			3,42**	
Living environment			3,98**	
Perceived behavioural control				**0,47****
Habit of sports				**-0,08***
Gender				**-0,11***
Distance				**-0,04***
Goodness of Fit statistics				
CMIN/*df*	<2 good, >5 n.a.		5,328	
RMSEA	<0.05 good, 0.1> n.a.		0,097	
PClOSE significance	0.05> good		0,000	
N.a. refers to not acceptable				
* significant on a p < 0.01 level				
** significant on a p < 0.05 level				
*** significant on a p < 0.1 level				

Also, gender partially has determines one's mode of transport in commuter traffic, with a significant β of -0.11. The negative relation points out that women are less likely to take up an active mode in commuting but make use of car or public transport facilities. Another sociodemographic indicator that has been included, is distance to work. Table 19 shows that it significantly contributes to the dependent variable. Yet, it is a minor relation as reflected by a β of -0,04. This suggests that if respondents live further away from work, they are less likely to take up an active mode to work. Other socio demographic indicators such as age, education and having a driving license were not found to be significant. This was considered to be a surprising finding as, for example, education is said to influence choice of transport mode since higher educated tend to live further away from work and therefore drive a car (Van Acker & Witlox, 2010).

7.2 INFLUENCING THE POTENTIAL USER

From a theoretical point of view several approaches can be applied to overcome the gap between one's intention and behaviour. Multiple researches have pleaded for crucial factors to assure action. Godin, Conner and Sheeran (2005) have argued that the moral norm plays an essential role in bridging the gap. In their research, they have stated that intentions better predict for actual behaviour when the intentions have been based on moral norm. Moral norms could also be termed as personal normative beliefs (Godin, Conner and Sheeran, 2005). However, others have argued that the subjective norm, component of behavioural intention, resembles much of one's own norm as stated in chapter three (Olde Kalter, Harms & Geurs, 2015). It would be complex to distinguish the moral and subjective norm. In other words, could the gap be bridged by moral norm if it simultaneously could be viewed as component of intention?

Reuter et al. (2010) have explained that age modifies the difference between planning an activity and carrying out that activity. Coming of age has positively influenced the decisiveness of people to carry out their intended actions. This might have been one of the factors declaring the average age of 48 among the speed pedelec users. Younger commuters postpone their decisions, according to Reuter et al. (2010). De Groot, Mulder, Das and Manting (2010) did not refer to age as a determinant but life changing events. Ending a relationship, moving in with your partner, child birth or job change could significantly contribute to executing one's intentions (De Groot, Mulder, Das & Manting, 2010). Life changing events appear to not solely have impact on migration patterns, it could also affect mobility patterns. When a life changing event has

occurred, a ‘window of opportunity’ could arise to breakthrough habitual behaviour (Berveling, Olde Kalter, Harms, 2016; Schäfer, Jaeger-Erben, Bamberg, 2012; Verplanken & Roy, 2016). In case of disturbance of old habits, ‘people may be more sensitive to new information and adopt a mind-set that is conducive to behaviour change’ (Verplanken & Roy, 2016, p.133). This evidence of influencing behaviour in times of life changing events, might assist in formulating policy strategies. Commuters have shown to be most vulnerable to interventions under disruptive circumstances.

7.2.1 Determinants per segment

Given the variety of users and the respective mode choice trajectories, user profiling poses a structured way to design potential intervention scenarios. Considering the preceding chapter on behavioural intention of the potential user, a segmentation to current transport modes may reveal deviations in intention. Bamberg and Schmidt (2001) have stated that identifying subgroups with specific sociodemographic and value profiles contributes to the designing of effective intervention programs. Anable (2005) has referred to this as segmentation: defining meaningful sub-groups of individuals. Therefore, groups based on current transport modes have been tested on the indicators of behavioural intention indicators to discover significant divergences. The results are included in appendix 3.

First, within the attitude dimension significant deviations are found. The flexibility indicator is appreciated significantly lower by public transport users than car drivers, cyclists or e-bikers. The latter indicating the highest score on flexibility. Also, comfortably is valued significantly higher by car drivers than cyclists. At last, public transport users and cyclists feel that their mode of transport is contributing to a better living environment. In the perceived behavioural control section for the current transport mode there are also differences visible. Conventional cyclists and e-bike users appreciate the three indicators on costs the highest. Cyclists and e-bike users also suggest that their active transport modes result in more accessibility and have positive effects on their personal health and the living environment. Lastly, the potential user has been asked to verify the attributions of a speed pedelec. Respondents already involved in active modes stated that the speed pedelec would contribute to a shorter travel time. Contemplating health effects and impact on the living environment, current car and public transport users valued the speed pedelec significantly higher. In other words, there is a health gain identified by car and public transport users and not for current (e-) cyclists.

To summarise these facts, table 20 is presented. It offers a quick overview of the differences in behavioural intention of the speed pedelec user and that of the potential user. A preliminary conclusion that we can draw from this is that cyclists and e-bike users might not be triggered by the flexibility argument. Their main gain is found in travel time. In the contrary, public transport users are more sensitive to the flexibility criteria as they feel they have limited flexibility due to travelling by public transport. Car users might feel enthusiasm for the accessibility, health and contribution to the living environment gains. This knowledge could be well integrated in the approach that is extensively researched on and executed by 'Beter Benutten programs' discussed in the section below. Additionally, specific demographic attributes of the various user groups should assist in a thorough frame of the target group.

TABLE 20 INSIGHT IN INTENTION - BEHAVIOUR GAP

	Speed pedelec user	**Potential user**			
		Car user	PT user	Conventional cyclist	E-bike user
Attitude	Flexible Comfortably Relaxing Safety Travel time	Flexible Comfortable	Regard for environment	Flexible Regard for environment	Flexible Regard for environment
Subjective norm	Not significantly contributing to intention	Colleagues	Colleagues	Colleagues	Colleagues
PBC own transport mode			Costs	Costs Accessibility Health Living environment	Costs Accessibility Health Living environment
PBC Speed pedelec	Accessibility Health Living environment	Health Living environment	Travel time	Travel time	Travel time

7.2.2 EXISTING METHODS TO STIMULATE SUSTAINABLE MODES OF TRANSPORT

A practical approach to influencing travel behaviour can be found in methods on mobility management or travel demand management. This may be defined as a concept to stimulate sustainable transport and controlling demand of car use through changing travellers' habits and behaviour (Epomm, n.d.; Litman, 2010). Mobility management specifically concerns managing the demand rather than the supply of mobility (Epomm, n.d.). In the Netherlands, many pilots on

changing behaviour to gain an augmenting number of cyclists have been carried out and evaluated. This has functioned as input for the development of 'het Gedragshuis' designed by the national 'Beter Benutten' program (Ministry of Infrastructure & Environment, 2016). This approach has distinguished four pillars on which a stimulation program should be based: good timing, addressing social influence, attractive and easy to participate. Good timing coheres with the earlier described life changing events and social influence relates to the development of and supporting the moral norm. Next to these ingredients, five process related steps are pointed out presented in figure 14.

The crux of the figure below is the fundament: the initial phase in which the problem is mapped and a strategy to address this problem is selected (Ministry of Infrastructure and Environment, 2016). Components of the fundament are a traffic, environment and behaviour analysis. These all lead to outlining the target group. As this research has demonstrated, the speed pedelec user and usage is different than the average cyclist or e-bike user and their mobility pattern. Therefore, innovative measures should be developed and defining the target group in terms of problem analysis is crucial.

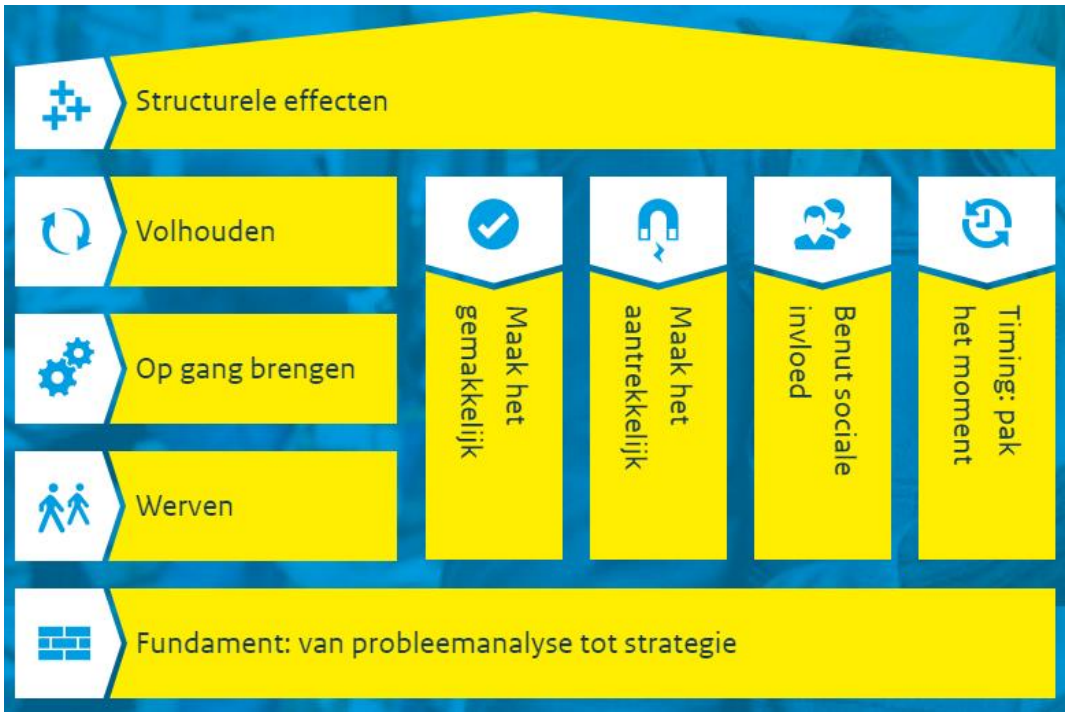

FIGURE 14 'HET GEDRAGSHUIS' (MINISTRY OF INFRASTRUCTURE AND ENVIRONMENT, 2016)

8. CONCLUSION

The final chapter gives answer to the main question and the supporting sub questions. Additionally, the research's contribution to theory, policy and practice will be illustrated. The thesis will be finished with outlining the research's limitations and subsequently recommendations for future research.

8.1 ANSWERS TO THE RESEARCH QUESTION

Before formulating the answer to the research question, the main question will be recalled:

'The aim of this research is to contribute to the expansion of the role of speed pedelecs in commuter traffic in daily urban systems through gaining insights in behavioural intentions of riding a speed pedelec and the perceived needs to successfully ride a speed pedelec.'

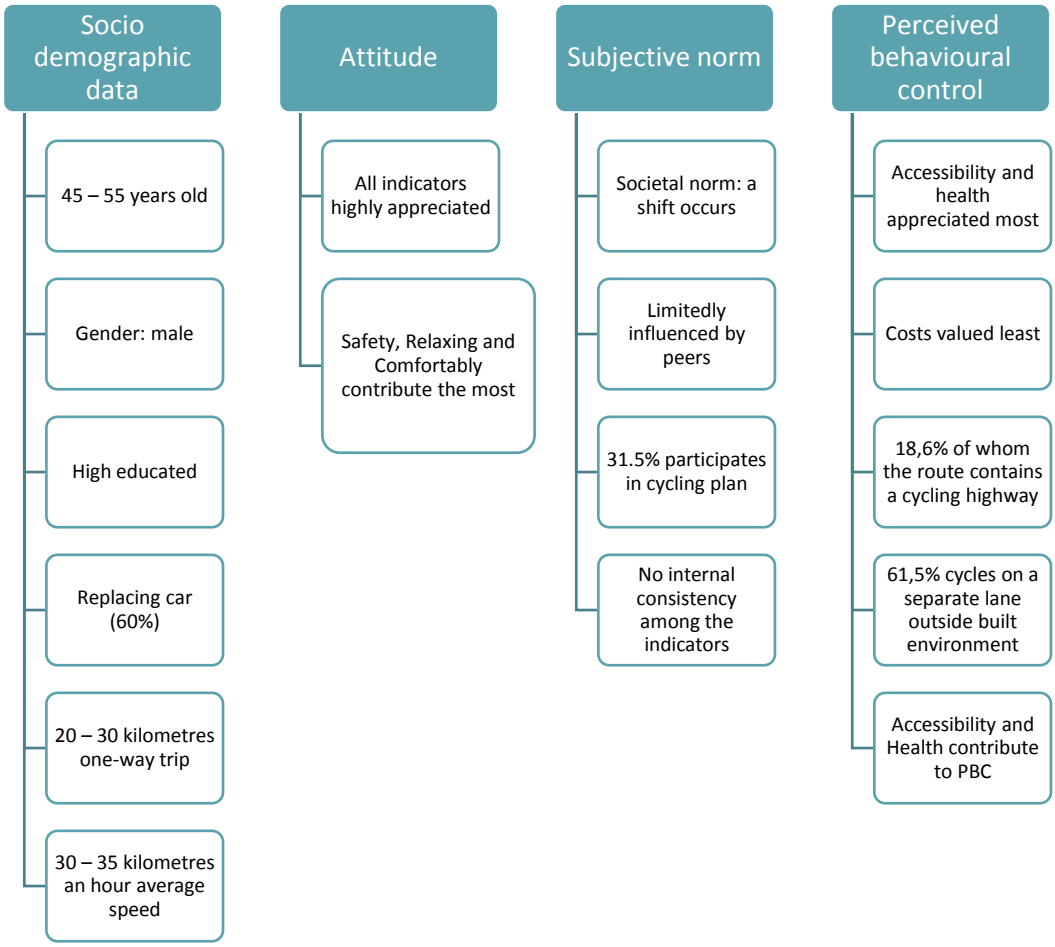

FIGURE 15 SUMMARY OF THE SPEED PEDELECER AND HIS BEHAVIOURAL INTENTION

The insight that is gained on the commuting speed pedelecer and his behavioural intention is captured in figure 15 above. This thesis has demonstrated that the ordinary speed pedelec commuter is a middle aged, highly educated man bridging a distance between 20 – 30 kilometres on an average pace of 30 – 35 km an hour. 60% of the speed pedelec users in commuter traffic have replaced their car and currently employ the speed pedelec for 80% of their trips. As expected when an individual is already carrying out the behaviour, all dimensions confirm the intention to carry out the behaviour. Remarkably, a speed pedelecer attaches value to CO_2 reduction and contribution to a better living environment. It appears that that they are minimally affected by their peers and believe themselves to be precursors of society: they consider the societal norm not yet matching with their behaviour.

The potential user in commuter traffic is a commuter who daily travels 10 – 30 kilometres for a one-way trip. The respondents are equally spread over car, public transport, cyclists and e-bikers. A third of the potential users was unaware of the possibility to utilise a speed pedelec in commuter traffic. Another third was conscious of the opportunity, yet still doubting to try a speed pedelec. It appeared to be rewarding to distinguish groups based on current mode of transport. Present car users have regarded the car as a flexible and comfortably transport mode in commuter traffic and therefore are not susceptible for the flexibility criteria speed pedelecer pose. However, travelling by public transport is not viewed as flexible and therefore a gain can

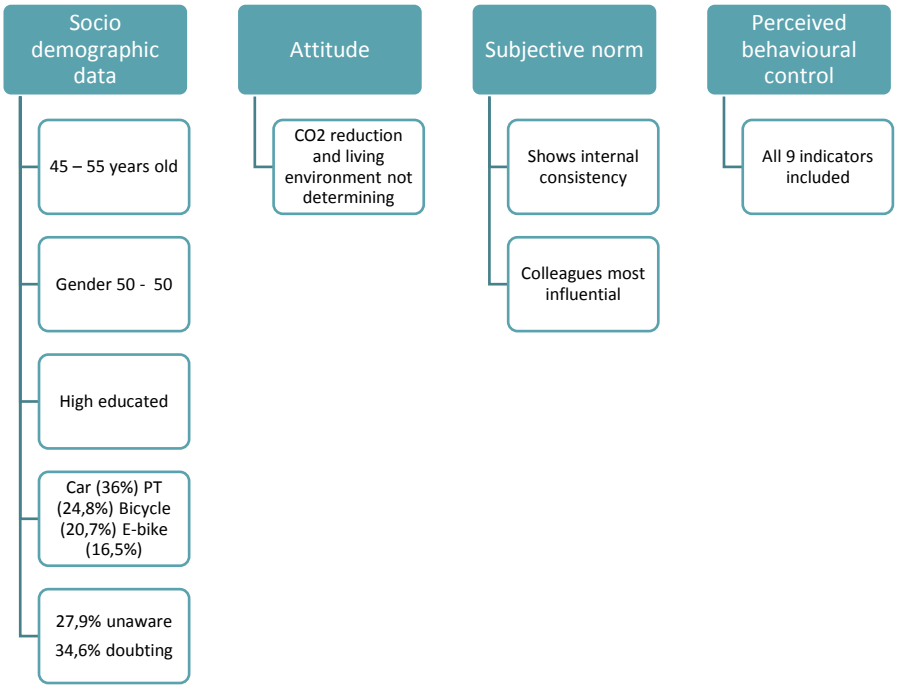

FIGURE 16 SUMMARY OF THE POTENTIAL SPEED PEDELECER AND HIS BEHAVIOURAL INTENTION

be attained here. Car drivers have indicated that their current transport mode is not beneficial for health nor regarding the living environment.

Contemplating the final model, attitude turned out to be the strongest influence on behaviour whereas perceived behavioural control came second. As expounded on in paragraph 3.1.2, the relation between attitude and behaviour is understood to be reciprocal. The known 'test period' approaches used to encourage use of e-bikes could be recommended as well for speed pedelec stimulation. If a commuter has been given the chance to try the speed pedelec, his attitude might turn out to be increasingly positive towards the behaviour and therefore his intention to definitely choose a speed pedelec for commuting might augment. Regarding attitude being the strongest determinant for commuter mode preference, this approach might work effectively.

Reflecting on the position of perceived behavioural control towards behaviour, one should recognise the difference among commuters. There are significant deviations between current commuter transport modes and what they value most within the perceived behavioural control section and what they expect to improve on once riding a speed pedelec. This knowledge could be applied when formulating strategies with help of the 'Beter Benutten' approach on mobility management. The especially designed programs for the various target groups presumably have the best chance in being successful if they are launched during life changing events, the so-called windows of opportunities. These findings might contribute to an increase of speed pedelecers in commuter traffic in the daily urban system, the area where the speed pedelec supposedly fits best.

8.2 CONTRIBUTIONS

The theory of planned behaviour has been applied on mode preference and car use multiple times (Anable, 2005; Olde Kalter, Harms & Geurs, 2015; Scheinzer & Holz-rau, 2007; Schwanen, Banister & Anable, 2012). This is the first time whereby the theory of planned behaviour has been subjected to test for preference active modes or not. Even though the main question asked for the speed pedelec's behavioural intention, it was found necessary to identify the determinants for mode choice preference to bridge the gap for potential users. However, conclusions from this structural equation model are confined in generalisation as the sample's size is arguable. Nonetheless, it is the first research that has incorporated the different varieties of cycles. Characterising the speed pedelec user's behavioural intention has not been done before.

Considering policy, this research has shown the urgency to embed the speed pedelec properly in the urban landscape by its proven contribution to accessibility. It allows people to bridge a distance up to 30 kilometres and therefore connects cities within the daily urban system. Since it is a cycle, it is accommodating any destination as long as the road network provides connections. This thesis proved that 60% of the speed pedelecers used to drive their car to work. A decrease in cars on the road may enhance accessibility in urban areas. As people must put in physical effort, health benefits probably out rule augmented risks. This research has specifically contributed to policy in the sense that outcomes show that stimulation programs for speed pedelec users require a different approach than e-bike users or cyclists. Their travel behaviour is not fully comparable. In specific, policy makers might benefit from the finding that different transport mode groups bring forward varying arguments. Within the Province of Gelderland there is knowledge on the Gedragshuis approach, this has been extensively illustrated in paragraph 7.2. The responsible policy makers could integrate this research's findings within this approach. Moreover, the Province of Gelderland in specific could share the findings with the Mobility Brokers [1] who are responsible for encouraging behavioural change considering commuting behaviour within companies.

For practical situations, this research's outcomes have offered marketing directives to address the potential speed pedelec commuter. Moreover, it has provided insight in the controversy on the right place for the speed pedelecer on the road. Like previous research, it became visible that the speed pedelecer's average speed is between 30 and 35 kilometres per hour. This is significantly lower than the 45 kilometres per hour for which the law change has been designed. These findings strengthen doubts on the Ministry determined law change activated on the 1st of January 2017 and which will be fully effective from 1st of July 2017.

8.3 LIMITATIONS

A first limitation to this research that should be emphasised considers the respondents that have been included. Exclusively commuters have been questioned on their travel behaviour. Either those who already travel by speed pedelec or the potential group currently employing another mode of transport for commuting. This implies that this research has not integrated recreational trips by the speed pedelec. Therefore, stimulating programs that may be designed based on this

[1] Mobility broker is illustrated in the glossary

research's outcomes only may be applied to potential commuters on the designated distance of 10 – 30 kilometres.

Another limitation concerns the survey among the potential user group considering the discussion on stated versus revealed preference. The former refers to claims on executing a behaviour without performing that behaviour and the latter to attitudes and preferences based on actual behaviour (Olde-Kalter, Harms & Geurs, 2015). This implies that the attitude of potential speed pedelec commuters towards speed pedelecs may not conform their future behaviour. On top of this, designing campaigns could use more profound research to delineate the potential user groups even further. Latent class analysis might reveal the socio demographic characteristics among potential user groups.

The surveys are both conducted on national scale. This implies that the survey's outcomes are not representative for one specific region. This while it is suggested that cycling policy differs per area as contextual factors determine what works best (Oldenziel, Emanuel, De la Bruhèze & Veraart, 2016). In the Netherlands, there are differences visible between regions. Not every area has developed the same level of cycling highways for example. Nevertheless, differences will be minor as speed pedelecers have to cycle on car tracks within the built environment since 1st of January. The argument of cycling infrastructure does not fully apply anymore for speed pedelecers.

The model on mode choice preference is not significant. Causes may be found in the indicators and variables that were integrated in the questionnaire. Furthermore, the dataset of potential users would have led to better conclusions if it was larger. In the total dataset speed pedelecs comprise almost 50% of the dataset while in reality the speed pedelec commuter group is a minority in commuter traffic. Future research could bring in extra knowledge to develop these questionnaires and gather a larger dataset. On top of this, the conclusion cannot be generalised without noting that it cannot be guaranteed that the sample represents all speed pedelec users in the Netherlands. Since it concerned a non-probabilistic sample whereby it is indistinct how large the total population is.

8.4 CRITICAL REFLECTION

This thesis has functioned as the closure of the Master Local and Regional Planning in the Netherlands. Besides aiming for results, it has also been a learning process in doing research. Therefore a critical reflection is appropriate to improve as a scientist and researcher.

First of all, the designing of the surveys could have been done more profoundly. Established research has been addressed and indicators have been derived from literature. However, more time could have put into formulation of the indicators. Terms as contribution to living environment may not always be understood or interpreted equally by respondents. Moreover, the surveys' links have been spread without a profound action plan. This resulted in a time consuming period of waiting and putting effort in reaching people. Beforehand, a list of names was constructed with whom the link could be shared. However, this appeared not to be enough and I had to be creative in finding more respondents.

Secondly, the research proposal incorporated a mixed-method approach to find the answers to the new phenomenon of the speed pedelec. However, throughout the process it became apparent that quantitative methods would serve the purpose better. It took some time to realise this and adjust the plan towards a fully quantitative research. Nevertheless, it has led to an improvement of quantitative research skills and valuable data.

All in all, it has been worthwhile to carry out this research in commission of the Province of Gelderland. This has created chances to expose the research and learn more on the policy aspects around this new mode of transport. It has put the results and a vision for the speed pedelec into perspective.

8.5 THE FUTURE OF THE SPEED PEDELEC

The speed pedelec offers great potential in contributing to sustainability and accessibility matters considering commuter trips between 10 – 30 kilometres. It may be a good competitor to other transport modes on this distance. With minor effort compared to the conventional bicycle it enables the commuter to bridge longer distances: guaranteeing a reliable travel time, improving health conditions, improving accessibility and flexibility compared to car use or public transport use and reducing CO_2 emission when the speed pedelecs replaces car trips. However, its potential

is limited by the legal barriers that are implemented since January 2017 and the uncertainty evolving from implementing these regulations.

To encourage speed pedelec use for commuting, policy makers should guarantee that the speed pedelec may be considered as a convenient and comfortable mode of transport by putting effort in certain regulations. For example, as a result of the new law some parts of the cycle highway are prohibited for speed pedelecers. This holds that continuity and convenience of such a route has decreased. While cycling highways were intended for cyclists who wanted to bridge longer distances with high speed. Moreover, it may be recommended to disseminate the speed pedelec regulations in general, to all traffic participants. This might take away uncertainty and ignorance on this new mode of transport. The potential commuter group has estimated the costs to be fairly high. A big stimulus may arise when the government decides to financially support commuters when buying a speed pedelec.

All in all, encouraging speed pedelecs in commuter traffic does not involve large scale infrastructure investments but requires specified stimulation programs which may result into enhanced accessibility and improved commuter's health. In other words, if the government would make it financially attractive and communicate on all the opportunities a speed pedelec offers, moving on to the active modes would be encouraged and a shift towards a sustainable mobility system will be accomplished.

GLOSSARY

Concept	Description
Daily Urban System	An area consisting of one or more urban cores and their relational sphere by determining the commuters travelling back and forth to this centre or these centres
E-bike	Also known as pedelec: a power assisted bicycle up to 25 km/h
Gedragshuis	Method on mobility management designed by national program Beter Benutten.
High speed e-bike	Referred to as speed pedelec: a power assisted bicycle up to 45 km/h
KiM	Knowledge Institute for Mobility, a Dutch research institute linked to the ministry of Infrastructure and Environment
Mobility broker	In Dutch referred to as mobiliteitsmakelaar. This person has the task to inform and advise companies on their mobility plans with the specific goals to encourage active modes of transport and change behaviour to reduce the number of people in rush hours.
PBC	Perceived behavioural control, one of the determining dimensions of behavioural intention
Pedelec	Referred to as e-bike: a power assisted bicycle up to 25 km/h
Potential user	A commuter that travels 10 – 30 kilometres on a single trip between home and work and up to now does not use a speed pedelec as a mode of transport
SEM	Structural equation model
Speed pedelec	Also known as high speed e-bike: a power assisted bicycle up to 45 km/h
Speed pedelecers	Travellers using a speed pedelec as means of transport in commuter traffic
TPB	Theory of Planned Behaviour as designed by Ajzen (1991)

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APPENDICES

A. THE SPEED PEDELEC USER SURVEY

Intro Allereerst hartelijk bedankt dat u de tijd wil nemen om een bijdrage te leveren aan het onderzoek naar het gedrag van speed pedelec gebruikers en wat beleidsmakers hiermee kunnen doen. Deze enquête is uitsluitend bedoeld voor mensen die in het bezit zijn van een speed pedelec (high speed e-bike, een snelheid mogelijk tot 45 km per uur) of er een leasen en deze voornamelijk gebruiken in het woon-werkverkeer. De vragenlijst zal gaan over u als type reiziger en waarom u de speed pedelec heeft uitgekozen als vervoersmiddel. De informatie die hieruit voortkomt zal een bijdrage leveren aan onderzoek naar hoe andere reizigers gestimuleerd kunnen worden om te kiezen voor de speed pedelec. Het beantwoorden van de vragen zal u ongeveer tien minuten kosten. Druk volgende om te starten met de enquête.

Leeftijd 1. Wat is uw leeftijd?

Geslacht 2. Wat is uw geslacht?

- ❍ Man (1)
- ❍ Vrouw (2)

Opleiding 3. Wat is uw hoogst voltooide opleiding?

- ❍ Geen opleiding (1)
- ❍ Lagere school / basisonderwijs (2)
- ❍ Middelbaar onderwijs (3)
- ❍ MBO (4)
- ❍ HBO (5)
- ❍ Universiteit (6)

Rijbewijs 4. Heeft u een rijbewijs?

- ❍ Ja (1)
- ❍ Nee (0)

Auto 5. Heeft u een auto ter beschikking?

- ❍ Ja (1)
- ❍ Nee (0)

Vervoer 6. Van welk vervoersmiddel maakte u hoofdzakelijk gebruik in het woon-werkverkeer voordat u de speed pedelec gebruikte?

- ❍ Auto (alleen reizen) (1)
- ❍ Auto (carpoolen) (2)
- ❍ Openbaar vervoer (3)
- ❍ Scooter, bromfiets of snorfiets (4)
- ❍ Fiets (5)
- ❍ Elektrische fiets (6)
- ❍ Te voet (7)

Werkdagen 7. Hoeveel dagen in de week werkt u gemiddeld?

- 1 dag (1)
- 2 dagen (2)
- 3 dagen (3)
- 4 dagen (4)
- 5 dagen (5)

T Het volgende blok zal gaan over uw gebruik van uw speed pedelec en wat u er van vindt. Druk op volgende om door te gaan met de enquête.

Type_SP 8. Wat voor een merk speed pedelec heeft u?

Bezit_SP 9. Hoe lang bezit u al een speed pedelec?

- Korter dan 6 maanden (1)
- 6 - 12 maanden (2)
- 1 tot 2 jaar (3)
- Meer dan twee jaar (4)

Reisdagen_SP 10. Hoe vaak in de week reist u gemiddeld per speed pedelec naar uw werk?

- 1 dag (1)
- 2 dagen (2)
- 3 dagen (3)
- 4 dagen (4)
- 5 dagen (5)

Afstand_SP 11. Welke afstand legt u enkele reis af tussen uw woon- en werkadres?

- < 10 kilometer (1)
- 11 - 15 kilometer (2)
- 16 - 20 kilometer (3)
- 21 - 25 kilometer (4)
- 25 > kilometer (5)

Houding_SP 12. Geef bij de volgende stellingen aan in welke mate u het eens bent.

	Zeer oneens (1)	Oneens (2)	Neutraal (3)	Eens (4)	Zeer eens (5)
Ik vind de speed pedelec een flexibel vervoersmiddel (1)	❍	❍	❍	❍	❍
Ik vind de speed pedelec een comfortabel vervoersmiddel (2)	❍	❍	❍	❍	❍
Ik vind de speed pedelec een ontspannend vervoersmiddel (3)	❍	❍	❍	❍	❍
Ik vind de speed pedelec een veilig vervoersmiddel (4)	❍	❍	❍	❍	❍
Ik ben tevreden met de reistijd op mijn speed pedelec (5)	❍	❍	❍	❍	❍
Ik vind het belangrijk dat mijn speed pedelec elektrisch is aangedreven en niet op benzine (6)	❍	❍	❍	❍	❍
Ik vind dat mijn speed pedelec zorgt voor een betere leefomgeving (7)	❍	❍	❍	❍	❍

Snelheid_SP 13. Wat is uw gemiddelde rijsnelheid?

- < 25 km per uur (1)
- 26 - 30 km per uur (2)
- 31 - 35 km per uur (3)
- 36 - 40 km per uur (4)
- 41 - 45 km per uur (5)
- Weet ik niet (9)

Vervoer_SP 14. Gebruikt u nog andere vervoerswijzen tijdens uw reis naar werk?

- Ja, ik reis ook een deel met de auto (1)
- Ja, ik reis ook een deel met het openbaar vervoer (2)
- Nee, ik reis de complete reis op mijn speed pedelec (0)

Doeleinden_SP 15. Gebruikt u de speed pedelec nog voor andere doeleinden dan woon-werkverkeer?

- Ja (1)
- Nee (0)

If Nee Is Selected, Then Skip To End of Block

Doeleinden2_SP 16. Waar gebruikt u de speed pedelec dan nog meer voor, naast woon-werkverkeer?

T Het volgende blok bevat twee vragen over de normen in Nederland. Druk op volgende om door te gaan.

Bewustzijn_SN 17. Geef aan in hoeverre u vindt dat de gemiddelde Nederlander bezig is met het milieu.

- Matig, mensen zijn er maar weinig mee bezig. (1)
- Redelijk, er is bewustzijn maar dit lijkt nog niet overal door te zetten in acties. (2)
- Sterk, er is bewustzijn in de maatschappij en dit zie je terug in ontwikkelingen op alle gebieden. (3)

Beleid_SN 18. Vindt u dat er in Nederland aandacht wordt geschonken aan duurzame mobiliteit?

- Nee, ik vind dat de focus te veel op ouderwetse vervoerswijzen ligt. (1)
- Ja, ik vind dat er een verschuiving merkbaar is naar duurzame mobiliteit. (2)
- Ja, ik merk dat er steeds meer alternatieve vervoerswijzen zijn en ze worden veel gebruikt. (3)

T Het volgende blok bevat vragen over uw omgeving en hun gebruik van de speed pedelec. Druk op volgende om door te gaan met de enquête.

Peerinfluence_SN 19. Wie heeft u beïnvloed in de keuze voor uw speed pedelec?

	Zeer sterk (5)	Redelijk (4)	Neutraal (3)	Nauwelijks (2)	Niet (1)
Partner (1)	❍	❍	❍	❍	❍
Buren (2)	❍	❍	❍	❍	❍
Familie (3)	❍	❍	❍	❍	❍
Vrienden (4)	❍	❍	❍	❍	❍
Collega's (5)	❍	❍	❍	❍	❍

Peerinfluence2_SN 20. Wie heeft er in uw omgeving een speed pedelec?

	Bezit speed pedelec	
	Ja (1)	Nee (0)
Partner (1)	❍	❍
Buren (2)	❍	❍
Familie (3)	❍	❍
Vrienden (4)	❍	❍
Collega's (5)	❍	❍

Aantalmensen_SN 21. Hoeveel mensen gebruiken er in uw sociale netwerk een speed pedelec?

_____ Partner (1)
_____ Buren (2)
_____ Familie (3)
_____ Vrienden (4)
_____ Collega's (5)

Fietsplan_SN 22. Kunt u op uw werk deelnemen aan een fietsplan of fietsstimuleringsprogramma?

- ❍ Ja, maar ik maak er geen gebruik van (1)
- ❍ Ja, ik heb er gebruik van gemaakt ten tijde van de aanschaf en/of ik maak er nog steeds gebruik van. (2)
- ❍ Nee, er is geen fietsstimuleringsprogramma of iets soortgelijks. (0)
- ❍ Ik weet het niet (9)

If Nee, er is geen fietsstimul... Is Selected, Then Skip To End of BlockIf Ik weet het niet Is Selected, Then Skip To End of Block

Collegas_SN 23. Nemen uw directe collega's deel aan dit fietsstimuleringsplan?

- ❍ Ja (1)
- ❍ Nee (0)
- ❍ Weet ik niet (9)

If Ja Is Not Selected, Then Skip To End of Block

Deelnamecollegas_SN 24. Heeft de deelname van uw collega's aan het fietsstimuleringsprogramma uw keuze voor deelname aan het fietsstimuleringsprogramma beïnvloed?

- ❍ Ja (1)
- ❍ Nee (0)

T Het laatste blok zal gaan over uw mogelijkheden en gewoontes qua mobiliteit en de speed pedelec. Druk op volgende om door te gaan met de enquête.

Utility_PBC 25. Hoe zou u de speed pedelec beoordelen op de onderstaande aspecten?

	Zeer slecht (1)	Matig (2)	Neutraal (3)	Redelijk (4)	Zeer goed (5)
Aanschafkosten (1)	❍	❍	❍	❍	❍
Onderhoudskosten (2)	❍	❍	❍	❍	❍
Wegenbelasting (3)	❍	❍	❍	❍	❍
Reistijd (4)	❍	❍	❍	❍	❍
Bereikbaarheid werkadres (5)	❍	❍	❍	❍	❍
Bereikbaarheid woonadres (6)	❍	❍	❍	❍	❍
Eigen fysieke gezondheid (7)	❍	❍	❍	❍	❍
Eigen mentale gezondheid (8)	❍	❍	❍	❍	❍
Leefomgeving (9)	❍	❍	❍	❍	❍

Gewoonte_PBC 26. Heeft u altijd al veel gefietst naar school, studie en of werk?

- ❍ Ja, zeer veel (5)
- ❍ Ja, vaak (4)
- ❍ Neutraal (3)
- ❍ Nee, nauwelijks (2)
- ❍ Nee, nooit (1)

Sport_PBC 27. Bent u actief lid van een sportvereniging, sportschool of oefengroep?

- ❍ Ja, ik sport één of meerdere keren in de week (1)
- ❍ Ja, ik sport af en toe (2)
- ❍ Nee, ik sport niet (0)

Snelfiets_PBC 28. Rijdt u tijdens uw woon-werk route over een snelfietsroute?

- ❍ Ja, ik rijd over een snelfietsroute (1)
- ❍ Nee, deze is niet in de buurt van mijn route (2)
- ❍ Nee, ik fiets hier bewust niet over (0)

Rijbaan_PBC 29. Uit wat voor een soort rijbaan bestaat uw route hoofdzakelijk?

- ❍ Vrijliggend fietspad buiten de bebouwde kom (1)
- ❍ Vrijliggend fietspad binnen de bebouwde kom (2)
- ❍ 60 kilometer wegen buiten de bebouwde kom (3)
- ❍ 50 kilometer wegen binnen de bebouwde kom (4)

PBC 30. Geef aan of je het eens of oneens bent met de volgende stellingen.

	Zeer eens (1)	Eens (2)	Neutraal (3)	Oneens (4)	Zeer oneens (5)
Ik achtte mijzelf voor de aanschaf van de speed pedelec fit genoeg om er mee te fietsen in het woon-werkverkeer. (1)	❍	❍	❍	❍	❍
Ik vind de infrastructuur rond en op mijn route voldoende ontwikkeld voor speed pedelecs. (2)	❍	❍	❍	❍	❍
Ik vind dat er te veel stoplichten of andere elementen op mijn route staan die te veel tijd kosten. (3)	❍	❍	❍	❍	❍
Ik vind de speed pedelec een bovengemiddeld dure aanschaf. (4)	❍	❍	❍	❍	❍

Wet_PBC 31. Bent u op de hoogte van de wet- en regelgeving die vanaf 1 januari 2017 van kracht is voor de speed pedelec?

- ❍ Ja, ik ben op de hoogte van de consequenties van de veranderende wet- en regelgeving (1)
- ❍ Ja, ik ben op de hoogte dat er iets verandert voor de speed pedelec maar ik weet niet precies wat. (2)
- ❍ Nee, tot op heden heb ik niets geweten van veranderende wet- en regelgeving met betrekking tot de speed pedelec. (0)

If Ja, ik ben op de hoogte van... Is Not Selected, Then Skip To End of Block

Gevolgenwet_PBC 32. Geef bij deze aan waar u denkt dat voor u problemen ontstaan door de nieuwe wetgeving vanaf 1 januari 2017.

	Helemaal eens (1)	Eens (2)	Neutraal (3)	Oneens (4)	Helemaal Oneens (5)
De nieuw ontwikkelde helm zorgt er voor dat ik mij minder prettig voel op mijn fiets. (1)	❍	❍	❍	❍	❍
Het is voor mij duidelijk waar ik vanaf 1 januari 2017 mag gaan fietsen met mijn speed pedelec. (2)	❍	❍	❍	❍	❍
Indien ik op een 50 kilometer weg moet mengen met autoverkeer, voel ik mij nog steeds veilig op mijn speed pedelec. (3)	❍	❍	❍	❍	❍
Ik ga de nieuw ontwikkelde helm dragen. (4)	❍	❍	❍	❍	❍
Het gele kentekenplaatje lijkt mij een belemmering voor de aanschaf voor nieuwe gebruikers. (5)	❍	❍	❍	❍	❍
Andere fietsers ondervinden geen hinder wanneer er steeds meer speed pedelecs op het fietspad zijn. (6)	❍	❍	❍	❍	❍
De toenemende kosten (verzekering en belasting) zijn belemmerend voor nieuwe gebruikers. (7)	❍	❍	❍	❍	❍

Vervolg Hartelijk bedankt voor het invullen van de enquête. Indien u bereid bent om mee te werken aan het vervolg op deze enquête of hier eerst meer informatie over wil, vult u dan uw e-mailadres en woon-werkgebied in.

B. THE POTENTIAL USER SURVEY

Intro Allereerst hartelijk bedankt dat u de tijd wil nemen om een bijdrage te leveren aan het onderzoek naar het gedrag van zowel speed pedelec gebruikers als niet speed pedelec gebruikers en wat beleidsmakers hiermee kunnen doen. Deze enquête is uitsluitend bedoeld voor mensen die geen speed pedelec gebruik en/of hebben. Bovendien gaat het om woon-werkverplaatsingen tussen 10 - 30 kilometer enkele reis. De vragenlijst zal gaan over u als reiziger en wat u belangrijk vindt aan een vervoersmiddel. De informatie die hieruit voortkomt zullen alleen gebruikt worden voor een onderzoek naar hoe reizigers gestimuleerd kunnen worden om te kiezen voor de speed pedelec. Het beantwoorden van de vragen zal u ongeveer tien minuten kosten. Druk volgende om te starten met de enquête.

SCR1 Bent in u in het bezit van een speed pedelec?

- ❍ Ja (1)
- ❍ Nee (2)

If Ja Is Selected, Then Skip To End of Survey

SCR2 Welke afstand legt u enkele reis af tussen uw woon - en werkadres?

- ❍ < 10 kilometer (1)
- ❍ 10 - 15 kilometer (2)
- ❍ 16 - 20 kilometer (3)
- ❍ 21 - 25 kilometer (4)
- ❍ 26 - 30 kilometer (5)
- ❍ > 30 kilometer (6)

If < 10 kilometer Is Selected, Then Skip To End of SurveyIf > 30 kilometer Is Selected, Then Skip To End of Survey

Leeftijd 1. Wat is uw leeftijd?

Geslacht 2. Wat is uw geslacht?

- ❍ Man (1)
- ❍ Vrouw (2)

Opleiding 3. Wat is uw hoogst voltooide opleiding?

- ❍ Geen opleiding (1)
- ❍ Lagere school / basisonderwijs (2)
- ❍ Middelbaar onderwijs (3)
- ❍ MBO (4)
- ❍ HBO (5)
- ❍ Universiteit (6)

Nationaliteit 4. Wat is uw nationaliteit?

- ❍ Nederlands (geboren) (1)
- ❍ Nederlands (genaturaliseerd) (2)
- ❍ Dubbele nationaliteit (3)
- ❍ Andere EU landen (4)
- ❍ Anders, (5) _____

Rijbewijs 5. Heeft u een rijbewijs?

- ❍ Ja (1)
- ❍ Nee (0)

Auto 6. Heeft u een auto ter beschikking?

- ❍ Ja (1)
- ❍ Nee (0)

Ebike 7. Heeft u een reguliere e-bike (tot en met 25 kilometer per uur) of een ander vervoersmiddel met trapondersteuning tot uw beschikking?

- ❍ Ja (1)
- ❍ Nee (2)

Werkdagen 8. Hoeveel dagen in de week werkt u gemiddeld?

- ❍ 1 dag (1)
- ❍ 2 dagen (2)
- ❍ 3 dagen (3)
- ❍ 4 dagen (4)
- ❍ 5 dagen (5)

T Het volgende blok zal gaan over uw huidige reisgedrag en uw houding ten opzichte van mobiliteit.

Vervoer_SP 9. Gebruikt u meerdere vervoerswijzen tijdens uw reis naar werk?

- ❍ Ja, ik combineer fietsen en/of lopen met openbaar vervoer (1)
- ❍ Ja, ik combineer de auto met openbaar vervoer (2)
- ❍ Nee, ik reis de complete reis met hetzelfde vervoersmiddel (0)
- ❍ Ja, ik combineer fietsen en/of lopen met de auto (3)

Vervoer_SP 10. Van welk vervoersmiddel maakt u voor het grootste deel gebruik in het woon-werkverkeer?

- ❍ Auto (alleen reizen) (1)
- ❍ Auto (carpoolen) (2)
- ❍ Openbaar vervoer (3)
- ❍ Scooter, bromfiets of snorfiets (4)
- ❍ Fiets (5)
- ❍ Elektrische fiets (6)
- ❍ Te voet (7)

Werkdagen2 11. Hoeveel dagen in de week maakt u gebruik van het vervoersmiddel dat u hoofdzakelijk gebruikt in het woon-werkverkeer?

- ❍ 1 dag (1)
- ❍ 2 dagen (2)
- ❍ 3 dagen (3)
- ❍ 4 dagen (4)
- ❍ 5 dagen (5)

Snelheid_SP 12. Wat is uw gemiddelde rijsnelheid?

- ❍ < 25 km per uur (1)
- ❍ 26 - 30 km per uur (2)
- ❍ 31 - 35 km per uur (3)
- ❍ 36 - 40 km per uur (4)
- ❍ 41 - 45 km per uur (5)
- ❍ > 45 km per uur (6)
- ❍ Weet ik niet (9)

T De volgende vraag zal gaan over uw mening over de speed pedelec (high speed e-bike). Dit is een fiets die elektrisch wordt ondersteund en in theorie 45 kilometer per uur kan redden. Onderzoeken wijzen uit dat de gemiddelde behaalde snelheid 35 kilometer per uur is als er geen kruispunten of stoplichten zijn.

Overweging_SP 13. Welke van onderstaande statements beschrijft u het best over het vervangen van uw vervoersmiddel door een speed pedelec in het woon-werkverkeer?

- ❍ Ik heb hier eigenlijk nog niet aan gedacht (3)
- ❍ Ik ben mij bewust van de mogelijkheid maar heb nog geen keuze gemaakt of ik het wil uitproberen (4)
- ❍ Ik heb het overwogen om te proberen en besloten om het niet te doen (2)
- ❍ Ik heb de speed pedelec gebruikt, en ik twijfel of ik het zal blijven doen (5)
- ❍ Ik heb de speed pedelec uitgeprobeerd, en wil het niet gaan gebruiken (1)

Overweging2_SP 14. Waarom heeft u de speed pedelec nog niet uitgeprobeerd of twijfelt u nog?

Houding_SP 15. De volgende stellingen hebben betrekking op het vervoersmiddel waarmee u nu het grootste deel aflegt in woon-werkverkeer (antwoord vraag 10). Geef bij iedere stelling aan in welke mate u het eens bent.

	Zeer oneens (1)	Oneens (2)	Neutraal (3)	Eens (4)	Zeer eens (5)	Weet ik niet (9)
Ik vind mijn vervoersmiddel flexibel (1)	❍	❍	❍	❍	❍	❍
Ik vind mijn vervoersmiddel comfortabel (2)	❍	❍	❍	❍	❍	❍
Ik vind mijn vervoersmiddel ontspannend (3)	❍	❍	❍	❍	❍	❍
Ik vind mijn vervoersmiddel veilig (4)	❍	❍	❍	❍	❍	❍
Ik ben tevreden met de reistijd met mijn vervoersmiddel (5)	❍	❍	❍	❍	❍	❍
Ik vind het belangrijk dat mijn speed pedelec elektrisch is aangedreven en niet op benzine (6)	❍	❍	❍	❍	❍	❍
Ik vind dat mijn vervoersmiddel zorgt voor een betere leefomgeving (7)	❍	❍	❍	❍	❍	❍

T Het volgende blok bevat twee vragen over de normen in Nederland. Druk op volgende om door te gaan.

Bewustzijn_SN 16. Geef aan in hoeverre u vindt dat de gemiddelde Nederlander bezig is met het milieu.

- ❍ Matig, mensen zijn er maar weinig mee bezig. (1)
- ❍ Redelijk, er is bewustzijn maar dit lijkt nog niet overal door te zetten in acties. (2)
- ❍ Sterk, er is bewustzijn in de maatschappij en dit zie je terug in ontwikkelingen op alle gebieden. (3)

Beleid_SN 17. Vindt u dat er in Nederland aandacht wordt geschonken aan duurzame mobiliteit?

- ❍ Nee, ik vind dat de focus te veel op ouderwetse vervoerswijzen ligt. (1)
- ❍ Ja, ik vind dat er een verschuiving merkbaar is naar duurzame mobiliteit. (2)
- ❍ Ja, ik merk dat er steeds meer alternatieve vervoerswijzen zijn en ze worden veel gebruikt. (3)

T Het volgende blok bevat vragen over de mensen in uw omgeving en hun vervoerswijzen. Druk op volgende om door te gaan met de enquête.

Peerinfluence_SN 18. Wie heeft u beïnvloed in de keuze voor het huidige vervoersmiddel die u hoofdzakelijk gebruikt in woon-werkverkeer?

	Zeer sterk (5)	Redelijk (4)	Neutraal (3)	Nauwelijks (2)	Niet (1)
Partner (1)	❍	❍	❍	❍	❍
Buren (2)	❍	❍	❍	❍	❍
Familie (3)	❍	❍	❍	❍	❍
Vrienden (4)	❍	❍	❍	❍	❍
Collega's (5)	❍	❍	❍	❍	❍

Peerinfluence2_SN 19. Heeft er iemand in uw omgeving een speed pedelec?

	Bezit speed pedelec	
	Ja (1)	Nee (0)
Partner (1)	❍	❍
Buren (2)	❍	❍
Familie (3)	❍	❍
Vrienden (4)	❍	❍
Collega's (5)	❍	❍

Aantalmensen_SN 20. Hoeveel mensen gebruiken er in uw sociale netwerk een speed pedelec?

_____ Partner (1)
_____ Buren (2)
_____ Familie (3)
_____ Vrienden (4)
_____ Collega's (5)

Fietsplan_SN 21. Kunt u op uw werk deelnemen aan een fietsplan of fietsstimuleringsprogramma?

- ❍ Ja, maar ik maak er geen gebruik van (1)
- ❍ Ja, ik heb er gebruik van gemaakt ten tijde van de aanschaf en/of ik maak er nog steeds gebruik van (2)
- ❍ Nee, er is geen fietsstimuleringsprogramma of iets soortgelijks (0)
- ❍ Ik weet het niet (9)

If Nee, er is geen fietsstimul... Is Selected, Then Skip To End of BlockIf Ik weet het niet Is Selected, Then Skip To End of Block

Collegas_SN 22. Nemen uw directe collega's deel aan dit fietsstimuleringsplan?

- ❍ Ja (1)
- ❍ Nee (0)
- ❍ Weet ik niet (9)

If Ja Is Not Selected, Then Skip To End of Block

Deelnamecollegas_SN 23. Heeft de deelname van uw collega's aan het fietsstimuleringsprogramma uw keuze voor deelname aan het fietsstimuleringsprogramma beïnvloed?

- ❍ Ja (1)
- ❍ Nee (0)

T Het laatste blok zal gaan over uw mogelijkheden en gewoontes qua mobiliteit en de speed pedelec. Druk op volgende om door te gaan met de enquête.

UtilityEV_PBC 24. Hoe zou u in het algemeen uw vervoersmiddel die u voor het grootste deel gebruikt in woon-werkverkeer beoordelen op de onderstaande aspecten?

	Zeer slecht (1)	Matig (2)	Neutraal (3)	Redelijk (4)	Zeer goed (5)	Weet ik niet (9)
Aanschafkosten (1)	❍	❍	❍	❍	❍	❍
Onderhoudskosten (2)	❍	❍	❍	❍	❍	❍
Wegenbelasting (3)	❍	❍	❍	❍	❍	❍
Reistijd (4)	❍	❍	❍	❍	❍	❍
Bereikbaarheid werkadres (5)	❍	❍	❍	❍	❍	❍
Bereikbaarheid woonadres (6)	❍	❍	❍	❍	❍	❍
Eigen fysieke gezondheid (7)	❍	❍	❍	❍	❍	❍
Eigen mentale gezondheid (8)	❍	❍	❍	❍	❍	❍
Leefomgeving (9)	❍	❍	❍	❍	❍	❍

UtilitySP_PBC 25. Hoe zou u in het algemeen de speed pedelec beoordelen op de onderstaande aspecten?

	Zeer slecht (1)	Matig (2)	Neutraal (3)	Redelijk (4)	Zeer goed (5)	Weet ik niet (9)
Aanschafkosten (1)	❍	❍	❍	❍	❍	❍
Onderhoudskosten (2)	❍	❍	❍	❍	❍	❍
Wegenbelasting (3)	❍	❍	❍	❍	❍	❍
Reistijd (4)	❍	❍	❍	❍	❍	❍
Bereikbaarheid werkadres (5)	❍	❍	❍	❍	❍	❍
Bereikbaarheid woonadres (6)	❍	❍	❍	❍	❍	❍
Eigen fysieke gezondheid (7)	❍	❍	❍	❍	❍	❍
Eigen mentale gezondheid (8)	❍	❍	❍	❍	❍	❍
Leefomgeving (9)	❍	❍	❍	❍	❍	❍

Gewoonte_PBC 26. Heeft u altijd veel gefietst naar school, studie en of werk?

- ❍ Ja, zeer veel (5)
- ❍ Ja, vaak (4)
- ❍ Neutraal (3)
- ❍ Nee, nauwelijks (2)
- ❍ Nee, nooit (1)

Sport_PBC 27. Bent u actief lid van een sportvereniging, sportschool of oefengroep?

- ❍ Ja, ik sport één of meerdere keren in de week (1)
- ❍ Ja, ik sport af en toe (2)
- ❍ Nee, ik sport niet (0)

Snelfiets_PBC 28. Ligt er in de buurt van uw route tussen uw woon- en werkadres een snelfietsroute?

- ❍ Ja, ik weet dat er een snelfietsroute is (1)
- ❍ Nee, deze is niet in de buurt van mijn route (2)
- ❍ Ik weet niet of dit er is (0)

PBC 29. Geef aan of je het eens of oneens bent met de volgende stellingen.

	Zeer eens (1)	Eens (2)	Neutraal (3)	Oneens (4)	Zeer oneens (5)	Weet ik niet (6)
Ik ben fit genoeg om met een speed pedelec te fietsen in het woon-werkverkeer. (1)	❍	❍	❍	❍	❍	❍
De infrastructuur tussen mijn woon- en werkadres is voldoende ontwikkeld voor het gebruik van een speed pedelec. (2)	❍	❍	❍	❍	❍	❍
Er zijn te veel stoplichten of andere elementen op mijn potentiële route die te veel tijd kosten wanneer ik met een speed pedelec ga. (3)	❍	❍	❍	❍	❍	❍
De speed pedelec is een bovengemiddeld dure aanschaf. (4)	❍	❍	❍	❍	❍	❍

Mening 30. Wat is uw algemene mening over de speed pedelec?

- ❍ Weet ik niet (9)
- ❍ Positief, want (1) _____
- ❍ Negatief, want (0) _____

Aanschaf 31. Denkt u erover om een speed pedelec aan te schaffen voor het woon-werkverkeer?

- ❍ Nee, want (0) _____
- ❍ Ja, want (1) _____
- ❍ Weet ik niet, want (9) _____

Wet_PBC 32. Bent u op de hoogte van de wet- en regelgeving die vanaf 1 januari 2017 van kracht is voor de speed pedelec?

- ❍ Ja, ik ben op de hoogte van de consequenties van de veranderende wet- en regelgeving (1)
- ❍ Ja, ik ben op de hoogte dat er iets verandert voor de speed pedelec maar ik weet niet precies wat. (2)
- ❍ Nee, tot op heden heb ik niets geweten van veranderende wet- en regelgeving met betrekking tot de speed pedelec. (0)

Vervolg Hartelijk bedankt voor het invullen van de enquête. Indien u geïnteresseerd bent in de uitkomsten van het onderzoek, laat dan hier uw e-mailadres achter.

C. BEHAVIOURAL INTENTION PER TRANSPORT MODE

Observed variables	Description	Car	Carpooling	PT	Bicycle	E-bike	Chi-square	Sig
Flexibility	Respondent considers their transport mode to be a flexible transport mode	4,52	4,33	3,43	4,63	4,70	**79,795**	**0.000**
Comfortable	Respondent considers their transport mode to be a comfortable transport mode	4,77	4,33	4,07	4,00	4,20	**72,459**	**0,000**
Relaxing	Respondent considers their transport mode to be a relaxing transport mode	4,03	3,67	3,88	4,39	4,60	39,693	0,111
Safety	Respondent considers their transport mode to be a safe transport mode	4,41	4,00	4,33	4,08	4,15	22,900	0,526
Travelling time	Respondent is content with travelling time with their transport mode	4,22	3,67	4,07	4,10	4,08	20,212	0,911
Importance of electrical support	Respondent finds it important that their transport mode contributes to a reduction of their CO_2 footprint	2,98	2,33	3,12	3,25	3,55	20,967	0,889
Living environment	Respondent thinks that their transport mode contributes to a better living environment	2,09	1,67	3,74	4,02	4,15	**155,235**	**0,000**

Observed variables	Description	Car	Carpooling	PT	Bicycle	E-bike	Chi-square	Sig
Purchase costs	Assessment of purchase cost of their transport mode	2,78	3,00	3,57	4,22	3,35	**120,236**	**0,000**
Maintenance costs	Assessment of maintenance cost of their transport mode	3,05	3,00	3,94	4,08	3,68	**141,539**	**0,000**
Road tax	Assessment of road tax of their transport mode	3,05	3,33	4,03	4,47	4,29	**187,142**	**0,000**
Travelling time	Assessment of travelling time of their transport mode	4,33	3,67	4,05	4,12	4,28	22,815	0,531

Accessibility working address	Assessment of accessibility working address	4,02	4,33	4,21	4,80	4,85	**59,668**	**0,001**
Accessibility home address	Assessment of accessibility home address	4,77	5,00	4,29	4,76	4,85	35,541	0,061
Own physical health	Assessment of effects on own physical health	3,05	4,00	3,86	4,92	4,70	**114,010**	**0,000**
Own mental health	Assessment of effects on own mental health	3,80	4,33	4,19	4,86	4,74	**61,748**	**0,001**
Living environment	Assessment of contribution to living environment	3,05	2,67	4,39	4,78	4,55	**129,861**	**0,000**

Observed variables	**Description**	**Car**	**Carpooling**	**PT**	**Bicycle**	**E-bike**	**Chi-square**	**Sig**
Purchase costs	Assessment of purchase cost of a speed pedelec	2,60	2,50	1,89	1,95	2,15	35,804	0,215
Maintenance costs	Assessment of maintenance cost of a speed pedelec	3,25	3,00	2,53	2,44	2,71	34,386	0,266
Road tax	Assessment of road tax of a speed pedelec	4,32	3,00	4,03	3,97	3,76	39,847	0,108
Travelling time	Assessment of travelling time of speed pedelecs	3,44	2,50	4,02	4,60	4,79	**101,302**	**0,000**
Accessibility working address	Assessment of accessibility working address	4,46	5,00	4,69	4,75	4,76	32,488	0,345
Accessibility home address	Assessment of accessibility home address	4,55	5,00	4,70	4,69	4,80	27,554	0,594
Own physical health	Assessment of effects on own physical health	4,44	4,00	4,22	3,55	4,00	**71,000**	**0,000**
Own mental health	Assessment of effects on own mental health	4,37	5,00	4,42	3,76	4,03	**49,442**	**0,014**
Living environment	Assessment of contribution to living environment	4,63	3,00	4,24	3,94	4,18	**52,934**	**0,006**

Observed variables	Description	Car	Carpooling	PT	Bicycle	E-bike	Chi-square	Sig
Fit enough for cycling	To what extent do commuters consider themselves to be fit enough for cycling	4,27	4,50	4,47	4,68	4,53	30,830	0,424
Infrastructure	To what extent do commuters consider the infrastructure to be adequate for potential use of speed pedelec	3,69	2,00	3,74	3,73	2,94	**48,792**	**0,017**
Impedings or traffic lights	To what extent is the route to work hindered by impedings or traffic lights (very much = 1 – not so much = 5) for potential use of speed pedelec	3,28	3,00	3,33	3,31	2,73	37,844	0,154
Above average expensive	To what extent does a commuter consider the speed pedelec to be above average expensive	2,07	2,00	1,56	1,93	1,94	42,032	0,071

Note: only significant variables are included in table 19, chapter 7