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The Groningen cycling infrastructure - adequate for an ageing population?

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ABSTRACT

Population ageing is currently a common phenomenon in the western world. This leads to a diminishing workforce and an increase in the number of people who need health care. To avoid extensive dependency on health care, it is of great importance to keep older adults mobile as long as possible. This benefits their physical health, as well as contributing to their social and physical well-being.

In Groningen, cycling is a hot topic, and the municipality actively seeks to motivate people to cycle. However, when comparing two adult age groups (50-64 and 65-81 years old) with regard to their perception of the safety of the cycling infrastructure in the city centre, it can be concluded that a significant difference in perception exists. Older adults rate infrastructural situations significantly lower for safety than adults in the 50-64 age group. A further conclusion is that speed limit and cycling infrastructure are important factors that determine this rating, while road type is of less importance.

Additionally, it can be seen that as soon as cyclists lose their 'private' place on the road, perceived safety ratings get much lower. This is most strongly seen for roads with a maximum speed of 50 kilometres per hour. Respondents said in interviews that they agreed with the results of the survey, making the survey a good method of rating roads for their perceived safety for cyclists. However, they also stated that context is important too.

If the municipality of Groningen wants to keep one step ahead of the population's ageing, it should make sure that the elderly continue cycling and stay mobile, which means that it should invest in better cycling infrastructure, separate cycle lanes or lower speed limits, to increase cycling's perceived safety for these older adults.

FOREWORD

Cycling has always intrigued me. It is a non-polluting technology present in every city and town in the Netherlands, while in most parts of the world cycling is not even seen as a mode of transport. While studying in Groningen, I began to realize how big this cycling culture is in the Netherlands. For example, the municipality of Groningen is putting a lot of effort into motivating people to use bicycles, contrary to many cities around the world.

When I started this master's program in September, I already knew I wanted to write my thesis about cycling. During the presentation of the thesis subjects, dr. ir. Tan spoke about the cycling culture in Groningen and it got me from the start. At first I wanted to do something with the busy 'shared space' roads in Groningen, but I saw online that there had already been a lot of research done in this field. Therefore I focussed more on the interaction between older adults who cycle, cycling infrastructure and motorized traffic. This was quite challenging, because I wanted to work with a survey, a set of interviews, statistical analyses, theoretical support and ArcGis.

Now, in August, after more than nine months of working on my thesis, the final product is there. With support and input from my supervisor I think I have put together an interesting thesis, one that has a theoretical and abstract basis, worked out towards practical conclusions. Furthermore, I would like to thank all of the respondents who worked together with me by providing data.

Last, I want to thank my friends and family, whom I have forced to follow my thesis work step by step, annoying them endlessly with pictures through WhatsApp or asking them for advice and tips. It almost feels as if I have written my thesis together with them and they even asked if they could get part of my grade in return. One of my friends gave me a most inspiring quote to motivate me to work on my thesis:

"Je heb niet altijd *zin* nodig, om aan de slag te gaan"
(M. Weener, 2015)

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B. LIST OF ABBREVIATIONS

ANBO – Algemene Nederlandse Bond voor Ouderen *[General older adults union]*

CROW – Centrum voor Regelgeving en Onderzoek in de Grond-, Water- en Wegenbouw en de Verkeerstechniek (Dutch). *[original full name, now known as Crow]*

KBO – Katholieke Bond Ouderen (Dutch) *[Catholic older adults union]*

OOG – Omroep Organisatie Groningen (Dutch) *[Groningen broadcast organisation]*

PCOB – Protestants Christelijke Ouderen Bond (Dutch) *[Protestant Christian older adults union]*

SOOG – Stedelijk Overleg Ouderenbonden Groningen (Dutch) *[Urban older adults union of Groningen]*

SWOV – Stichting Wetenschappelijk Onderzoek Verkeersveiligheid (Dutch) *[Organisation for academic research on traffic safety]*

1. INTRODUCTION

The Netherlands is currently dealing with an ageing population (Statistics Netherlands, 2014d). The proportion of older adults (those over 65 years of age) is rapidly increasing in most parts of the Netherlands (Statistics Netherlands, 2014d), and will increase from 17% to somewhere around 26% by 2040. This means that the proportion of people under 65 is going to decrease from 83% to 74%. Currently there are 4.88 people under 65 years old for every older adult; this rate will decrease to 2.84.

This pattern of an ageing population will also have its effect on road users. According to Statistics Netherlands (2014b), older adults in the Netherlands are frequent cyclists, with an increase in cycling by this group evident over the last three years (Statistics Netherlands, 2014b). This increase is partly explained by the increasing use of e-bikes. These electric bicycles make it possible for older adults who are less mobile to still be able to travel by bicycle.

When these two factors, the ageing population and the increase in bicycle use, are combined, it can be expected that the number of elderly cyclists is going to increase rapidly in the upcoming decades. This raises the question of the extent to which the existing cycling infrastructure in cities is capable of handling this. From a strictly quantitative point of view, the number of cyclists is not going to change much, so the capacity of the cycling infrastructure will not be the issue (Statistics Netherlands, 2014d). But what does this shift in users mean as far as the quality demanded of the roads? Do the elderly wish to cycle in different bicycle lanes? What do they regard as safe roads for cycling and what do they mention as unsafe roads?

When putting this in the context of Groningen, a few issues emerge. At first glance, Groningen is seen as one of the most bicycle-friendly cities in the world (City Clock Magazine, 2013). The city centre has a unique infrastructure that is designed to keep cars out of the inner city (Tsubohara, 2010). This also helps motivate people to use bicycles. However, the SOOG has complained about certain roads in Groningen city centre that are regarded as unsafe by older adults (OOG Radio and Television, 2014), where cyclists and pedestrians share the same road in a shared space concept. Furthermore, earlier research has shown that older adults are afraid to cycle on roads where cyclists share the road with motorized traffic. Finally, OOG Radio and Television (2014) broadcast an article about older adults who do not dare to cycle through the inner city anymore, due to these roads being regarded as dangerous.

1.1 THE PROBLEM

The introduction clearly showed that the infrastructure of Groningen is properly designed, and that it can handle the number of cyclists. However, a large increase in elderly cyclists can be expected in the upcoming decades, and some older adults face problems when cycling on certain roads. The real problem, though, arises when the concept of well-being is added to this mix.

According to various sources, well-being is strongly related to people's mobility (Levine et al., 2012). Being mobile enables people to stay independent for as long as possible, and being independent is regarded as a very important aspect of a person's well-being. When linking this back to the introduction, the problem becomes clear. A large increase in the number of elderly cyclists, who are confronted with an infrastructure that does not meet their qualitative needs, is going to cause a certain level of immobility among those older adults. Therefore, this research will focus on what older adults regard as safe roads and infrastructure for cycling. Additionally, this research will use the city centre of Groningen as a case study, to see to what extent the city centre is older adult-proof.

1.2 RESEARCH QUESTIONS

This all raises a few questions. What types of cycling infrastructure can be distinguished? And what other factors influence perceived safety? What can be regarded as safe cycling infrastructure? And is there a difference between age groups regarding perception of the safety of cycling infrastructure? This research will focus on these elements through a survey, a set of interviews, statistical analysis and the use of ArcMap.

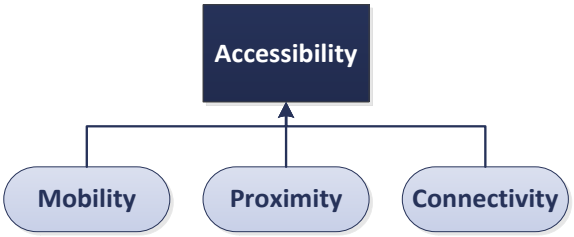
2. THEORETICAL FRAMEWORK & CONCEPTS

In order to conduct this research, a set of theoretical concepts is used to define and set out the research problem, questions and goals. First, a brief set of concepts is discussed to provide foundational understandings about the topic and issue. Then a new conceptual model is created, containing several important factors related to this research. In this conceptual model the different concepts are linked together, and the relevance of the relations between aspects is explained.

2.1 MOBILITY

Mobility is strongly related to the term accessibility. Levine et al. (2012) break out the accessibility of a phenomenon into three important factors. Mobility is among these three; the other two are proximity and connectivity (see figure 2.1). In this research the emphasis will be on the pillar of mobility. This due to the fact that mobility is related to people's well-being.

Figure 2.1 **Levine's accessibility model** (Levine et al., 2012).



John Urry (2002) also makes the link between mobility and proximity, and explains that it is very important. He adds to this that proximity is important for which type of transport people choose. Furthermore, he links people's mobility to the social aspect of travelling. He says that every face-to-face contact requires travel and thus mobility. Face-to-face contact is important for well-being, and so mobility is related to that as well (Urry, 2002).

THE MOBILITY OF OLDER ADULTS

Since being mobile depends on having good physical health, older adults are more likely to face immobility. Rantakokko et al. (2013) showed that the older people get, the more likely they are to lose their mobility. Important factors in this loss can include pain (Lihaivainen et al., 2010; Sallinen et al., 2010) or obesity among older adults (Stenholm et al., 2008). Beyond those factors, a loss of strength in legs and/or arms (Sallinen et al., 2010) and sensory impairment can also reduce the mobility of older adults (Rantakokko et al., 2013; Viljanen et al., 2009). A combination of reduced vision and hearing impairment can even quadruple the likelihood of making the transition to immobility (Kulmala et al., 2008).

The likelihood of developing these issues increases with age; older adults over 85 are particularly likely to face many problems that result in their becoming less mobile. This affects

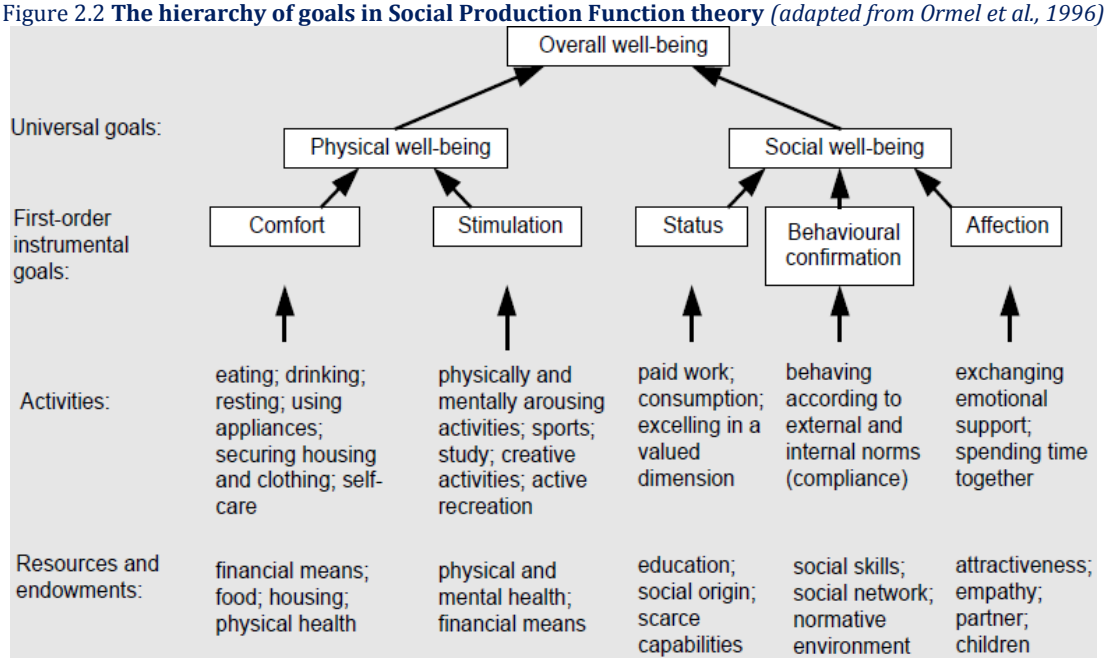
their physical health. Older adults who fall frequently also become less mobile, because they do not dare to go outside their houses any more (Rantakokko et al., 2013). The elderly who are 85 or older are increasing rapidly in the Netherlands (Bootsma-Van der Wiel, Westendorp, & Knook, 1997), with this group even likely to triple in size in the upcoming twenty to thirty years. This phenomenon is also known as double population ageing.

2.2 WELL-BEING

Why, then, is the physical health and mobility of older adults so important? According to Lindenberg's (1986, 1993, 1996) Social Production Function Theory, as seen in figure 2.2, the physical health of a person can be seen as a resource or endowment necessary to reach overall well-being. Additionally, figure 2.2 shows that well-being is influenced in various ways, such as recreation, sports and other physical activities. This in return leads to a stimulation of physical well-being, which contributes to overall well-being.

To provide optimal well-being for older adults, a good infrastructure is necessary to motivate older adults to stay physically active. Besides that, personal motivation can be a good avenue for increasing the activity of older adults. In this research, the opinions of older adults about physical activities and physical health will be used to see whether the Groningen infrastructure is contributing to these.

Figure 2.2 **The hierarchy of goals in Social Production Function theory** *(adapted from Ormel et al., 1996)*



Ziegler and Schwanen (2011), carry this further, placing five dimensions of mobility alongside five dimensions of well-being. Their model (Figure 2.3) shows that mobility and well-being are connected through various ways, and that mobility directly influences people's well-being. However, their model focuses more on which dimensions of mobility relate to which

dimensions of well-being. Lindenberg's model focuses more on resources, endowments and activities (1986, 1993, 1996).

Figure 2.3 **Conceptual relationships between mobility and well-being with individual factors of influence** *(Ziegler & Schwanen, 2011)*

Mobility dimensions	Individual factors that influence, and are influenced by, mobility and wellbeing ⟷	Wellbeing dimensions
Practices	Level of activity; capability	Physical health
Moving through space	Means of transport; control	Autonomy and independence
Disposition	Personality; motivation; engaging with difference; psychological coping strategies	Mental health and emotional wellbeing
Attitudes towards moving and practices	Attitudes to transport, local access; social engagement; degree of inter-dependence	Social relationships
Imaginary mobility	Previous experience; memories; future and ageing	Continuity of the self and identity

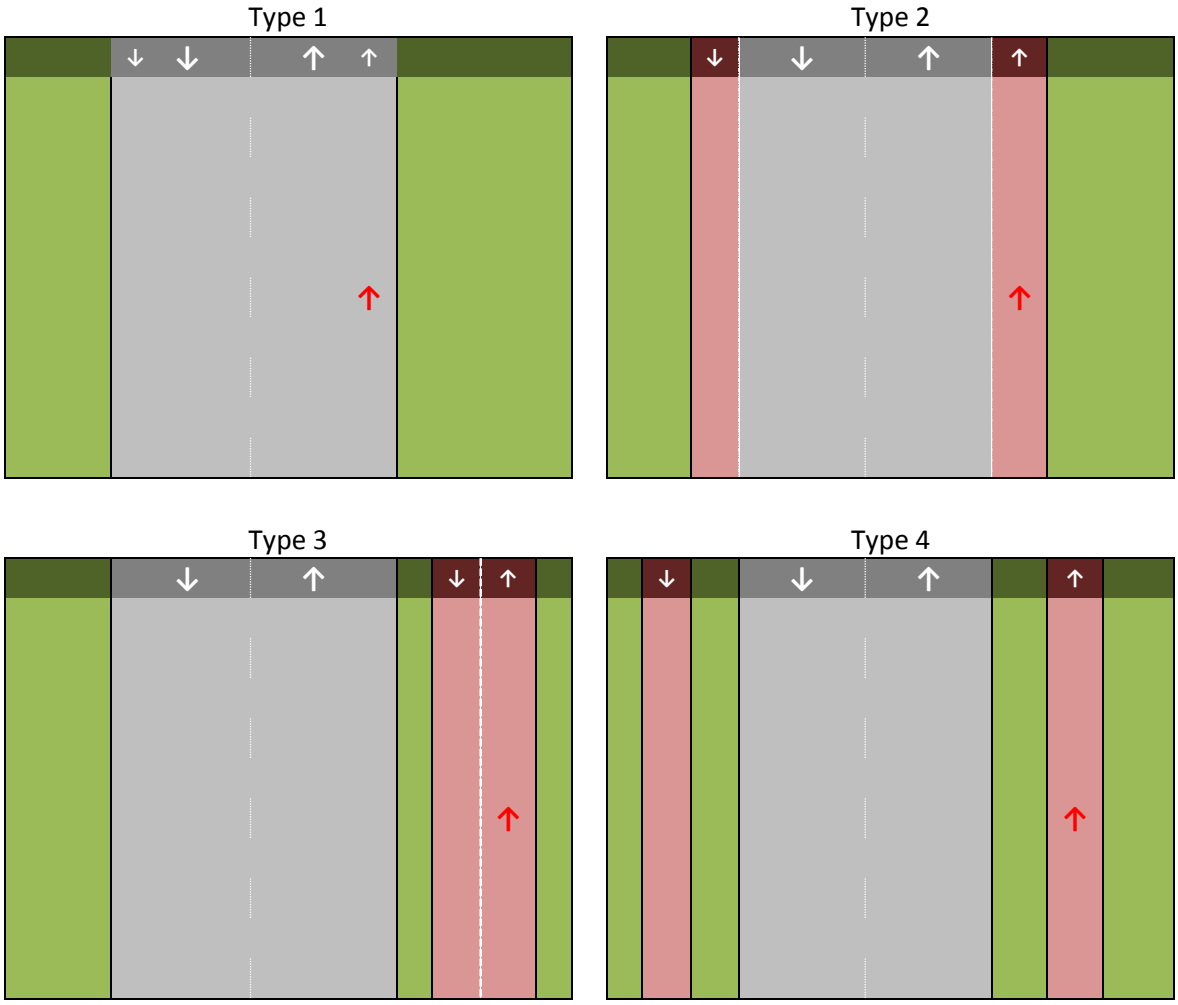
2.3 SAFETY

Safety is another important aspect of mobility. According to the World Health Organization (1998). safety can be split up into two different domains (see figure 2.4). The two domains are objective safety and subjective safety. By objective safety, we mean safety according to the statistics, as in the number of crimes or accidents. Subjective safety, on the other hand, stands for safety as people perceive it. The number of bicycle accidents on a street might be low, but the street might feel unsafe for various reasons (Nilsen et al., 2004), such as bad street lightning, low road quality, or being shared with high-speed motorized traffic. According to Beecham and Wood (2013), women tend to weigh perceived safety more when it comes to choosing a cycling route.

Figure 2.4 **Safety model** (*adapted from World Health Organization, 1998)*

In this research, the perceived safety of different types of infrastructure will be measured. For this purpose, a distinction is drawn between 4 different types of cycling infrastructure. The first type is roads where motorized traffic and cyclist share the same surface without any markings. The second type is where the same surface is again shared, but a cycling lane is marked on the streets with white lines or a red colour. The third type of cycling infrastructure is when the cycling lanes are combined together on one side of the road and separated from the roads for motorized traffic. The fourth and final type is where cyclists have their own separate lane next to the main road, on each side of the road. The four different types can be seen in figure 2.5.

Figure 2.5 **The four different types of cycling infrastructure**



2.4 CYCLING

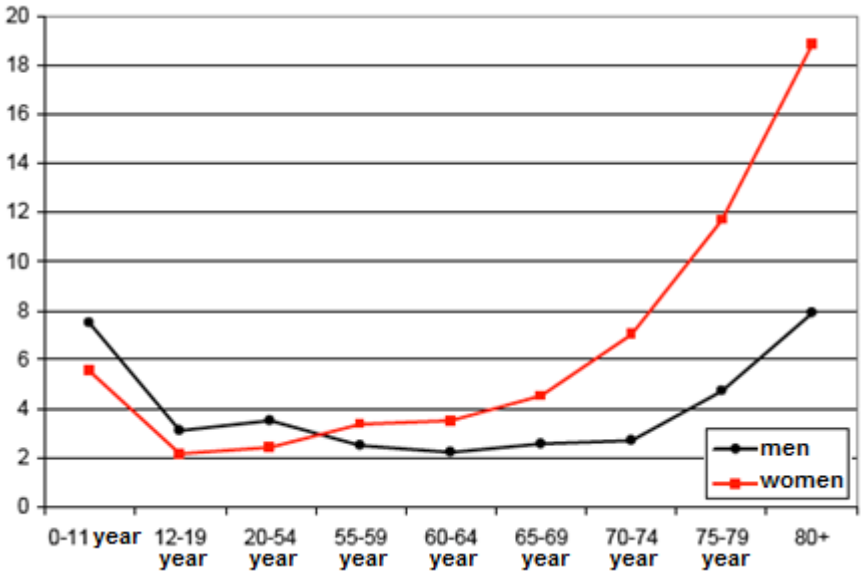
Cycling is very popular in the Netherlands, especially when compared to other countries. According to Pucher and Buehler (2008), the percentage of trips made by bicycle in the Netherlands was around 27% in 2003. Besides that, cycling is healthy activity and an effective form of mobility. According to Aldered (2013), cycling can be seen as part of someone's identity In most countries, cycling is primarily seen as a leisure activity. However, cycling is in fact more often used as a means of transport (Banister, 1990).

To enhance the quality of life for older adults, it is important to stimulate them to be socially and physically active; cycling can play an important role in this (Tacken, 1998; Rejeski & Mihalko, 2001). However, cycling does bring certain risks with it, and older adults are especially prone to these risks (see figure 2.6). This is primarily due to their having more physically vulnerable bodies and a greater risk of falling (Van Kampen, 2007; Veiligheid, n.d.a; Veiligheid, n.d.b). One-third of older adults fall at least once a year (Rissel et al., 2013).

Figure 2.6 shows clearly that as Figure 2.6 **Yearly average single person accidents needing medical help for**

adult get older, they are more likely to have a single person accident that requires medical aid. Furthermore, this risk is higher for older women than for men. Since the population of the Netherlands is ageing and the total number of older adults is going to increase rapidly, the number of injured elderly cyclists is also expected to increase rapidly.

each million kilometres cycled per age group (2003-2007) (Statistics Netherlands, 2007).



REQUIREMENTS FOR CYCLING INFRASTRUCTURE

To set up a good and functional cycling infrastructure, certain criteria must be met. CROW (1993a, 1993b) made a list of fundamental criteria for providing a good cycling infrastructure. Five points are listed; first of all, the cycling network must be comprehensive: it must connect the start and end points of the cyclists' trips.

Secondly, the routes must be as direct as possible. According to CROW (1993a, 1993b), the shorter the route is, the more likely cyclists are to take it. However, this does not always apply, because women tend to choose slower and 'safer' roads more often than men do (Beecham & Wood, 2013)

A third point is that the infrastructure must be attractive, according to CROW. The design of the roads should be integrated with the surroundings to cycling pleasant. Fourthly, the cycling facilities must safe, in terms of both road safety and safety from other road users, meaning personal security and safety. The fifth and last point is the comfortableness of the roads, as a rapid and comfortable trip is motivating for cyclists (CROW, 1993a, 1993b). This research focuses mainly on the fourth point on CROW's list (1993a, 1993b).

Interestingly, there are differences between the sexes when it comes to the preferred type of infrastructure. According to Beecham and Wood (2013), women tend to take slower roads and avoid major routes and busy crossings, while men tend to go for the shortest route. Besides that, not every type of cycling infrastructure suits every cyclist. Advanced cyclists might prefer roads

without a lot of stops, traffic lights and lane-switching, while the beginner cyclists might want all these, for safer cycling conditions (Forsyth & Krizek, 2011).

BARRIERS TO CYCLING

Different reasons can cause people to avoid cycling and to use motorized vehicles such as a car or bus instead. One major reason is the length of the distance that must be cycled (Stinson & Bhat, 2003) When this distance gets longer the likelihood of cycling decreases, particularly when the person owns a car that he or she could use instead (Rosen, Cox, & Horton, 2007). To overcome this phenomenon, cities have started creating cycling highways that should promote cycling by providing an optimal road that uses a nearly direct connection between destinations (City of Copenhagen, 2002).

Another aspect that could reduce the likelihood of cycling is the lack of good infrastructure and a comprehensive network. The lack of these could make it more attractive for people use a different form of transportation. Pucher and Buehler (2008) explained that whenever the built environment becomes more dense, it becomes more attractive to travel by bike or by foot. A good network is thus not necessary per se, when the use of cars is strongly demotivated (Litman & Steele, 2011). Dill and Voros (2007) explain this by using the example of residents living in the city centre, versus residents living in the city's suburbs. The residents in the city centre tend to cycle more than the residents in the suburbs.

The last issue of note is the type of cycling infrastructure that is present. This can be split out in different types, consisting of roads that have a separate cycling lane, roads that share the same area with cyclists, but the cycling lane is marked on the road, and roads where there is no visible area meant for cyclists. Taylor and Mahmassani (1996) showed that the type of infrastructure is of great importance, especially when it comes to inexperienced cyclists or people who face difficulties when cycling. There is also a noteworthy difference between sexes. In the past, say 130 years ago, it was not really accepted for women to cycle. The cycling clothes designed back were also not appropriate for women (Knuts & Delheye, 2012).

BENEFITS OF CYCLING

Cycling is a cheap form of transportation and can be fun and healthy to do. Cycling four miles daily reduces the risk of coronary heart disease by 50%, for example (Cyclorama, n.d.). Besides that, there are other positive effects on people's health of people as well (Nielsen, Skov-Petersen & Argeriv Carstensen, 2013). Rissel et al. (2013) showed that cycling frequently improves the balance of older adults, which reduces the likelihood that they will fall and injure themselves. Strength in the leg muscles also improved (Rissel et al., 2013). Being physically active leads to a

reduced likelihood of developing cardiovascular diseases, strokes, cancer or type II diabetes (Cavill et al., 2008). Not only that, it can also reduce anxiety and depression.

Furthermore, cycling has positive effects on the environment as well. In particular, the immediate environment has cleaner air than environments where motorized traffic dominates. Cycling is also good for the environment in general, because it reduces the emission of greenhouse gases (Furness, 2010; Institute for Sustainable Mobility, 2015). Additionally, cycling causes no noise pollution and does not use up any non-renewable resources (Pucher & Buehler, 2012).

CYCLING OLDER ADULTS

According to Pucher and Buehler (2008), in general older adults hardly cycle at all, but when looking at specific countries they found that this is not the case for the Netherlands. Dutch older adults make around 25% of their daily trips by bicycle (see figure 2.7), which is the highest percentage in the world. Within the Netherlands, this percentage is even greater than in the 25-45 and 45-65 age groups. Looking more closely, there is even growth visible over the past few years. While the 65-75 age group shows no major differences in percentage of daily trips made by bicycle, the 75 and older age group is increasing its percentage of bicycle trips, from 18.7% up to 23.1%,, as can be seen in figure 2.8. It can thus be said that cycling is a very popular form of transportation in the Netherlands, and that older adults use bicycles a lot. This percentage has been increasing over the past few years. And with the upcoming ageing of the Dutch population, the number of elderly cyclists will also increase.

Figure 2.7 **The percentage of trips made by bicycle per age group in the Netherlands, 2013** (Statistics Netherlands, 2014b)

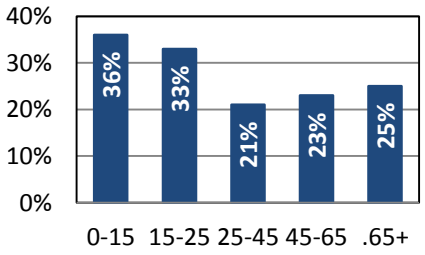
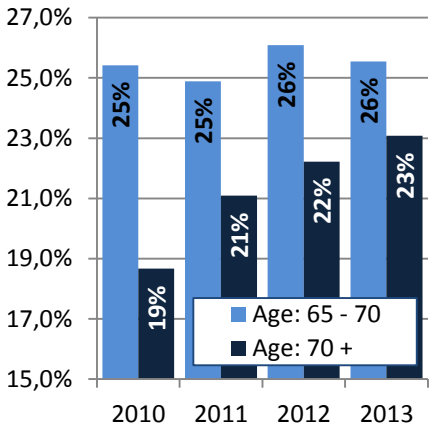


Figure 2.8 **The percentage of daily trips made by bicycle among older adults in the Netherlands over four years** (Statistics Netherlands, 2014b)

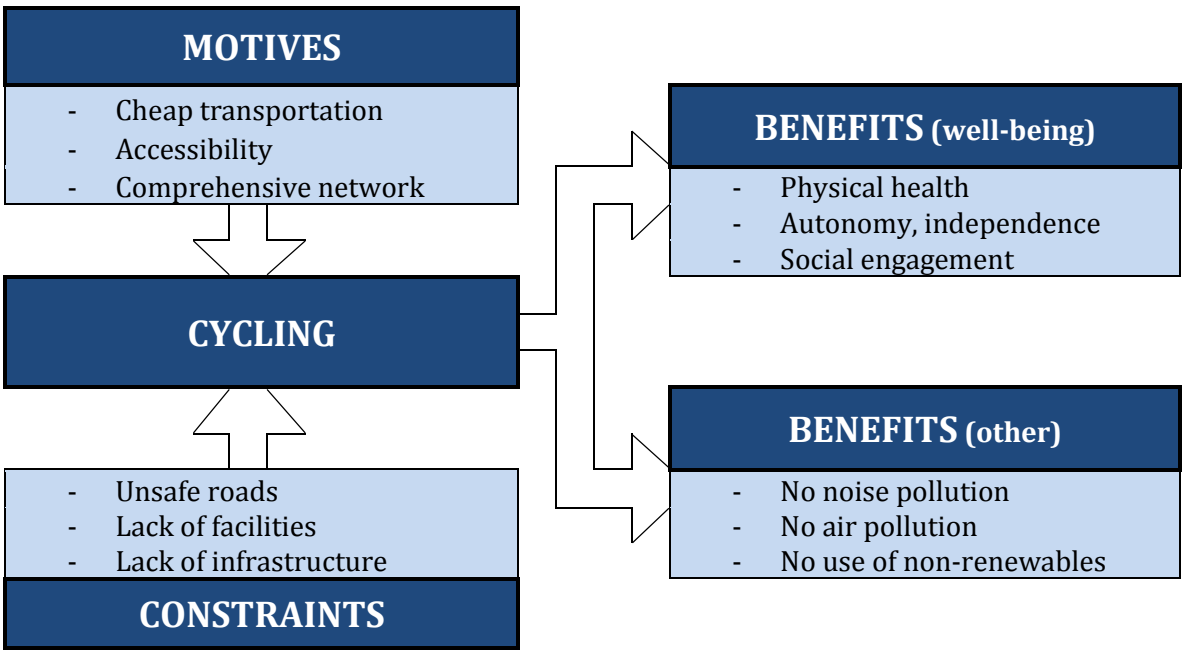


In addition, older adults are remaining more and more mobile due to the growing popularity of E-bike use. E-bikes make it possible for older adults in poor physical condition or physical constraints to remain physically active and mobile. However, the number of injured e-bike users in increasing, too (Kruier et al., 2010).

2.5 CONCEPTUAL MODEL

The concepts that have been mentioned thus far have a certain pathway with regard to their influences on each other, as can be seen in the conceptual model (figure 2.9). The conceptual model has examples for each concept. As can be seen in the model, cycling is influenced in two ways. People can be motivated to take the bicycle on the one hand, but also can be demotivated by constraints that lead them not to cycle on the other hand. As mentioned before, one of the reasons to bicycle is that it is a cheap form of transportation, because a bicycle is not expensive and does not require the purchase of fuel to take you around. Additionally, in the case of Groningen, accessibility also plays a role in this decision-making. The focus and aim of this research is the adequacy of the cycling infrastructure of Groningen. The Groningen city centre is designed in such a way that the accessibility is very good for cyclists and very bad for motorized traffic; this motivates those making trips in the city centre to use their bicycles. Thirdly, a comprehensive network of cycling roads influences the choice to take the bicycle as well (Pucher & Buehler, 2008).

Figure 2.9 **The conceptual model**



Unsafe roads are constraints to cycling. This can be an objective safety issue, where there is statistical proof of an unsafe situation. This could also mean a perceived unsafe situation. In this case, the road is safe in terms of accidents, but it has an unsafe feeling. A second constraint is the lack of cycling facilities, such as bicycle racks, free pumps along the bicycle path, mirrors for clearer view and bars to lean against at traffic lights (City of Copenhagen, 2002). The last

constraint is the lack of cycling infrastructure; as Pucher and Buehler (2008) explained, the lack of cycling infrastructure demotivates people to take the bicycle.

Cycling has various benefits for the cyclist and for the environment. In the conceptual model these two things have been split out. This is done because the main focus of this research is upon the positive effects that cycling has upon well-being; however, the effect upon the environment does play a role in the choice to take the bicycle.

The benefits of cycling for the cyclists affect the person's well-being. As shown in figures 2.2 and 2.3, physical activities and mobility have a positive effect upon people's well-being. First of all, they have an effect on the cyclists' physical health. As studies have shown, cycling benefits the cardiovascular system (Cavill et al., 2008), and therefore it lowers the risk of heart diseases (Cavill et al., 2008; Cyclorama n.d.). Additionally, cycling is good for the person's autonomy and independence (Ormel et al., 1996; Ziegler & Schwanen, 2011). Thirdly, cycling has benefits for social engagement and strengthens the person's social network (Ormel et al., 1996; Ziegler & Schwanen, 2011).

Besides these effects upon well-being, cycling also has other positive effects. One is the lack of noise pollution (Pucher & Buehler, 2012). Additionally, there is also no air pollution produces when people use the bicycle instead of motorized travel (Institute for Sustainable Mobility, 2015). Finally, cycling does not consume any non-renewable resources, and in this way has a very small environmental footprint (Pucher & Buehler, 2012).

3. METHODOLOGY

In this section of the paper, the methodology used is explained. Furthermore it shows which techniques are used with which reason. It also elaborates on the limitations and benefits these techniques give. Additionally this section explains some of the choices made during the research, such as the participant selection and the research methods. At last it critically reflects on the acquired data and explains which limitations this data-set gives.

3.1 STUDY POPULATION

Respondents participating in this research were carefully selected. Since this study focuses on older adults in general, this group was selected as the population of interest for this study. However, older adults is a vague container term that stands in general for adults above the age of 65. For this research, the group of respondents was broader than only adults above the age of 65. This is done to see how wishes and demands regarding cycling infrastructure change over the years. Therefore, adults from the age of 50 and up were selected as respondents for the survey about cycling infrastructure.

Additionally, the participants in this research were selected based upon where they live. Only participants who live in the city of Groningen or close by were used in this research. This is done because these respondents have a better idea of their opinion about the Groningen cycling infrastructure.

Whenever interviews were conducted, the participants were allowed to stay anonymous in this research. This was done by changing their names to pseudonyms or by masking personal characteristics. Guaranteeing a person's anonymity can lead to a more open interview that will result in better and more suitable answers (Clifford & Valentine, 2003).

3.2 METHODS OF DATA COLLECTION

Five different data collection techniques were used for this research. This is done to create an extensive data-set. Through mixed methods the data is analysed. This means that the same phenomenon is tested using multiple methods of data collection to see whether all techniques give the same output (Bogdan & Biklen, 2007; Hennink, Hutter, & Bailey, 2011).

SURVEY

The first technique that was used was data collection through a survey. This survey asked the respondents to rate certain types of cycling infrastructure on how safe they regard them to be.

This was done by using either an online survey including several pictures of different types of cycling infrastructure, or by using a printed survey for older adults who do not have access to a computer or internet. This was done to make sure that every older adult had the same chance to be part of the research, which increases its reliability. The printed survey can be found in appendix I. The online survey consisted of the same questions, although in full colour and with more explanation.

Participants in the survey were contacted in various ways. First, friend family and neighbours were asked to participate in the research. Furthermore contact was made with the Stedelijk Overleg Ouderenbonden Groningen [Urban Older Adults Union of Groningen]. They sent the online survey to all their members. Additionally, citizen of Groningen were asked on the streets to fill in the survey.

FOCUS GROUP WITH KEY INFORMANTS

The second method of data collection was a focus group with key informants. During the research process a small focus group was held with three key informants, at the main office of the SOOG [Urban Older Adults Union of Groningen], a group which had already complained about the cycling infrastructure in the municipality of Groningen (OOG Radio and Television, 2014). This focus group included Sierdtje Oosterhof, member of the older adults council, Menno van der Wis, member of the older adults council and Victor Möhlmann, member of the older adults council and president of two committees.

Focus groups are useful when the researcher wants to orient himself or herself in the field (Greenbaum, 1993 in Clifford & Valentine, 2003; Morgan, 1997). Furthermore, in a focus group participants get the opportunity to talk to each other and to convince each other about their different opinions. The informal setting in which a focus group can take place can enhance the quality of the data, as the respondents will be more at ease. In this case, the focus group was semi-structured. With the help of probes, a list of questions was developed to ask the members of the older adults council (Clifford & Valentine, 2003).

INTERVIEWS

The third method of data collection was interviews. These were done with respondents who also participated in the surveys. Interviews give the respondents more opportunity to discuss and explain their opinion. Therefore they provide a much more qualitative data set. In this research, the interviews were used to reflect on the findings from the survey.

The interviews were done by e-mail. Due to the fact that all respondents who wanted to participate in further research gave their e-mail address on the survey, these participants could easily be contacted. Some remarkable conclusions that were drawn from the survey were sent to the respondents who wanted to participate in further research.

Interviewing is a useful technique for getting qualitative data. Respondents can write or tell about their own experiences (Hennink et al., 2011). Besides that, because the interviews were done by e-mail, the respondent could answer the questions whenever he or she had time for them (Bampton & Cowton, 2002; Kivits, 2005. He or she could easily change or erase parts and decide completely for themselves what they were going to send. A negative aspect of interviewing by e-mail is that as a researcher you are limited in responding and asking for elaboration. You could always send an e-mail with questions for clarification, but face-to-face is easier in that case (Dunn, 2005, Newton 2010). For sensitive topics this can be an issue; however, the questions that were used in this research are not very sensitive and do not ask people about their feelings on ethical issues (Bampton & Cowton, 2002). Therefore interviewing by e-mail was appropriate for this research.

NUMERIC DATA FROM STATISTICAL NETHERLANDS

The fourth type of data was numeric data from Statistical Netherlands. Statistical Netherlands is a Dutch organization that collects data. This data can easily be downloaded from their website. In this case various data-sets from Statistical Netherlands were used. The themes that were used for this research are, mobility, cycling, population by age, ageing prognosis' and population by region. These various data-sets were combined to create graphs and charts. These graphs and charts were to support statements and findings.

THEORY FROM ACADEMIC JOURNALS

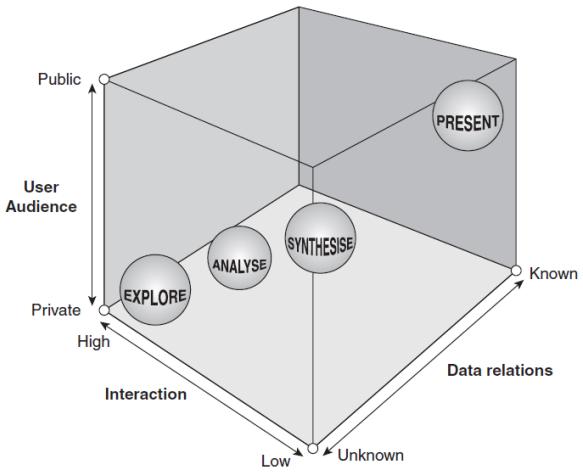
The fifth and last set of data is theory from academic journals. To support this research a theoretical framework is created with several theories that are linked to this research. These theories are then put together in a conceptual model to show their coherence. The theory in this research focuses on themes as well-being, safety, cycling and population ageing.

SPATIAL AND STATISTICAL ANALYSIS

To analyse the collected data, several techniques have been used. One of these programs was IBM SPSS 22, to conduct various tests on the quantitative data from the survey. This was done to see whether there were significant results. Outcomes for the different questions were compared, as well as outcomes for the different age groups.

This same data set was also used to do analysis with the help of ArcMap 10.2. Mapping is a practical way of visualizing data (Clifford & Valentine, 2003). Maps are a tool to simplify complex data and an efficient way of storing a lot of data (Tufte, 1983). As figure 3.1 shows, a map can be used and created in different stages of the research. Some maps are more exploratory while others are meant for presenting results or conclusions.

Figure 3.1 **MacEachren's cubic map space** (MacEachren 1994)



3.3 RECRUITMENT PROCEDURE

The survey participants were recruited in various ways. Survey respondents were selectively contacted in order to achieve a random sample. These respondents were mostly located in Groningen, because the respondent's location is important for the answers they give. All participants had to be 50 years of age or older to take part in this research.

Survey respondents in this research were contacted in three different ways. The first group was contacted on the streets in Groningen city centre. The second group were members of a choir in Groningen that has mostly elderly members. The third group was contacted through the SOOG, the union for older adults in the city of Groningen. Using these three different methods of contacting respondents created a more diverse and representative sample.

The respondents for the interviews were selected from among the survey participants. This was necessary because the interview participants had to reflect on the survey outcomes, so they needed to have already taken part in the survey.

3.4 ANALYZING THE DATA

Several statistical tests were done in SPSS using the survey data. First some general analyses were done about the sample characteristics, such as the distribution by age and sex.

Secondly, responses about infrastructure types were compared to similar infrastructure types to see whether their perceived safety rating was significantly higher or lower. This resulted in 126 paired samples t-tests. (The full table of all comparisons of response outcomes can be seen in appendix II).

Besides that, tests were also done between groups of respondents. In this case the groups were divided by age, one group of people from 50 to 64 and another group with all respondents over 65. These two groups were compared on all their results as well to see if any significant differences existed between the two age groups. This led to 36 independent samples t-tests where the two groups were compared on each of the 36 different questions about infrastructure types.

Ratings from the survey were also analysed with ArcMap. The numeric data derived from the survey was linked with location-related information that could be implemented in ArcMap to draw maps with it. One map was created with the base infrastructure of the city centre of Groningen, showing the primary and secondary cycling infrastructure of the city. Two other maps are more age oriented. One map shows the outcomes of the survey for adults between 50 and 64, while the other map shows the results for the 65-81 age group. Comparing these two maps shows some interesting results.

3.5 DATA QUALITY AND LIMITATIONS

The survey was completed by 78 respondents living in or around the city of Groningen. However, 8 respondents did not fill in the survey completely, and were therefore taken out of the dataset. 70 respondents is enough for many statistical tests; however, a larger sample size would have improved the data quality. Some results were close to significance now and could have been more definitely seen as significant (or not) with a larger sample size.

Besides that, men were a bit dominant in the 50-64 age group, and women in the 65-81 age group. This might have influenced the research outcomes, because the average perceived safety rating for women was a bit lower than for men.

Additionally the questions the respondents had to answer were presented in a fixed order. This might have influenced the outcomes. The questions were about situations that had to be rated from one to seven. This means that the first question could be the hardest for the respondents, because they had nothing to compare it with, which might have influenced their answers.

4. THE CASE OF GRONINGEN

The following chapter describes the case that is used in this research. It elaborates on its specifics and explains the motivation for picking this case. Furthermore, it creates a context in which the case of Groningen is situated. Additionally, the chapter links some of the theories from chapter 2, 'Theoretical framework', with the case, such as the ageing population and the bicycle culture of the Netherlands.

4.1 CYCLING IN THE NETHERLANDS

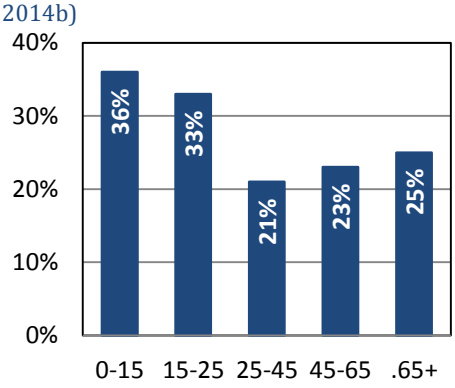
The Netherlands is a country world-famous for its infrastructure, and especially its cycling infrastructure. According to Hull and O'Holleran (2014), the Netherlands is regarded as a world leader when it comes to urban planning regarding cycling infrastructure. Two factors in this success are the compact city-building present in the Netherlands together with integrated policy aimed at cycling (Hull & O'Holleran, 2014). Forsyth and Krizek (2011) also elaborate on this topic, saying that cycling has a prominent role in Dutch everyday life.

Figure 4.1 **City of Groningen in the Netherlands** (SkatesCool, 2009)

Nielsen, Skov Petersen and Argeriv Carstensen (2013) even spoke of the Netherlands as being number one in the world when it comes to kilometres cycled yearly per inhabitant. According to them, this is 850 km per Dutch citizen; second place is taken by Denmark, where cyclists travel on average 570 kilometres per year (Nielsen et al., 2013; SWOV, 2009). Cycling is a popular form of transportation in the Netherlands. Currently, between 25-40% of all trips made in the Netherlands are made by bicycle (Bike-EU, 2015; Dutch Daily News, 2010; Statistics Netherlands, 2014b). This is a much higher percentage than in surrounding countries. According to Pucher and Buehler (2008), cycling typically occurs in nearly every age group but older adults. They add that this is the case in almost every country, except for the Netherlands.

In the Netherlands, the percentage of older adults who cycle is even higher than the percentage of cycling adults in the 25-65 age group, as can be seen in figure 4.2. This figure shows that the percentage of cycling older adults is higher than that of younger adult age groups. However, children and adolescents cycle the most, which is mainly due to the fact that they travel to school and often do not have the capability to drive a car or other form of motorized traffic.

Figure 4.2 **The percentage of trips made by bicycle per age group in the Netherlands, 2013** (Statistics Netherlands, 2014b)



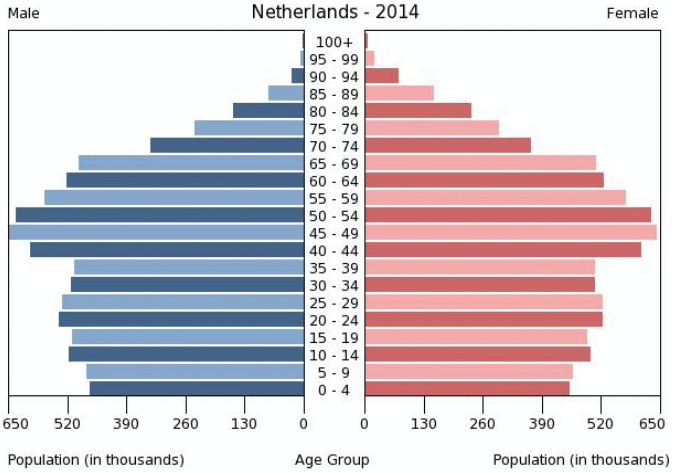
According to the BBC News (2013), the reason the Netherlands is such a cycling-friendly country is the high population density, the flat surface and the excellent infrastructure. Cycling is also accepted and associated with a healthy life-style, whereas in the United Kingdom, cycling is associated with negative moral discourses about youth crime and parents' irresponsibility (Aldered, 2012). Additionally, in many countries cycling is seen as a children's activity, and not as a mode of transportation (Banister, 1990).

This cycling infrastructure was not always there in the Netherlands. The first cycling roads were established in the late 19th century (Reid, 2012). Later on, in the 1960s and 70s, large protests put cycling safety upon the government's agenda (Furness, 2010). With slogans such as *Stop de kindermoord* (Stop the child murder), cycling safety became a big issue (Witness, 2013). The oil crises and shortages in the mid-70s can be seen as another factor that increased the demand for cycling infrastructure (Bicycle Dutch, 2013).

4.2 POPULATION AGEING IN THE NETHERLANDS

Population ageing is currently a common phenomenon in the western world. The decrease in new-borns and improved health care contribute to this. People are living to be older and older due to advances in health care. This changes the structure of the population pyramid. The percentage of adults above 65 is increasing, while the percentage of people below 20 years old is decreasing.

Figure 4.3 **The population pyramid for the Netherlands, 2014** (CIA Factbook, 2014)



As can be seen in figure 4.3, the population pyramid of the Netherlands no longer looks like a pyramid, but more like a mushroom. In particular, the age groups from 40-44 up to 65-69 are significantly larger than the other groups. These groups consist of two generations of baby-boomers. It is these age groups that cause the phenomenon of population ageing.

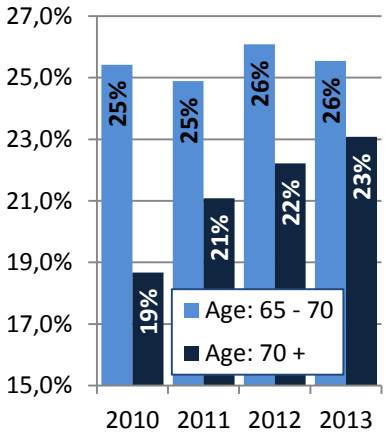
Statistics Netherlands (2014c) provides a forecast regarding this aging of the population. This forecast predicts a rapid growth in the percentage of older adults that will continue growing until at least 2040, where it will stop at around 26.4%. However, a significant change takes place in the years to follow. Altough the total percentage might be stable around 26%, the numbers of adults in the different age groups from 65 and up are expected to change a lot. This can clearly been seen in table 4.1.

Table 4.1 **Projected number of older adults in the Netherlands in thousands, per age group** (Statistics Netherlands, 2014c)

	65-70 years	70-75 years	75-80 years	80-85 years	85-90 years	90-95 years	95+ years	% of total population
2020	994	940	634	437	260	106	26	19.7
2030	1.152	993	831	697	364	150	38	23.8
2040	1.056	1.095	993	769	509	265	62	26.4
2050	907	861	933	887	658	329	105	26.0
2060	1.000	915	818	722	655	420	159	26.0

In table 4.1 it becomes clear that after 2040, the number of older adults who are 65 – 80 years will slowly decline. The number of older adults older than 85 is expected to increase tremendously between 2040 and 2060. This trend is going to affect the city of Groningen as well. As seen in chapter 2, figure 2.1 showed that older cyclists more often have accidents that lead to medical treatment. Combine this fact with table 4.1, and it becomes clear that in the future the absolute number of older adults with casualties could increase.

Figure 4.4 **The percentage of daily trips by bicycle among older adults in the Netherlands over four years** (Statistics Netherlands, 2014b)



When looking in greater detail, a trend is visible for this group of older adults with regard to their percentage of daily trips by bicycle. As can be seen in figure 4.4, while the 65-70 age group does not experience big changes in the percentage of trips they made by bicycle over the span of four years, this percentage is increasing for the 70 and up age group. Since 2010, the percentage of daily trips by bicycle for this age group has grown from 18.7% to 23.1% in 2013 (Statistics Netherlands, 2014b). To conclude, it can be said that cycling is a very popular mode of transportation in the Netherlands, that older adults use the bicycle very often and that this percentage has even increased in the past few years.

The electrical bicycle, or E-bike for short, is not a recent invention. The idea of a bicycle that uses an electrical motor to move it forwards comes from the 19th century (Google Patents, 1895). However, it is only recently that these bicycles are becoming more common on the streets. The number of E-bikes that have been sold has grown steadily in the last few years (Bike-EU, 2015; Dutch Daily News, 2010).

The E-bike is an interesting 'new' mode of transport among older adults, in particular. The bicycle supports the user and makes it easier to gain speed and to cycle longer distances. However, this E-bike also brings negative side effects with it. The number of cyclists riding an E-bike and getting injured is increasing, too (Fiets, 2015; Kruier et al., 2010).

4.3 THE CASE OF GRONINGEN

In this research a closer look is taken at the city of Groningen. Groningen is a large Dutch city located in the north of the country, as can be seen in figure 4.1. The city has an important regional function. It has an academic hospital which is the largest employer in the region, a university and an airport. It is the largest city in the northern part of the Netherlands and is the capital of the eponymous province: Groningen.

The city of Groningen is an old city whose history goes back far into the middle ages. The city has been important in the region since that time. The exact origin of the name and the precise age of the city, however, remain unknown (Duijvendak & Feenstra, 2008).

Groningen is accessible in various ways; as mentioned, it has an airport, but the city is also connected through waterways with Germany and the North Sea. There are highways that run to Friesland, Drenthe and Germany as well. The city itself has a ring road around the city and a smaller ring road around the city centre. The city centre uses a unique traffic circulation system about which more information will be presented in the following paragraph.

4.4 CYCLING IN GRONINGEN

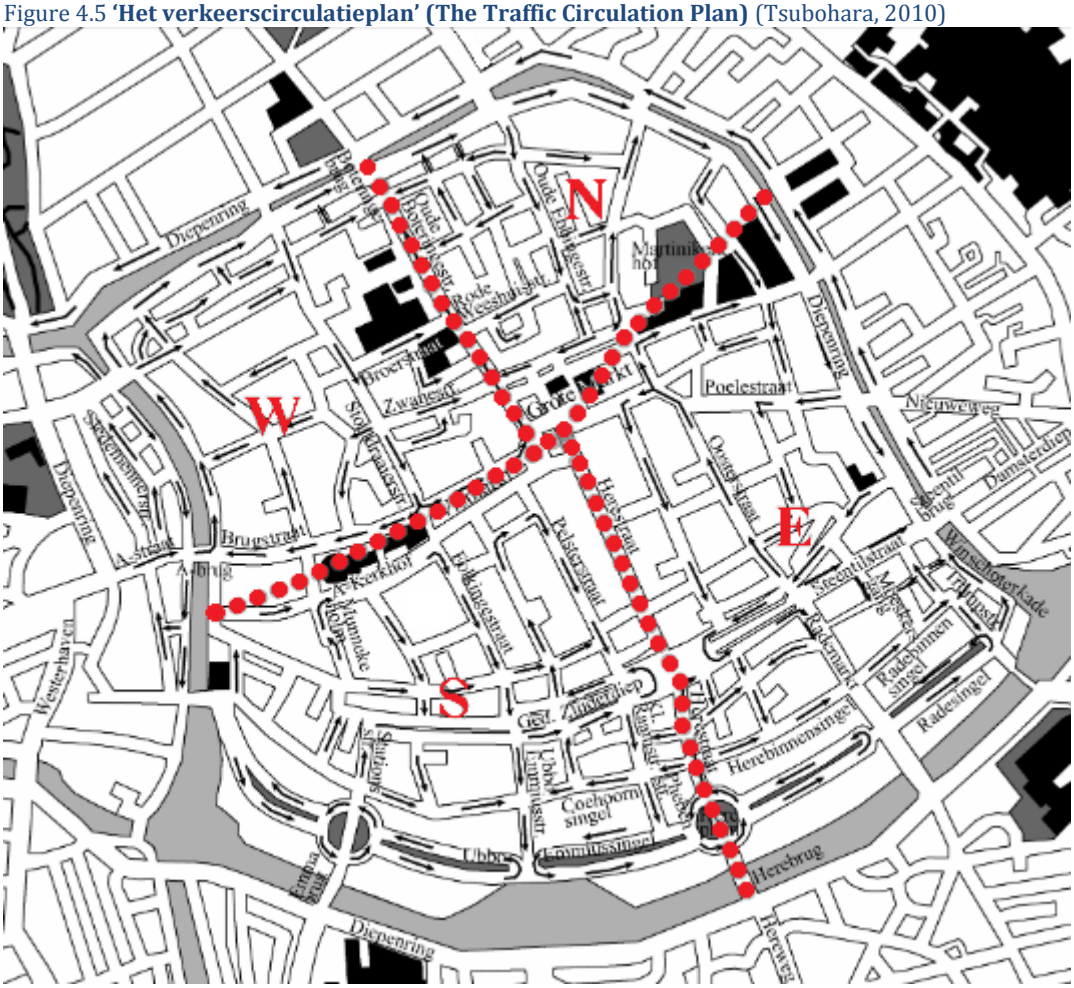
Groningen is famous for its high percentage of cycling (CityLab, 2013; The Urban Country, 2013). According to CityLab (2013) approximately 50% of all trips in Groningen are made by bicycle, making it among the cities in the world with the highest percentage of daily trips by bike (A View From the Cycle Path, 2009). But the city of Groningen was not always like this. In the '60s, the automobile industry was booming and the use of cars increased rapidly

everywhere in the world. This led to much investment in roads for motorized traffic. This was also the case in Groningen.

As mentioned previously, a noticeable shift in the policy regarding cycling occurred in the 1970s (Furness, 2010). This had multiple causes, such as the oil crisis in 1973. It was a window of opportunity for the people to demand a shift and to be less fuel-dependent. In the following years, policies regarding cycling emerged all over the country. In 1975, the first adjusted roads appeared in the Hague and Tilburg. No longer was the full capacity of the street meant for motorized traffic; cyclists had their own part of the road, too.

In 1976, a big shift in infrastructure planning occurred in Groningen. The city came up with a unique system to discourage cars in the city centre. The intention behind this plan dates to 1969; however, its true implementation took place in 1976 (Fietsberaad, 2009; Tsubohara, 2010) This plan is also known as the *Verkeerscirculatieplan* (Traffic Circulation Plan). This plan can be seen in figure 4.5.

Figure 4.5 **'Het verkeerscirculatieplan' (The Traffic Circulation Plan)** (Tsubohara, 2010)



This plan was designed in such a way that the city centre was divided into four different blocks. Cars and other motorized traffic were no long allowed to cross these borders. This plan made it impossible for them to cross through the city centre. Driving from one block to another would force the driver to leave the city centre, drive around, and enter the city centre from a different point (Tsubohara, 2010). This plan influenced life in the city centre significantly; cycling became much safer and more popular and use of the car less attractive.

In the ensuing years, various adjustments have been made to the plan. Some roads became car-free, such as Steentilstraat, Folkingestraat and Stoeldraaiersstraat. The ANWB, the Dutch union formed to support cyclists, also played an important role in the creation of bicycle-friendly infrastructure. In addition, the 'Fietsersbond' was established in 1975 to advocate for the interests of cyclists. Between 1975 and 1985, the government subsidized the development of cycling infrastructure (Masterplan Fiets, 1991). In the early '80s the city of Groningen started experimenting with guarded bicycle parking spaces in the city centre, to promote cycling (Boersma & Van Alteren 2004; Fietsberaad, 2009). In 1986, the city presented its first cycling plan, called *Nota Fietsvoorzieningen* (Plan for Cycling Facilities). In this report, various projects were proposed for installation in the city of Groningen, because the bicycle was again an upcoming mode of transportation (Fietsberaad, 2009). When the ring road system around the city was finished in 1987, the municipality of Groningen continued closing roads to cars, to give cyclists more space. In 1993, the Korrebrug was improved with two separate bicycle bridges high above the water, creating a permanent connection between the cycle paths on both sides of the canal. This is a perfect example of Groningen putting bicycles ahead of cars (Fietsberaad, 2009).

In 1997, the municipality of Groningen produced another report. This time, the municipality cooperated with local citizens and companies to find common interests. The plan was called *De Bereikbare Stad, Leefbaar* (The accessible city, liveable). However, the plan created a lot of commotion since there was no intention to restrict cars from the city centre, and the importance of cycling was also not very clear (Tsubohara, 2010). In 2002, the municipality of Groningen won the Dutch prize for being *Fietsstad van het jaar* (Cycling city of the year). This is a prize given by the *Fietsersbond* (Cyclists Union) every few years (Fietsersbond, 2014).

Even today, Groningen is very active in promoting itself as a cycling city. It tried to attract VeloCity 2017, a large cycling congress, to the city. Another good example of the city's investment is the *Slimme Route* (Smart Route), an initiative by students to make cyclists aware of the best routes to take in the city. These routes avoid traffic lights and busy crossings (Groningen Bereikbaar, n.d.). In June 2015, the municipality of Groningen presented its latest

city plan. The actual plan wants to keep buses out of the Grote Markt, increase pedestrian zones and create a cycling lane in front of the municipality house on the Grote Markt (Gemeente Groningen, 2015). A map of the current cycling infrastructure of Groningen can be found in appendix III.

4.5 POPULATION AGEING IN GRONINGEN

When looking at the population and demography statistics for Groningen, a few remarkable things are visible. The city of Groningen has approximately 197,000 inhabitants (Statistics Netherlands, 2015b). Of these 198,000 inhabitants, more than 50,000 are students.

Of all 23 municipalities located in the province of Groningen, only six realised a growth in population in the last ten years (Statistics Netherlands, 2015b). Groningen was among those six growing municipalities, while the other five all border the Groningen municipality or lie close by.

In table 4.2, the population of the Netherlands, the province of Groningen and the municipality of Groningen are shown. Whereas the province and the country share similarities in their population distribution by age groups, this is not the case for the municipality of Groningen. The municipality of Groningen shows a difference in the 20-40 age group. This can be explained by the high number of students who live in the city of Groningen. This high percentage of young people makes Groningen the city in the Netherlands that has the highest reversed dependency ratio (Zorgatlas, 2014).

Table 4.2 **Population table for 2014** (Statistics Netherlands, 2014a; 2015a)

Age groups	Netherlands	%	Province of Groningen	%	Municipality of Groningen	%
Total	16,829,289	100%	582,728	100%	198,317	100%
0 - 20	3,846,046	23%	125,005	21%	38,308	19%
20 - 40	4,117,652	24%	156,654	27%	82,571	42%
40 - 65	5,946,573	35%	198,438	34%	54,184	27%
65 - 80	2,201,935	13%	77,024	13%	16,959	9%
80 -	717,089	4%	25,607	4%	6,295	3%

To more clearly indicate this population dispersion, figure 4.6 shows the population in a pyramid, with men and women separated. Furthermore, the workforce is separated from the 'non' workforce through the use of colours. The grey colour represents the population that is over 65 years and is (probably) not working anymore. The green colour stands for children below the age of 15, who are considered not to work yet. The part of the graph in-between stands for the population that belongs to the workforce. Each bar in the graph represents a five-year age group.

Figure 4.6 **Population pyramid for Groningen in 2014** (Statistics Netherlands, 2015a)

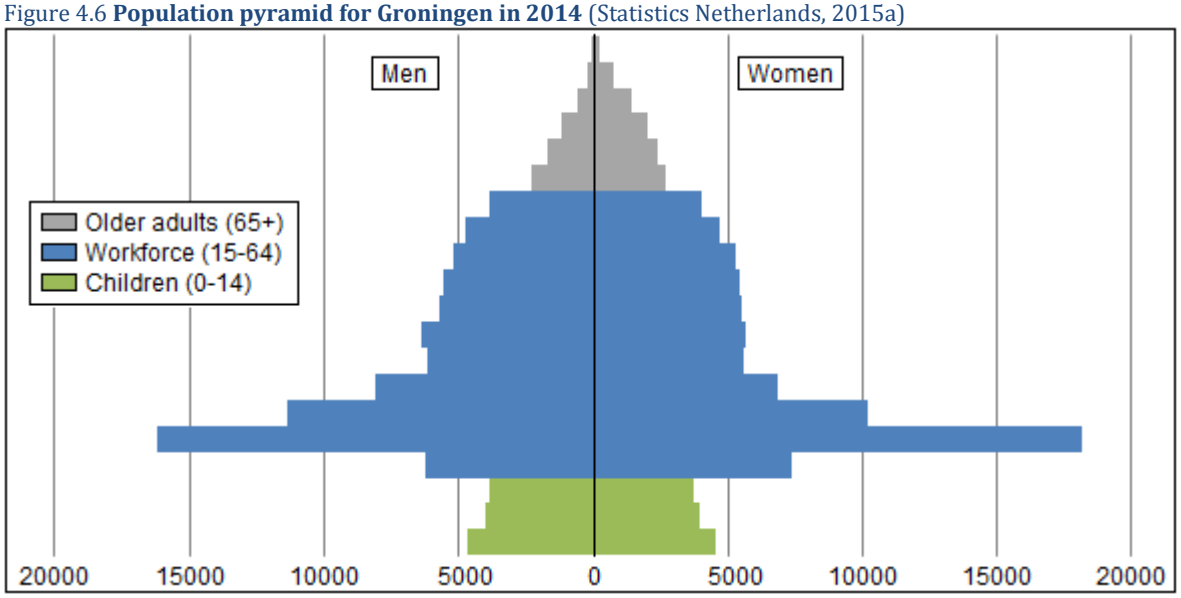
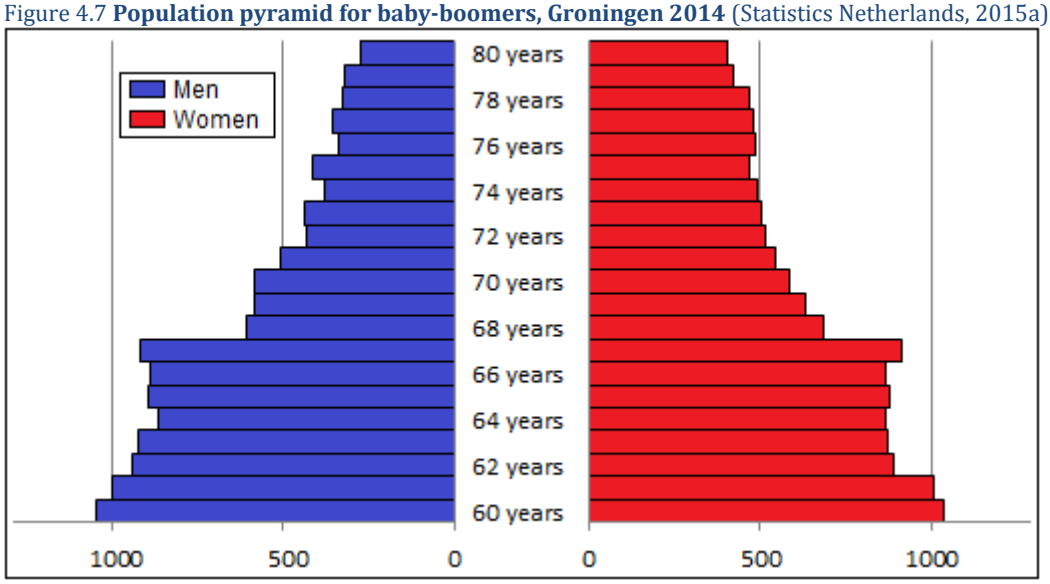


Figure 4.6 furthermore shows clearly the large number of students living in the city. Besides that, it shows that women tend to live longer, due to the larger grey bars on the women's side of the graph. Finally, the baby-boomers group is visible in this graph. The last several blue bars before the grey section are considered to be the baby-boomers' ages. A more detailed view of this transition is visible in figure 4.7.

Figure 4.7 **Population pyramid for baby-boomers, Groningen 2014** (Statistics Netherlands, 2015a)

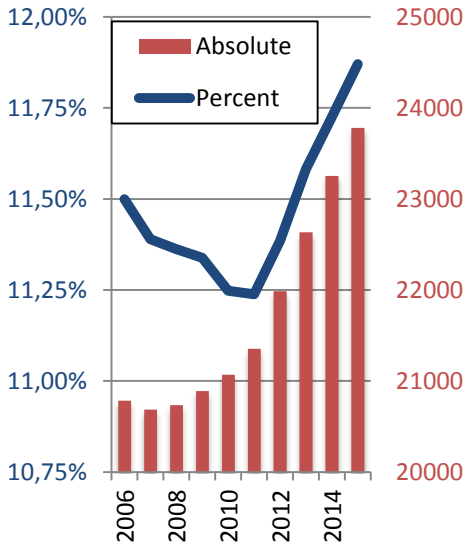


In figure 4.7, the population pyramid is drawn to emphasize a certain population group, the 60-80 age group. The graph shows clearly the group of baby-boomers who are 67 or younger (in 2014). This age group is part of the total population who will reach the status of older adults and will be more likely to stop working in the upcoming years. This effect is called the

ageing of the population. Because of the significant size of the baby-boomer age group, the ageing of the population will speed up in the upcoming years.

This pattern of ageing is already visible over the past five years. In figure 4.8, the number of people who are over 65 has been steadily increasing in the municipality of Groningen. This corresponds with the first cohort of adults belonging to the baby-boomers who retired in the last few years. The graph is furthermore split into the absolute numbers and the percentage of the population of the whole municipality. Both show that the group of older adults has grown significantly. However, the size of this group is quite low in comparison to the national percentage of approximately 17.4 as of 2014 (Statistics Netherlands, 2014a).

Figure 4.8 **Growth of the 65 years and older age group in Groningen in absolute numbers and as a percentage** (Statistics Netherlands, 2015a)



In the city of Groningen, there are currently living 23,254 older adults. This makes up 12% of the total population (Statistics Netherlands, 2014a; 2015a). In the Netherlands there are multiple unions that defend the interests of older adults in the Netherlands. Some of these unions are national organizations while others are more locally active. The three largest unions in the Netherlands are the ANBO (*Algemene Nederlandse Bond voor Ouderen*) (ANBO, 2015), Unie KBO (*Katholieke Bond Ouderen*) (Unie KBO, 2015) and the PCOB (*Protestants Christelijke Ouderen Bond*) (PCOB, 2015). In Groningen, they work together. An organization called SOOG functions as an overarching union for all three unions, and in this way serves more than 4.000 members (SOOG, 2015).

SOOG is the main union for older adults in the city of Groningen. It defends the interests of the elderly and is an important tool for communication between the elderly and the managers of the city and municipality. The SOOG addresses multiple fields, such as Politics and Finance, Social-Economic Assistance and Health Care and Welfare (SOOG, 2015). Besides these topics, the SOOG also addresses concerns about the traffic, transportation and mobility of the city. The organisation not only works bottom-up, where input from the members is brought to the city council, but also top-down, where it spreads news about upcoming events that are hosted by the municipality to its members.

Recently, the SOOG mobility team has set up a list of areas in Groningen that are considered dangerous places, in terms of traffic, for older adults. These points will be elaborated on more in the upcoming months before they are presented to the city council.

4.6 THE DUTCH POLICY FRAMEWORK

The Netherlands distinguishes three different layers when it comes to policy making. First there is the national level, which includes the entire Netherlands. Next there is the provinces layer, which includes 12 provinces. The third layer includes the municipalities, and consists of 403 municipalities. The planning of cycling infrastructure on the national level happens on a very broad scale. The government does not make concrete plans, but develops a list of key points on which the different provinces and municipalities should focus. These points concerning the cycling infrastructure in the Netherlands are: More cycle lanes and fewer traffic jams (Fiets Filevrij, n.d.; Rijksoverheid, 2014a); Reduce bicycle theft (Rijksoverheid, 2014b); Increase traffic safety (Rijksoverheid, 2014c); Increase bicycle racks at train stations (ProRail, n.d.; Rijksoverheid, 2014d). Special organizations are founded to address some of these key points, such as the *Fiets Filevrij* (Cycle Without Congestion*)*. On the other hand, the national government also tries to work together with private stakeholders such as ProRail, to provide more bicycle racks at train stations (ProRail, n.d.).

On the provincial level the plans made are more concrete than those from the national government. In the case of the province of Groningen, an overarching cycle policy has been developed. This is called the *Beleidsnota Fiets* (cycle policy document) (Provincie Groningen, 2013). The province's aims are defined in this document. For the province of Groningen these aims are: increasing the number of cyclists in the province and improvement of cyclists' safety (Provincie Groningen, 2012). Infrastructure outside the borders of municipalities, such as provincial roads, is planned and constructed by the province (Provincie Groningen, n.d.).

Finally, there is the planning of infrastructure that takes place at the municipal level. This is mostly about small projects that remain within the municipal borders. One issue that is part of the municipal agenda is the creation of cycle infrastructure within the municipality. The municipality also takes care of removing bicycles that are illegally parked or have not been used in a while (Gemeente Groningen, 2014b). Additionally, the municipality monitors the use of cycle lanes and sets up policies to encourage certain routes to avoid congestion (Gemeente Groningen, 2014a; Slimme Route, 2014).

4.7 WRAP-UP AND MOTIVATION FOR CASE SELECTION

The Netherlands and Groningen in particular are famous for their cycling networks. Cycling is a recognized and dominant mode of transport and cities try to adjust their environmental and infrastructure plans to it. Cities try to avoid cars in their centres and encourage people to use bicycles by constructing cycling lanes and creating cycling facilities such as guarded parking places.

However, the Netherlands and Groningen are also both dealing with an ageing population. In the upcoming years the percentage of older adults is going to increase rapidly. Additionally, a shift within the older adults is going to happen, too. Because cycling benefits people's well-being, municipalities are focusing on keeping their citizens as mobile as possible. This is an especially hot topic for older adults. Cycling has many benefits that can reduce health care costs and increase the well-being of the elderly.

Groningen is taken as the case study for this research because it represents one of the best-designed cities for cyclists. It is of moderate size and its large regional function makes it comparable with other cities in Europe that might face the same problems. Besides that, Groningen is a city for which a lot of data is available and a lot of research has already been done. For these reasons, Groningen is taken as the case for this research.

5. RESULTS

In the following chapter, the results from the various research methods are shown. First the results of the survey are presented, starting with the characteristics of the respondents, which are followed by the results of the questionnaire. The second part is about the online interviews done with some of the survey participants.

The survey was taken by 78 respondents; however, only 70 of these were filled in completely and could be used for statistical analysis. The analysis was done with use of the program IBM SPSS 22; whenever a comparison is called significant, a significance level of $p < 0.05$ is used. The creation of the maps was done with ArcMap 10.2.

Additionally, eight interviews were done. Seven of these were useful for analysis. Because of the relatively small sample, the analysis of these interviews was done without an extensive codebook and coding of the answers.

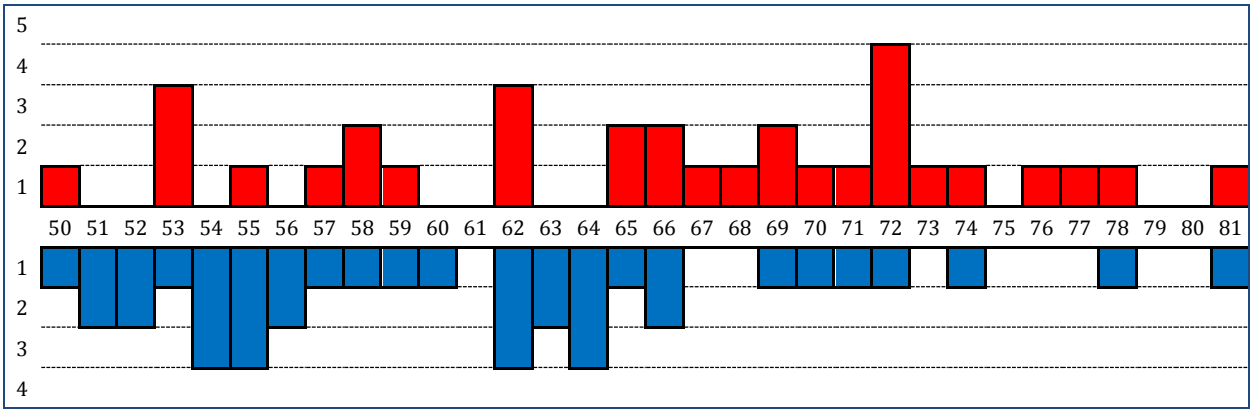
5.1 CHARACTERISTICS OF THE SURVEY RESPONDENTS

Table 5.1 shows the distribution of the respondents by sex. Due to the fact that the questions about age and other personal information were at the end of the survey, the sex and age of the respondents for the incomplete surveys is unknown. These are mentioned as 'missing values' here. In this case the distribution was almost even, although the group of male respondents was slightly larger. The distribution of age can be seen in figure 5.1. In this figure the age and sex of the respondents are combined. The red bars stand for the females, and the blue bars represent male respondents. The figure shows that there are somewhat more males in the lower age groups and somewhat more females in the higher age groups. However, this difference is not very great.

Table 5.1 **Number of survey respondents**

Category	n
Female	*33*
Male	*37*
Missing values	*8*
Total n	*78*

Figure 5.1 **Age distribution of the 70 respondents**



Out of the 70 completed surveys, 62 respondents currently live within the city of Groningen. The other 8 respondents mostly live in surrounding municipalities such as Haren. The geographic distribution of the respondents can be seen in figure 5.2. To simplify this, all zip codes that share the first three numbers have been grouped together. This figure shows that most respondents come from the areas with zip codes 9710 and 9720. This percentage might be the highest due to the fact that recruiting of respondents occurred partly in the city centre, which is located on the south side of area 9710, and is thus near to both areas.

Figure 5.2 **Distribution of the respondents by zip code in the city of Groningen**

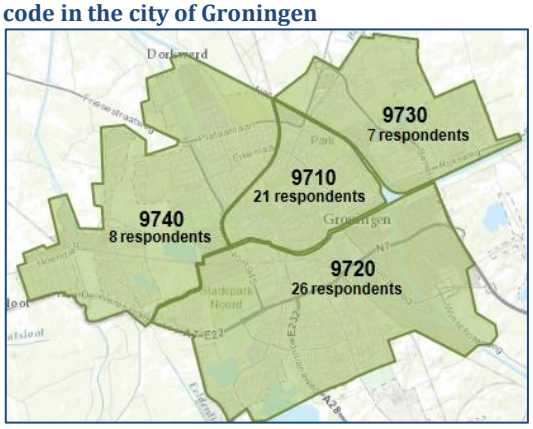
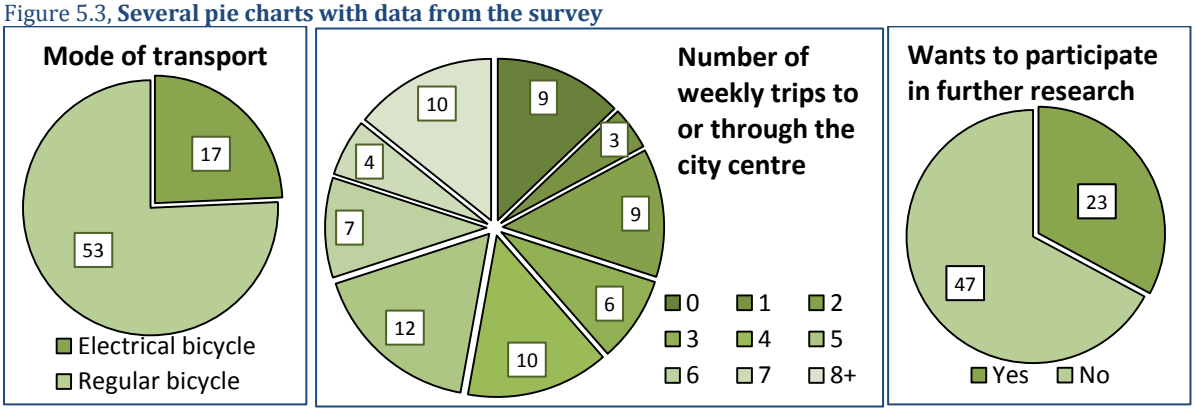


Figure 5.3 below shows three different pie charts with data from the survey. The first pie chart represents the percentage of use of different modes of bicycle transportation. Almost one-quarter of the sample (24%) uses an electric bicycle. The other three-quarters (76%) still use a regular bicycle.

The second pie chart shows the number of trips the respondents make weekly to or through the city centre. This varied between 0 and 25; to simplify the data, all respondents that indicated 8 or more trips were put into one group. Roughly half (47%) of the respondents cycle to or through the city centre at least five times a week.

The final pie chart show the numbers of respondents who would like to participate in further research (through interviews). A total of 23 respondents reported that they would like to take part in additional studies, 33% of the sample. However, only 22 of these respondents gave their details so that they could be contacted later.

Figure 5.3, **Several pie charts with data from the survey**



5.2 DESCRIPTIVE STATISTICS FOR THE SURVEY

Respondents had to answer questions about a total of 36 different infrastructure types. As explained in the theoretical framework, each of these 36 infrastructure types is defined by three variables: the road type, the speed limit, and the cycling infrastructure (see also appendix IV).

The following three figures on the right show the average ratings for the 36 different questions. Each figure represents the results for a different road type (letter variable), where the columns stand for the speed limit and the rows for the type of cycling infrastructure. The ratings used in the figures are on a 1 to 10 basis, and were recalculated from the ratings (from 1 to 7) the respondents gave on the survey. This was done to simplify the data, a rating from 1 to 10 is common in the Netherlands. A rate of 5.5 would be the break point for a sufficient score, or an insufficient score. A higher score stands for a safer road. A pattern can be detected such that both the speed limit and the type of cycling infrastructure influence the safety rating given by the respondents, for all three road types. Comparisons between the ratings were made and are presented later on.

Figure 5.4 **Means for the infrastructure types (A)**

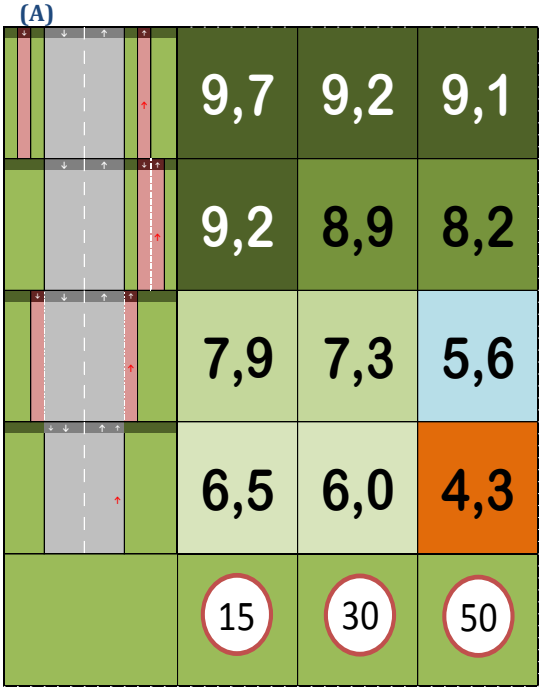


Figure 5.5 **Means for the infrastructure types (B)**

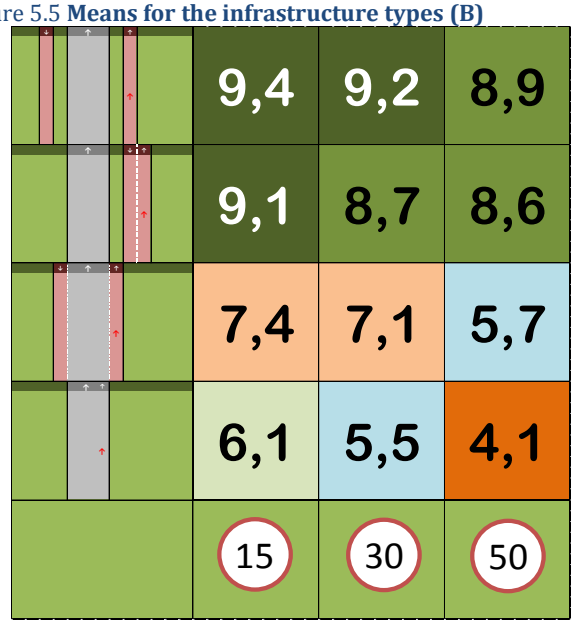
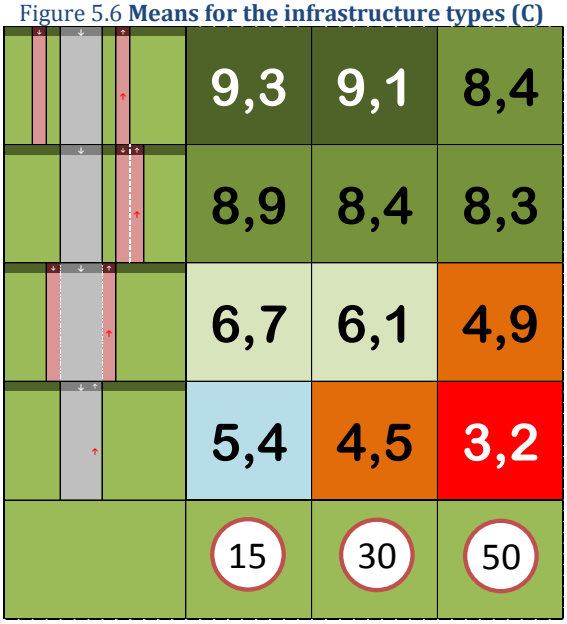
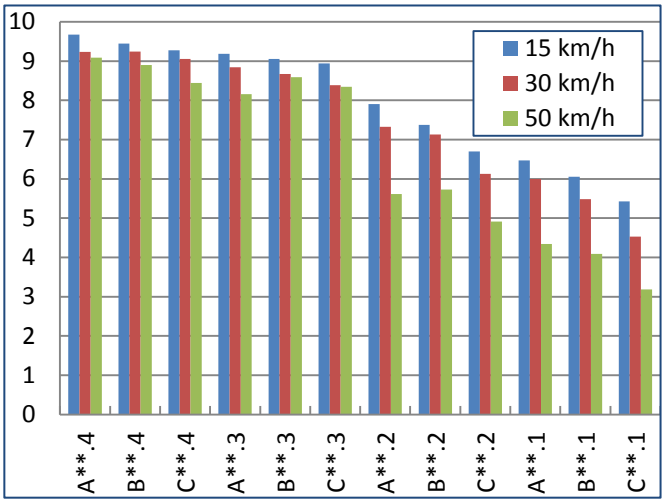


Figure 5.6 **Means for the infrastructure types (C)**



These data can also be visualized in a graph. This graph shows that roads with cycling infrastructure types three and four do not differ too much when compared on their speed limits. However, cycling infrastructure groups one and two do show a big difference in perceived safety; the roads with a maximum speed of 50 tend to be rated much lower there.

Figure 5.7 **Bar chart of all 36 ratings.**



When looking in greater detail, different conclusions can be drawn from the data gathered through the survey. Because the respondents had to rate all different kinds of infrastructure types, a top-10 list of the worst and best infrastructures can be made. These two top lists can be seen in table 5.2. Respondents who completed the survey had to rate the different types of infrastructure on a scale from one to seven. The ratings were then recalculated on a 1 to 10 scale.

As can be seen in table 5.2, the ten best roads all have cycling facilities in category 3 or 4. The ten worst roads on the other hand all have category 1 or 2 cycling facilities. Another remarkable difference is the maximum speed for motorized traffic. The best types of infrastructure are mostly 15 and 30 speed limit roads, whereas the worst roads are the roads with mostly speed limits of 30 and 50 kilometres per hour. The road type does not differ that much between the two lists.

Table 5.2 **List of the 10 best and worst types of infrastructure**

	Top 10 best types of infrastructure for safety			Top 10 worst types of infrastructure for safety	
		Road type	Grade	Road type	Grade
1		A15.4	9.7	C50.1	3.2
2		B15.4	9.4	B50.1	4.1
3		C15.4	9.3	A50.1	4.3
4		B30.4	9.2	C30.1	4.5
5		A30.4	9.2	C50.2	4.9
6		A15.3	9.2	C15.1	5.4
7		A50.4	9.1	B30.1	5.5
8		B15.3	9.1	A50.2	5.6
9		C30.4	9.1	B50.2	5.7
10		C15.3	8.9	A30.1	6.0

5.3 STATISTICAL ANALYSIS OF THE SURVEY

To see whether average safety perceptions for different situations really differ significantly, paired sample t-tests were done with IBM SPSS 22. A total of 36 different infrastructure types are possible by varying the three different factors (3 road types, 3 speeds and 4 types of cycling infrastructure). Each of these types can be compared with seven other infrastructure types, because as long as 2 variables stay the same, a comparison is relevant. Summed up, this means that 126 different tests could be done. The table in appendix II shows which infrastructure types were compared with each other. Out of the 126 tests, 103 of them showed a significant difference in safety perception. More remarkable are the 23 tests where there was no difference in safety perception. This means that the variable for which the two infrastructure types are different does not influence perceived safety, at least not when comparing those two possible values.

In 15 out of the 23 non-significant comparisons, the comparison was between two different road types, with the speed limit and cycling infrastructure left the same. A total of 36 comparisons between different road types were made overall; 42% of those comparisons were not significant. When comparing the different speed limits for motorized traffic, 36 different comparisons can be made. Out of these 36 comparisons, 31 were significant and only 5 (14%) did not show a significant difference in perceived safety. There are 54 possible comparisons between the four different types of cycling infrastructure. Among these comparisons, 51 showed a significant difference and only 3 (6%) did not.

More interesting for this research is a comparison between two age groups. In this case the respondents were split into adults between 50 and 64 years old, and respondents who are 65 or older. These two groups can be seen in table 5.3. A division into three groups each covering 10 years did not show any significant differences. Division into more groups than that would have decreased the group sizes too much to do the relevant statistical analysis.

Table 5.3 **Two different age groups**

Category	n
50-64 years old	39
65+ years old	31
Total	70

Respondents between the age of 50 and 64 gave an average safety rating of 7.7, while the older respondents gave an average rating of 6.9. Comparisons were made with h_0 = 'There is no difference in ratings between the two age groups', and h_1 = 'There is a difference in ratings between the two age groups'. When comparing these two means with the independent samples t-test, a significance level of 0.003 is shown, which indicates a significant difference between the total means for the two groups. This means that h_0 can be rejected and h_1 can be assumed.

It gets even more interesting when the different questions are compared one by one. Table 5.4 shows the result of this comparison, where the means by age group for all 36 questions have

been compared using independent samples t-tests. The pattern of the significant outcomes is remarkable. The negative means between the two age groups explains why there are so many significant outcomes in the comparisons.

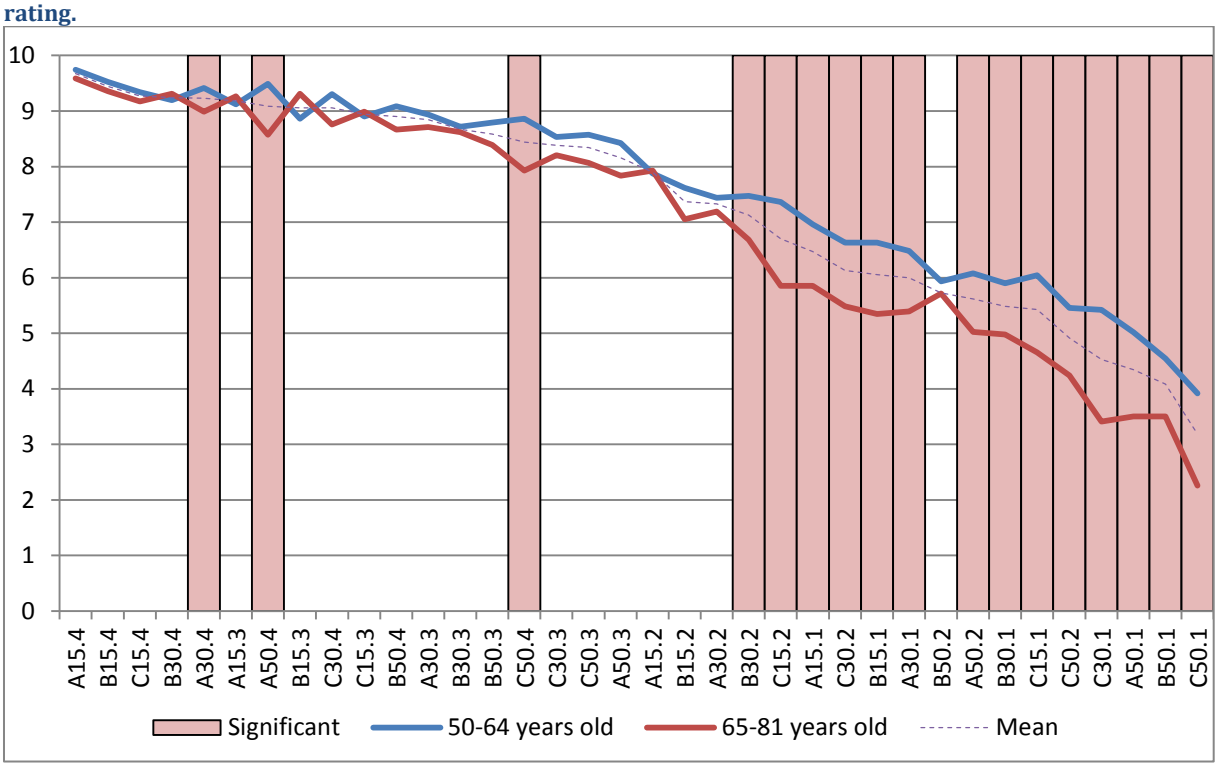
Table 5.4 **Comparison between the two age groups and the 36 different infrastructure types, significant results in red**

Infrastructure type	Grade 50-64 years old	Grade 65-81 years old	Difference	Significance level	Infrastructure type	Grade 50-64 years old	Grade 65-81 years old	Difference	Significance level	Infrastructure type	Grade 50-64 years old	Grade 65-81 years old	Difference	Significance level
A15.1	7.0	5.9	-1.1	0.024	B15.1	6.6	5.3	-1.3	0.004	C15.1	6.0	4.7	-1.1	0.003
A15.2	7.9	7.9	0.0	0.900	B15.2	7.6	7.1	-0.5	0.195	C15.2	7.4	5.9	-1.5	0.001
A15.3	9.1	9.3	+0.2	0.614	B15.3	8.9	9.3	+0.4	0.129	C15.3	8.9	9.0	+0.1	0.795
A15.4	9.7	9.6	-0.1	0.442	B15.4	9.5	9.4	-0.1	0.526	C15.4	9.3	9.2	-0.1	0.537
A30.1	6.5	5.4	-1.1	0.010	B30.1	5.9	5.0	-0.9	0.031	C30.1	5.4	3.4	-2.0	0.000
A30.2	7.4	7.2	-0.2	0.554	B30.2	7.5	6.7	-0.8	0.037	C30.2	6.6	5.5	-1.1	0.009
A30.3	8.9	8.7	-0.2	0.527	B30.3	8.7	8.6	-0.1	0.781	C30.3	8.5	8.2	-0.5	0.396
A30.4	9.4	9.0	-0.4	0.039	B30.4	9.2	9.3	+0.1	0.684	C30.4	9.3	8.8	-0.5	0.076
A50.1	5.0	3.5	-1.5	0.001	B50.1	4.5	3.5	-1.0	0.018	C50.1	3.9	2.3	-1.6	0.000
A50.2	6.1	5.0	-1.1	0.033	B50.2	5.9	5.7	-0.2	0.652	C50.2	5.5	4.2	-1.3	0.009
A50.3	8.4	7.8	-0.6	0.151	B50.3	8.8	8.4	-0.4	0.266	C50.3	8.6	8.1	-0.5	0.221
A50.4	9.5	8.6	-0.9	0.003	B50.4	9.1	8.7	-0.4	0.185	C50.4	8.9	7.9	-1.0	0.026

As can be seen in the table, all survey questions presenting situations that were categorized as cycling infrastructure type 1 (all infrastructure types that end with .1, also highlighted in pink) show significant age group differences in safety perceptions. See appendix IV for more elaboration with regard to the infrastructure coding. These options that make up 9 of the 36 questions all have in common that a cycling infrastructure is missing, placing them in group 1 in terms of cycling infrastructure. These nine type 1 infrastructure situations are consistently different by age group, while the other significant differences for the different age groups do not seem to follow a particular pattern.

It gets even more interesting when looking at all the different ratings listed from the best infrastructure type to the worst infrastructure type. This can be seen in figure 5.8. The blue and red line represent the ratings the two different age groups gave for all the different infrastructure types. The red bars represent the infrastructure types where a significant difference was measured between the two groups. It is remarkable that most significant differences occur for the cases that are considered less safe. As figure 5.8 clearly shows, the gap between the means of the two groups gets bigger as the overall safety ratings get lower.

Figure 5.8 **The means of the two age groups on every question, independently sorted from highest to lowest rating.**



The ratings by the two age groups presented in figure 5.8 have been visualized in two different maps as well. These maps can be found in appendices IV and V. Both maps show the ratings from one to ten for each road in the city centre of Groningen. The major roads into the city centre are also visualized to show the connection between the city centre and the suburbs.

The differences seen in figure 5.8 are also visible in the two maps. Roads that are regarded as safe, such as the road that runs in front of the train station, show little to no difference when being compared. However, the roads that are regarded as less safe or unsafe show significant differences on the maps. A good example of this is the road that borders the canal around the city centre in the north and east. This road is marked as a 'B50.1' road, where there is one-way traffic, a speed limit of 50 for motorized traffic, and no cycling infrastructure.

Furthermore, the map in appendix V (for the 50-64 age group) shows just a few orange roads that are regarded as not very safe. Appendix VI (for the 65 and over age group) shows more shades of orange and even red roads. Because the focus of the survey was upon roads that cyclists must share with motorized traffic, many roads in the city centre of Groningen could not be linked to the 36 possible types addressed in the survey. These roads are marked with either a black line or a black dotted line. Officially these roads are free of non-motorized traffic. However, taxis, buses and trucks often do take these roads to deliver goods or transport people. Among these roads are the Folkingestraat and the bridge at the Groninger Museum. These roads are known for being very busy and crowded with traffic.

5.4 RESULTS OF THE INTERVIEWS

The results from the survey led to a list of 10 most remarkable conclusions (See appendix VII). This list was sent to all respondents who wanted to participate in further research. Along with this list of conclusions, a list of six questions was included in the e-mail. The respondents were asked to answer these questions regarding the findings of the survey. Of the 22 respondents who wanted to participate in further research, eight of them responded to the interview by e-mail. However only 7 of these responses were useful, Sam (M, 74) only replied that he agreed on all the results and had nothing to add, ignoring the questions attached to the e-mail. . To secure the anonymity of the respondents, their names have been changed to pseudonyms. Their full answers can be seen in appendix VIII.

Table 5.5 **List of interview respondents**

#	Pseudonym	Sex	Age
1	Catelyn	F	70
2	Jaime	M	65
3	Jon	M	64
4	Lysa	F	66
5	Myranda	F	72
6	Robert	M	55
7	Rodrik	M	64
8	Sam	M	74

The respondents were asked to what extent they were surprised by the results that were shown in the attached file. Almost all respondents answered that they found most of the results not surprising. For example, Myranda (F, 72) said: “The findings are in line with what I expected”. Jon (M, 64) agreed with this, saying: “Your conclusions are in line with my expectations”. Robert (M, 55) said that there are only a few things that surprise him in the list of findings. According to Catelyn (F, 70), most of the results of the research seem pretty logical to her. Rodrik (M, 64) said: “In general I am not surprised by the results”.

Lysa (F, 66), Jaime (M, 65) and Jon were the only ones who specifically pointed out findings by which they were surprised. For Lysa this was point 9, about the low rating for the one-way roads in the city centre, where the maximum speed is set to 30. She said: “I regard those roads as pretty safe.” Jaime referred in his answer to point 5, about the roads that were rated the lowest. According to him, it is not the combination of infrastructure and driving speed, but the cyclists cycling on every part of the road and passing other traffic on the left side. Jon mentioned point 7, about the cycling path on the north side of the Gedempte Zuiderdiep, as surprising. In his opinion, that cycling path is not very safe due to the slippery road when wet and lack of clarity with its many crossings.

It is this importance of context mentioned by Jon that many of the other respondents also came up with. Myranda explained that unsafe feelings when cycling are also triggered by people who disregard the rules, or where the roads are very crowded. Myranda and Jaime both mentioned pedestrians who suddenly decide to cross the street without looking out for cyclists. Furthermore, Rodrik, Jaime and Jon mentioned the crossings where all cyclists have green lights

at the same time. Rodrik said: “This creates the most dangerous situations”; Jaime said: “Cyclists lack the rules and ride criss-cross the streets”; and Jon said that crossings are responsible for unsafe feelings especially during rush hours. Finally, Jon mentioned the quality of the pavement itself as a factor that determines safety.

This role of context and the influence of external factors are also seen in the answers to the question about which roads are regarded as unsafe. It is remarkable that most respondents picked roads where buses drive too. Lysa mentioned the switch from Kreupelstraat towards Sint Walburgstraat where she was once cut off by a harmonica-bus. Robert noted the east side of the Grote Markt as a unsafe road, a road that is well-known for the high number of buses that pass every hour. Jaime came up with the Brugstraat and the Zuiderdiep, a 5.0 and 5.5 respectively according to the survey (after recalculation), both roads where buses drive too. However he did not specifically say that buses are the main reason. According to him, cars that try to park are causing the trouble there. Myranda picked two roads in the northern part of the city centre. She noted the Ebbingestreet, a 5.0 according to the survey, for being too busy, and also the crossing between Korreweg and Boterdiep. Lysa mentioned this last crossing as well for feeling unsafe. Catelyn addressed the connection between the Damsterdiep and the Schuitendiep, due to the sudden turn in the main road, where cyclists often get cut off by cars. This specific corner was rated a 5.7 according to the survey. Rodrik said that in his opinion, crossings in general cause the most unsafe roads in Groningen. This is in line with the crossings mentioned by Catelyn, Myranda, and Lysa. Jon only said that in his opinion the width of cycling paths in general is too narrow; according to him, the city of Nijmegen has much wider cycling paths, which creates a higher safety perception.

Roads that are regarded as safe in the municipality varied per respondent. For example, Jaime named the Paterswoldseweg and the Hereweg, two roads where motorized traffic is allowed to drive 50 kilometres per hour. However the cycling infrastructure is regarded as type 4. These road types were rated a 9,1 according to the survey results. Robert said: “Zuiderdiep north side, except for the crossing with the Herestraat." The Zuiderdiep north side had the highest safety rating of all roads, at a 9,2. The link to crossings is again noteworthy as an important external factor. Lysa mentioned the Folkingestraat and the A-weg as safe roads. The Folkingestraat is not accessible to motorized traffic, so no rating is available for that road. However, the A-weg, with a 9.1, was also rated as a very safe road according to the survey results. Myranda and Rodrik did not answer this question and Catelyn could not come up with roads that she regards as safe. As mentioned in the previous paragraph, Jon only said that the wider cycling paths in Nijmegen felt safer than the narrower cycling paths in Groningen.

6. CONCLUSIONS, DISCUSSION & RECOMMENDATIONS.

In the following chapter several conclusions are presented. This is done by first making a statement, followed by a short explanation and elaboration. In the second part, the discussion takes place, as to which parts of the research could have been better and what the limitations of this research are. Finally, the recommendations are presented regarding what is interesting for further research, which topics could have been explored more and which fields need more attention.

6.1 CONCLUSIONS

Older adults in the 65-81 year old age group give significantly lower safety ratings to infrastructural situations than adults in the 50-64 year old age group.

First, it can be said that a difference in safety perception exists between different age groups. The 50-64 age group gave significantly higher safety ratings than the 65-81 age group. When the sample was divided into three age groups covering 10 years each, there were no significant differences to be found. This significance caused by the 'two group-division' might be caused by the higher percentage of women in the higher age group, and the larger percentage of men in the lower age group. A general comparison between just men and women did show a difference in means, but this difference was not significant. A bigger sample could have provided more detailed data to create more certainty about this.

Different road types have limited influence on safety perception, but speed limit and cycling infrastructure types have much more influence.

Second, interesting things can be said about the influence of different road-related factors. From the statistical analyses of all the ratings, it appeared that road type is of less importance than speed limit and cycling infrastructure. Cycling infrastructure types three and four are quite similar and are rated high for safety, but cycling infrastructure type four is rated even higher than all other cycling infrastructures. A clear pattern can be seen that the cycling infrastructure types are ordered from least safe, to most safe. Cycling infrastructure type one always has the lowest rating and number four always the highest

As soon as the cyclists' own place on the road is lost, the speed limit becomes an influential factor.

Speed limits of 15 and 30 show only small differences in safety ratings, no matter what the cycling infrastructure is. A speed limit of 50 shows different results. With cycling infrastructure types three and four, the difference in safety ratings is still not very big. However, a much bigger difference occurs when looking at cycling infrastructures one and two. A key difference between cycling infrastructures one and two, and cycling infrastructures three and four is whether cyclists have their 'own' place on the road (see also figure 5.7). It can thus be said that whenever as the cyclists' own place on the orad is lost, the speed limit becomes an influential factor.

The gap between the ratings from the two age groups increases significantly when a situation is generally regarded as less safe.

As well represented in the maps in appendices V and VI, an interesting difference is noticeable between the two age groups. The safest infrastructure types showed almost no difference between the two age groups. However, the lower a situation was rated on average, the bigger the gap was between the ratings of the two groups. This can also be seen in figure 5.8. In most of the lower ratings, the difference in means is significant. An area in Groningen that shows this big difference is the north and east side of the canals in the city centre. These roads are rated a 5.1 according to the 50-64age group, and only 3.5 according to the 65-81age group. This road is also known for being a big issue for cyclists.

The abstract rating of different infrastructure types is a useful way of determining safety perception.

After all mean ratings were calculated, the list of ratings with examples of roads that belong to those types were sent back to the respondents. They were asked to reflect on them. Most of the findings were not surprising, according to the respondents. This indicates that perceived safety of roads can be determined through an abstract survey. However, context is very important too, as many respondents replied. Crossings, other traffic, bad roads and people neglecting the rules are also causing perceptions that the roads are unsafe.

Population ageing will increase the percentage of older adults, and so also the percentage of people who perceive roads as dangerous for cycling.

As was shown in chapter 4, population ageing is going to be a big deal in Western Europe. This will also be the case in the Netherlands. The survey as well as the interviews have already shown that a significant difference in safety perception exists between two adult age groups. This means that the group of people that perceive roads as dangerous, those 65 and over, will increase even more in the future. The city of Groningen should try to stay ahead of this problem by improving roads that were rated as low in safety. According to the plans released in June 2015, the city has plans for redeveloping the north and east side of the roads along the canal.

6.2 DISCUSSION

As with any research, there is always room for improvement. For example, the sample for this research was quite limited. A bigger group of respondents for the survey could have allowed more detailed results. Besides that, it would have been possible to split the sample into three or more groups for a more detailed overview of the differences in ratings. Furthermore, a bigger age span could have led to interesting results, too. The age groups below 50 and above 80 might have different perceptions of cycling safety in the city of Groningen. A bigger sample could also yield more details about the difference in gender.

The way the respondents for the survey and interview were recruited can also be discussed. Most of the respondents were contacted in the Groningen city centre. This assumes that they are mobile and able to reach the city centre, which makes it impossible for immobile older adults to respond to the survey. Inclusion of this group of immobile adults might have led to different research results. Another big group of participants responded to the online survey. This can also be debated. Not every older adult has a computer with an internet connection.

Roads and infrastructure are complex systems, where context is very important. This study mainly focused on abstract infrastructural situations. The research did show some connection between the abstract research and feedback on those results from the respondents. However context remains very important when rating roads on their perceived safety.

Additionally, it was difficult to classify every road in the city centre of Groningen. Some roads are presented on maps as car free, such as the roads along the Vismarkt and Grote Markt, but taxis, market stalls, trucks and buses take these roads often. This is again an aspect of road context

that is not integrated in this research. Besides that, there are also roads where there is a lot of congestion for cyclists, but where motorized traffic is not allowed, such as the bridge from the train station towards the Folkingestraat. This road was also not taken into account in this research due to its lack of motorized traffic.

Another point of critique concerns the questions in the survey. These were all presented in a fixed order. This made it hard for the respondent to rate the situation in the first questions because they could not compare it with other questions. In this research the first question was about type A50.4, this option that was rated quite high. A mixed order of questions might have led to different research results.

6.3 RECOMMENDATIONS

Many recommendations can be made for further research. First of all, research making a comparison might be interesting. Groningen is already regarded as a cycling-friendly city, where cyclists are often valued over cars. Picking a city that is not cycling-friendly might give completely different results about safety perception. On the other hand, comparison with another cycling-friendly city such as Berlin or Copenhagen might be interesting, too.

Furthermore, broader research taking more age groups into account might also be interesting. Research on every age group in the society might show some interesting curves about safety perception in traffic in general, and might provide interesting insights about children's safety perceptions as well.

Research that focuses more on context is also recommended. This research had a primarily abstract focus with a small connection between the abstract level and the real world level. Research that incorporates real world observations and more interviews about safety perceptions might give new and interesting results about how older adults perceive safety in traffic. In this way context could also be taken into account more.

Another interesting line of research could pay more attention to the respondents' gender. In this research, the data were too limited to find significant differences by gender. In further research it might be interesting to see to what extent gender affects perceived safety. As Beecham and Woods (2013) said, women and men do have different reasons for cycling, do take different routes and see themselves differently in traffic.

7. REFLECTION

When I look back on this research and the research process, I see a lot of points that I could improve. First of all is my planning. In November I made a plan suggesting that I would finalize my entire thesis on June 18, 2015, the day before my birthday. Today we are more than two months further and I am about to finalize it. I have learned that it is hard to make an accurate plan and it is even harder to stick to your own plan. Some deadlines that were set by the university helped me a lot, like the deadline for the first three chapters in the beginning of this year. However, from that point on, I did not do a thing for weeks, except e-mailing with respondents and looking for respondents for my survey.

Another thing that I learned is that you have to dare and try, and that you can't tell wether doors are locked unless you try them. I contacted the *ouderraad* (older adults union) of Groningen in the beginning of this year, and they did not want to cooperate because they were already working on a research project. After contact with the faculty of behavioural and social sciences, we came to an agreement, that we would share our results to contribute to each other's research. Later in June I contacted them but never got a reply, which is sad, but I already had plenty of data myself to work with, because I convinced the *ouderraad* to cooperate with me.

Furthermore, I have experienced how difficult it can be to collect data. Respondents are often in a hurry, or say they do not live in Groningen (while they are walking their dog). It took me several days of asking people in the streets to complete my survey. I do realize that the number of completed surveys is perhaps not sufficient for making strong statements, but they give at least an indication.

Besides this, I found it also very hard to keep a clear overview of all the things that I had found, written and collected. It is easy to lose data or the right source, or forget things you heard from people in the street, for example. This documentation of things is something I could have done better. When finalizing my thesis it was a lot of work to refer to the right sources and put all the appendices in the right order.

8. APPENDICES

APPENDIX I

The survey that was held, the online survey was in full colour.

ENQUÊTE FIETSINFRASTRUCTUURBEHOEFTEN GRONINGEN

De onderstaande enquête gaat over de fietsinfrastructuur. Er zijn 36 mogelijke situaties weergeven hoe de fietsinfrastructuur naast de bestaande infrastructuur vormgegeven kan worden. Wilt u de onderstaande scenario's scoren op veiligheid? Waarbij 1 staat voor: *zeer onveilig*, 4 staat voor: *niet onveilig, niet veilig*, en 7 staat voor: *zeer veilig*.

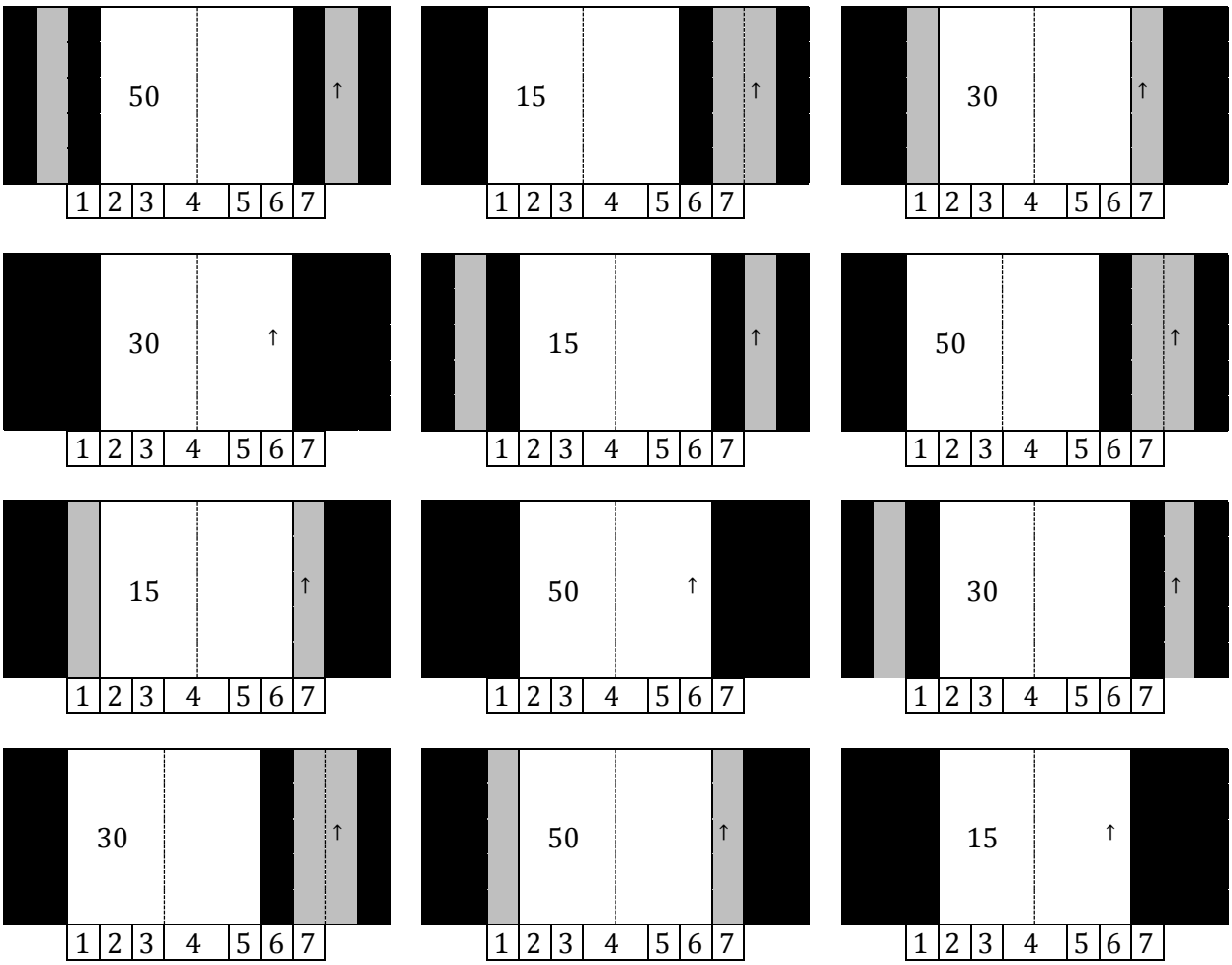
- Houd rekening met de rijrichting van het overig verkeer
- Houd rekening met de aangegeven snelheid voor overig verkeer
- U fietst waar de pijl staat.

rijksuniversiteit groningen

Dit onderzoek wordt gedaan voor een masterthesis vanuit de faculteit ruimtelijke wetenschappen aan de rijksuniversiteit Groningen.

Bedankt voor uw medewerking,
Tom Moekotte

TWEE-RICHTINGSWEGEN



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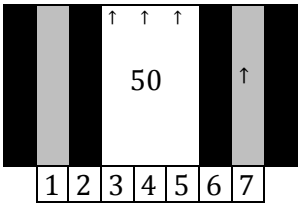

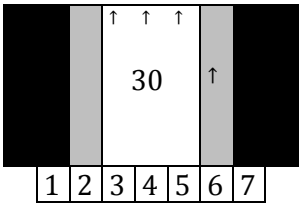

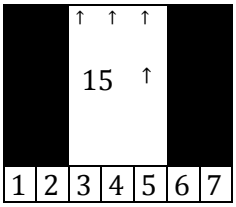

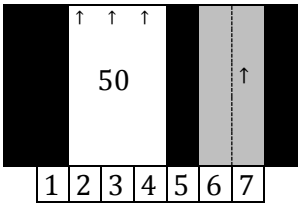

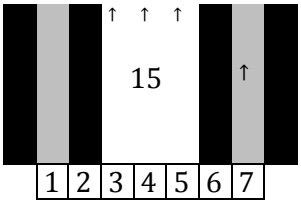

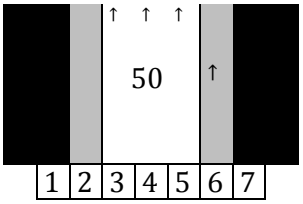

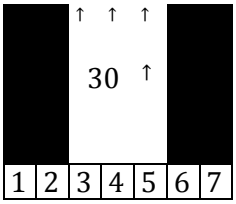

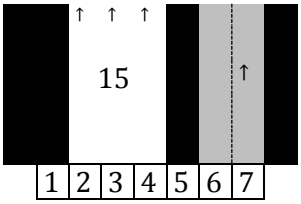

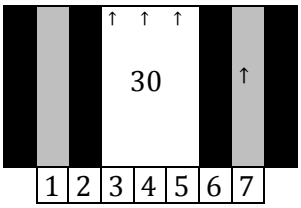

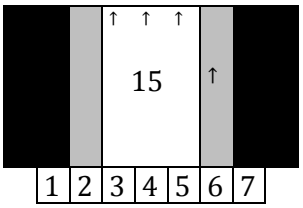

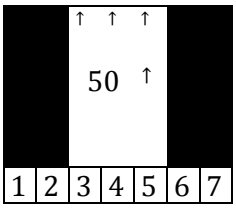

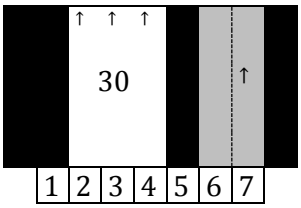

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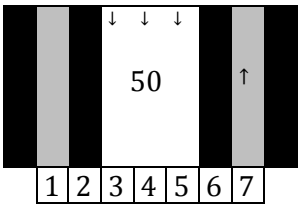
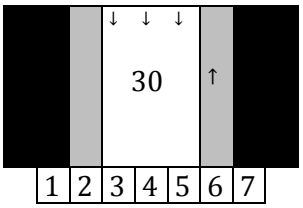
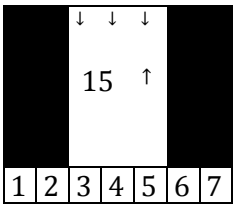
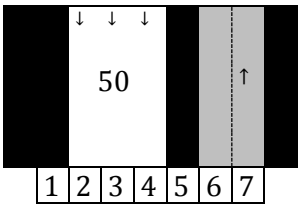
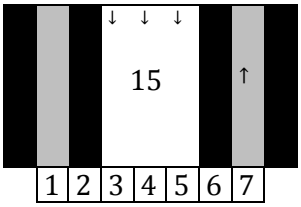
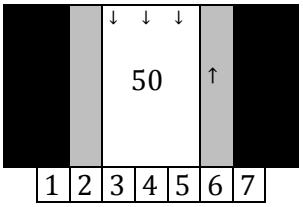


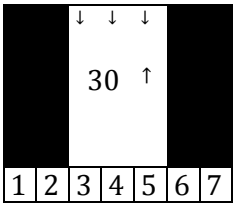


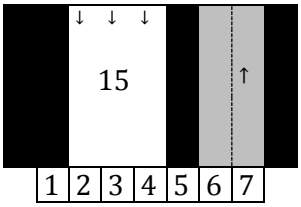


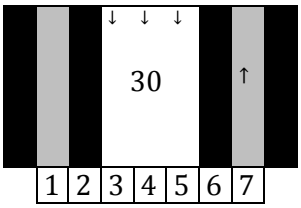


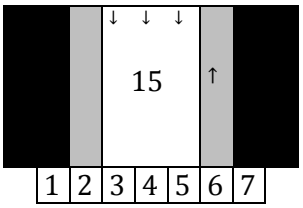


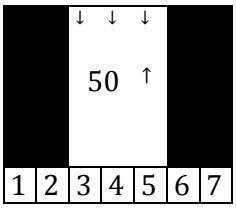


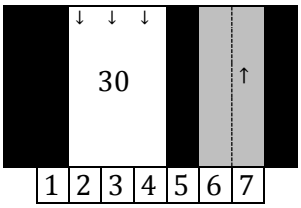












OVERIGE VRAGEN

Wat is uw geslacht? M/V

Wat is uw leeftijd? ……..

Wat is uw postcode? ……

Hoe vaak per week fietst u door het centrum van Groningen? ……..

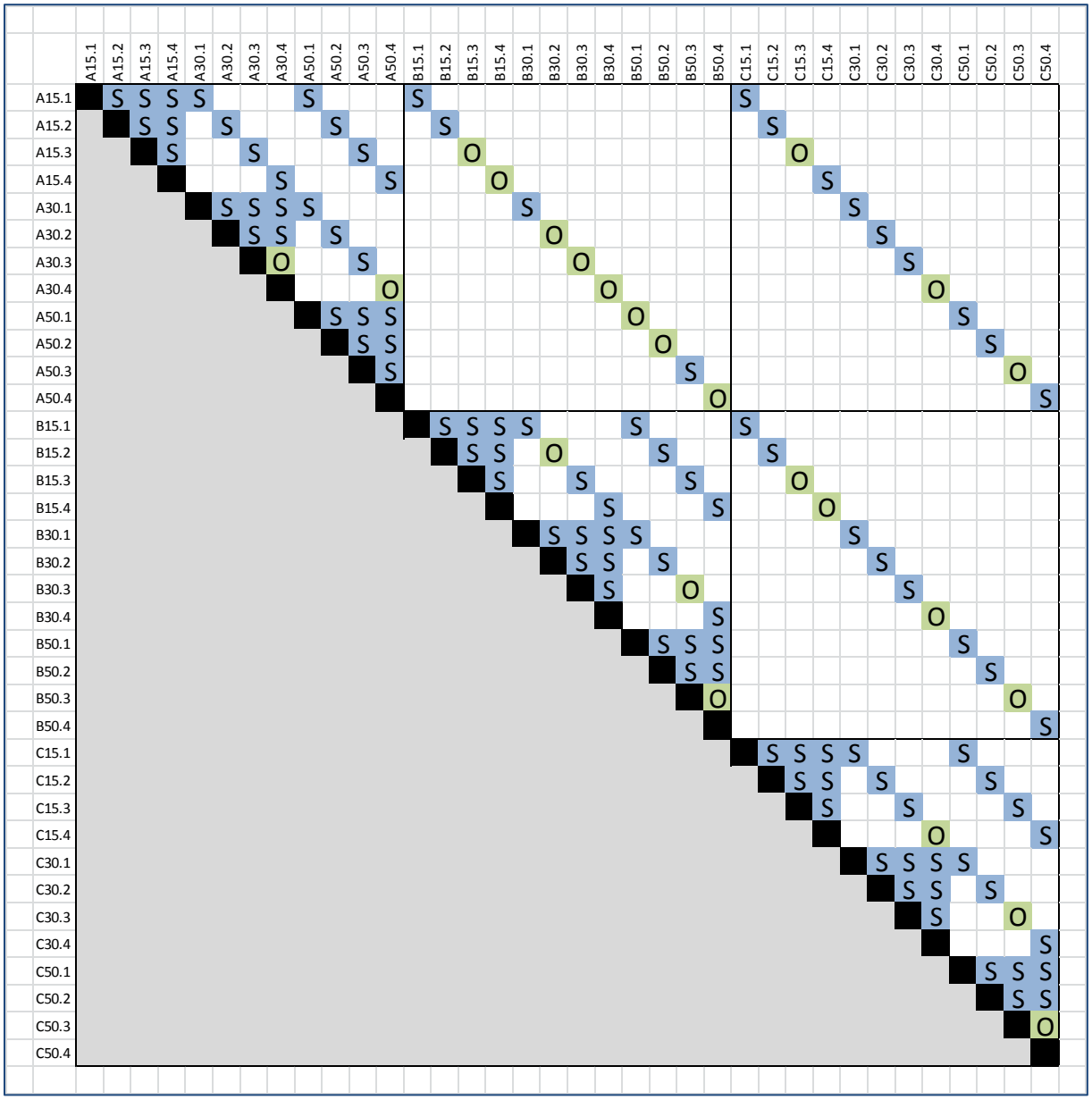
Rijdt u een elektrische fiets? Ja/Nee

Zou u mee willen werken aan vervolg onderzoek door middel van interviews? Ja/Nee

Indien ja, wat is uw email-adres of telefoonnummer?

……

Table with 126 different paired-sample t-tests. Blue fields with an S stand for comparisons that yielded significant results. Green fields with an O showed no significant difference.



	A15.1	A15.2	A15.3	A15.4	A30.1	A30.2	A30.3	A30.4	A50.1	A50.2	A50.3	A50.4	B15.1	B15.2	B15.3	B15.4	B30.1	B30.2	B30.3	B30.4	B50.1	B50.2	B50.3	B50.4	C15.1	C15.2	C15.3	C15.4	C30.1	C30.2	C30.3	C30.4	C50.1	C50.2	C50.3	C50.4
A15.1		S	S	S	S				S				S												S											
A15.2	S		S	S		S				S				S												S										
A15.3	S	S		S			S				S				O												O									
A15.4	S	S	S					S				S				O												S								
A30.1	S	S	S	S		S	S	S	S								S												S							
A30.2	S	S	S		S		S	S		S								O												S						
A30.3	S	S	O		S	S					S								O												S					
A30.4	S			S								O								O												S				
A50.1	S	S	S		S					S	S	S									O												S			
A50.2	S	S	S			S			S		S	S										O												S		
A50.3	S	S	S				S		S	S		S											S												O	
A50.4	S			S				O																O												S
B15.1					S	S	S	S						S	S	S	S				S				S											
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B15.3					S	S		S					S	S		S			S				S				O									
B15.4					S	S	S						S	S	S					S				S				O								
B30.1					S	S	S	S					S	S	S	S		S	S	S	S								S							
B30.2					S	S	S	S					S	S	S	S	S		S	S		S								S						
B30.3					S	S	S	S					S	S	S	S	S	S		S			O								S					
B30.4					S	S	S	S					S	S	S	S	S	S	S					S								S				
B50.1					S	S	S	S					S	S	S	S						S	S	S									S			
B50.2					S	S	S	S					S	S	S	S		S			S		S	S										S		
B50.3					S	S	S	S					S	S	S	S			O		S	S		O											S	
B50.4					S	S	S	S					S	S	S	S				S			O												S	
C15.1									S												S					S	S	S	S			S			
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C15.3									S	S	S										S				S	S		S			S			S	
C15.4									S	S	S	S									S				S	S	S				O				S
C30.1																	S	S	S	S					S	S	S	S		S	S	S			
C30.2																	S		S	S					S	S	S	S	S		S		S		
C30.3																	S	S		S					S	S	S	S	S	S		O			
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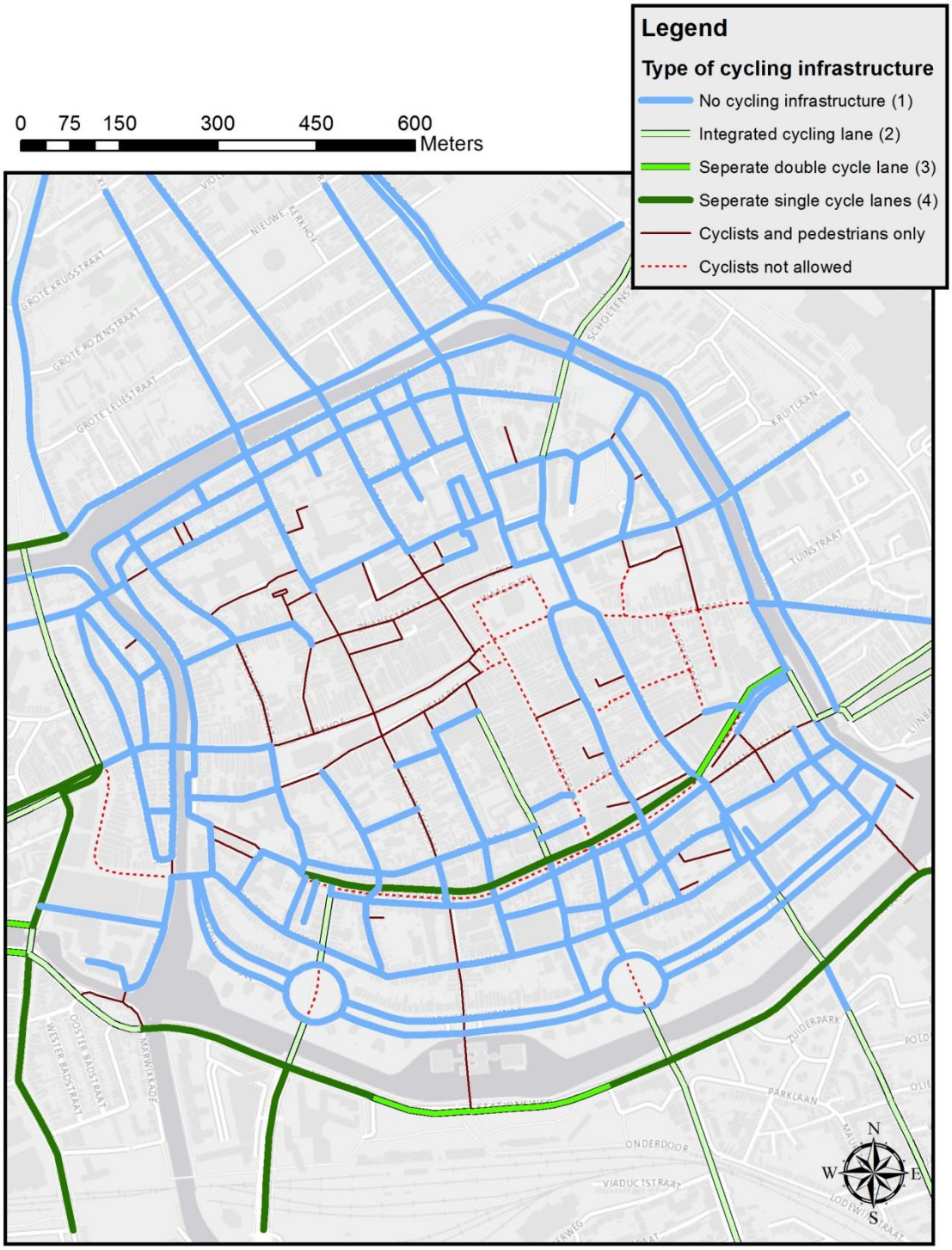
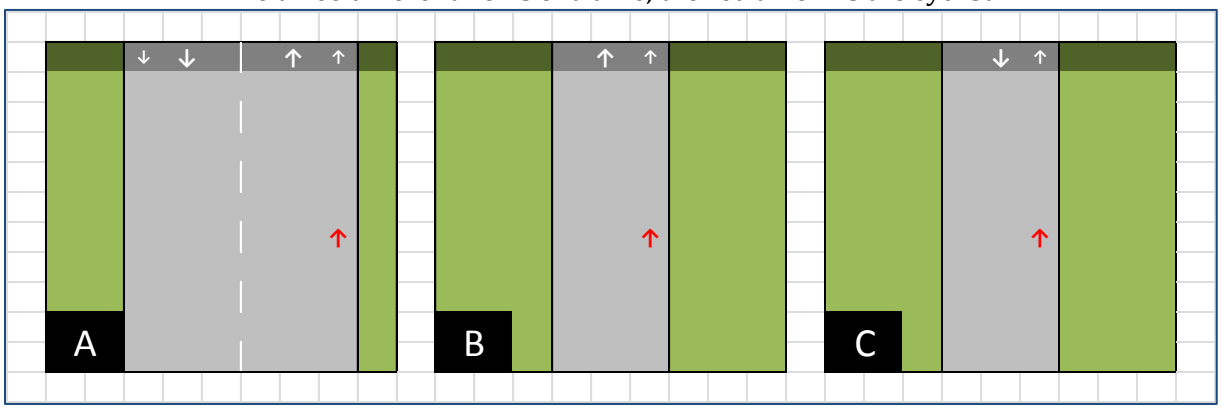
Cycling infrastructure in the city centre of Groningen, 2015

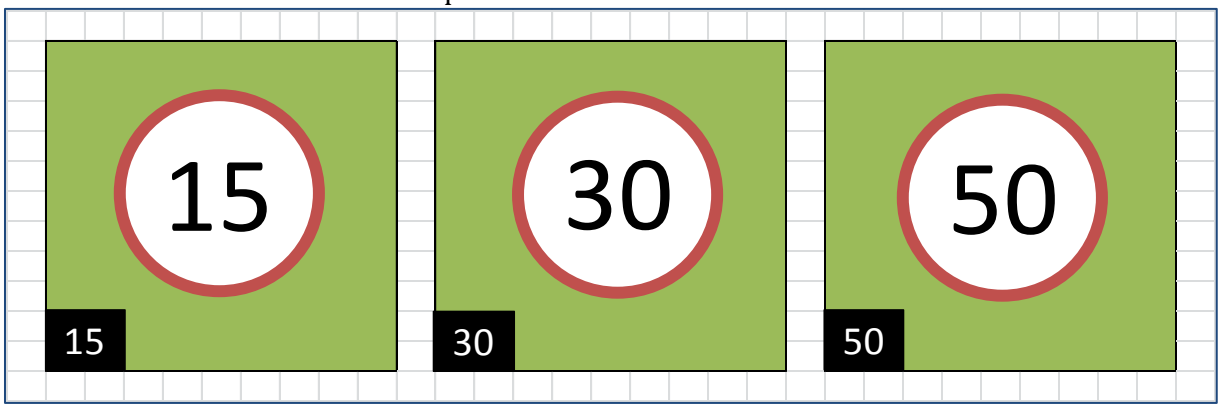


Source: (Google Maps, 2015; Esri Database 2015; Gemeente Groningen, 2015; Own survey, 2015)

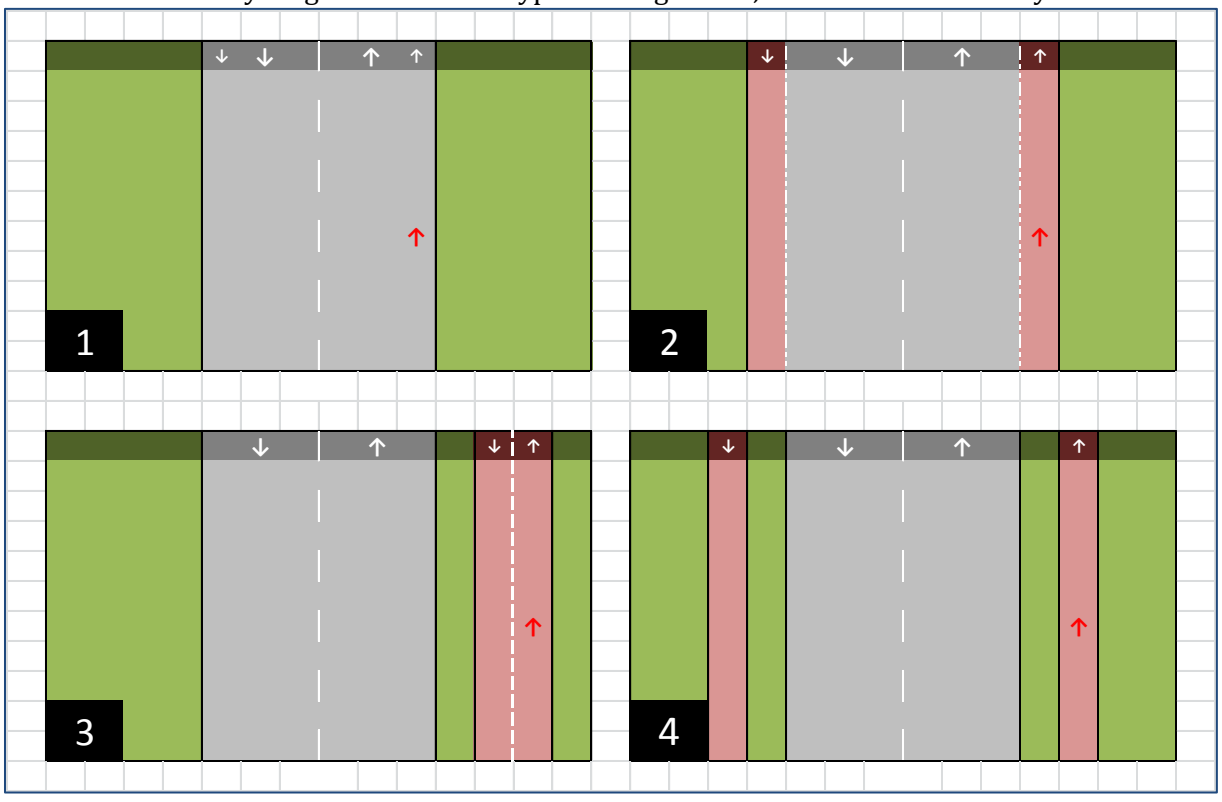
The three different flows of traffic; the red arrow is the cyclist



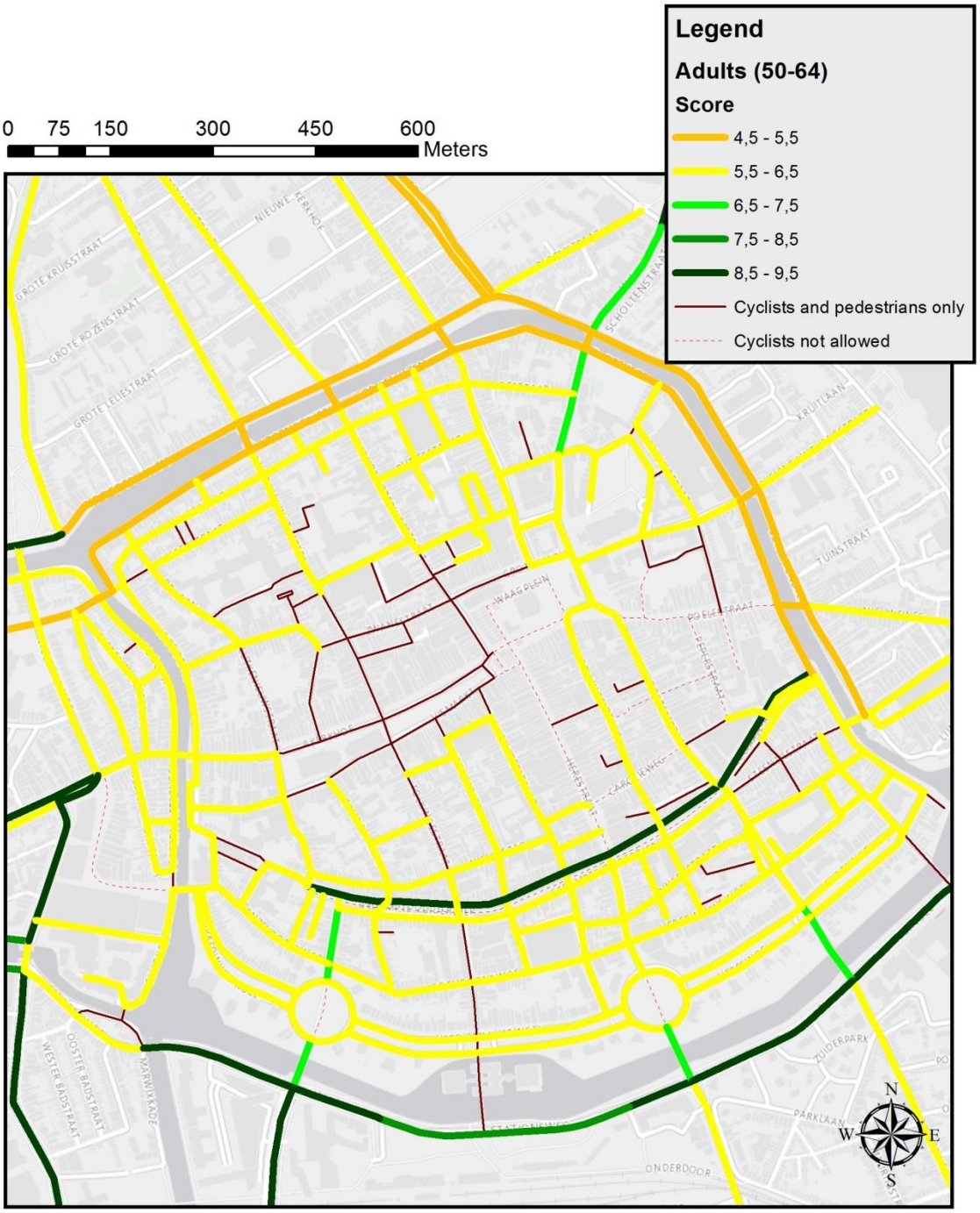
The three different speed limits taken into account in this research.



The four different cycling infrastructure types distinguished; the red arrow is the cyclist.

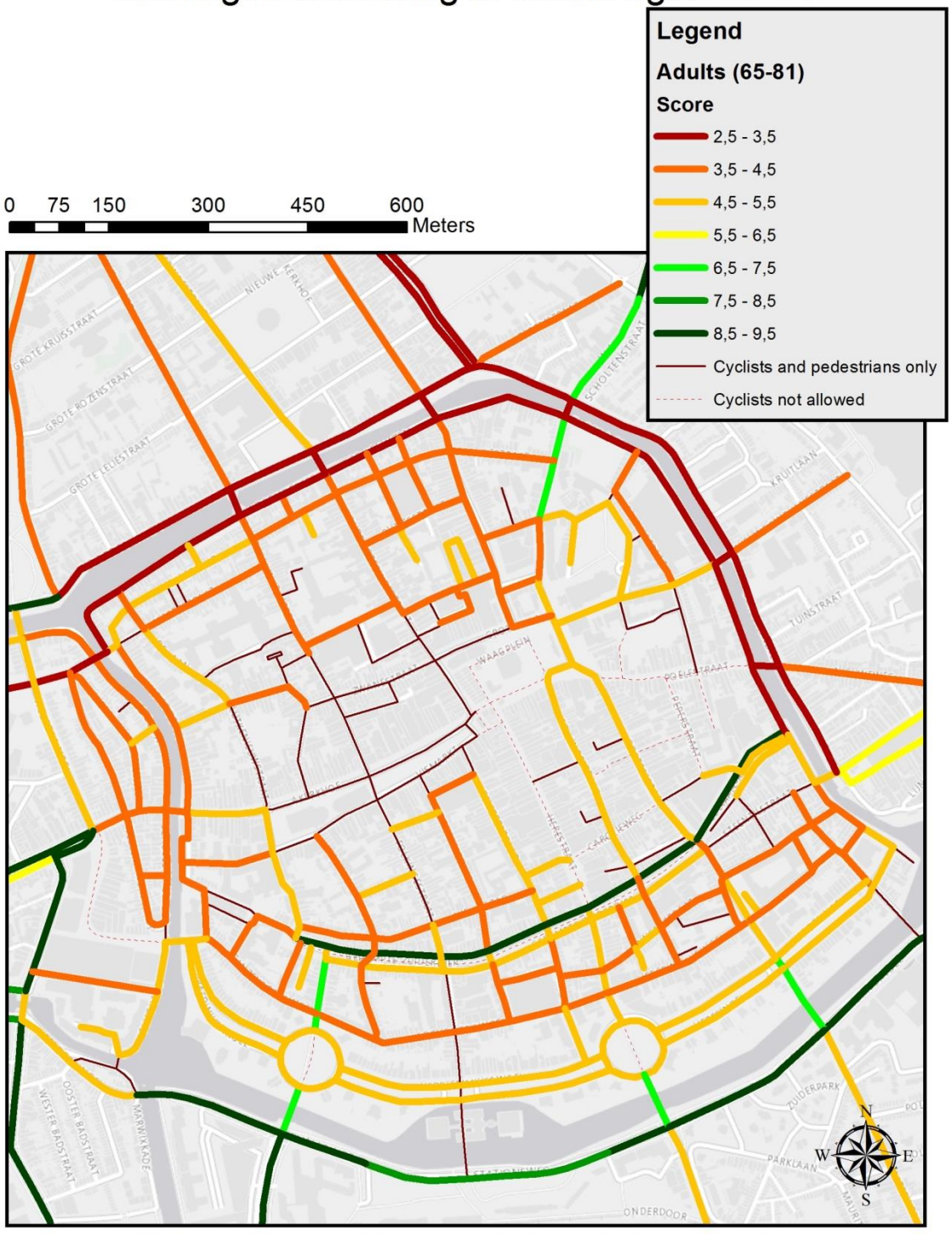


Safety perception of the infrastructure in the city centre of Groningen according to adults aged 50-64.



Source: (Google Maps, 2015; Esri Database 2015; Gemeente Groningen, 2015; Own survey, 2015)

Safety perception of the infrastructure in the city centre of Groningen according to adults aged 65-81.



Source: (Google Maps, 2015; Esri Database 2015; Gemeente Groningen, 2015; Own survey, 2015)

List of findings (in Dutch) that was sent to the respondents.

TIEN MEEST OPMERKELIJKE RESULTATEN

"De onderstaande uitspraken zijn gebaseerd op slechts een geringe steekproef uit de gemeente Groningen, het is daarom niet toegestaan deze in uitingen aan derden te gebruiken"

1. Personen van boven de 65 vinden infrastructurele situaties, waarin zij fietsen, eerder gevaarlijk dan de personen in de leeftijdsgroep 50-64 dat vinden.
2. Zowel een lagere snelheid als een eigen plaats op de weg voor de fietsers heeft een gunstig effect op de veiligheidsperceptie.
3. De rijrichting van het overige verkeer beïnvloed ook de perceptie van veiligheid. Echter, deze invloed is gering in vergelijking met de fietsinfrastructuur of de snelheid.
4. Het verschil tussen wegen waar het overig verkeer 15 of 30 kilometer per uur mag rijden is nihil. Echter, wegen waar gemotoriseerd verkeer 50 kilometer per uur mag rijden, worden als veel onveiliger beoordeeld.
5. De slechtst scorende weg is een eenrichtingsweg waar automobilisten 50 rijden en er voor de fietsers geen fietsvoorziening aanwezig is. Met een 4,1 is deze optie de hekkensluiter. Straten in Groningen die deze infrastructuur hebben zijn bijvoorbeeld: Schuitendiep, Turfsingel, Spilsluizen, Lopendediep en Noorderhaven.
6. Met een 4,3, vlak daarboven, scoren wegen met wederom een snelheidslimiet van 50 voor gemotoriseerd verkeer en het ontbreken van fietsvoorzieningen. Enige verschil met punt vier, is de rijrichting. In dit geval rijdt het gemotoriseerd in beide richtingen. Voorbeelden van deze wegen zijn: Verlengde Visserstraat en Kraneweg.
7. De hoogste score te vinden in de binnenstad van Groningen is de noordzijde van het Gedempte Zuiderdiep. De maximumsnelheid van 30 in combinatie met een apart fietspad zorgt ervoor dat deze weg een 9,2 scoort. Opmerkelijk is dat de weg aan de overzijde (voor de Albert Heijn langs) een 5,5 scoort omdat het het wegvak deelt met gemotoriseerd verkeer.
8. Overige wegen die hoog scoren zijn de A-weg (noordzijde), Wilhelminakade en de wegen langs de zuiderhaven richting het Station. Deze wegen hebben allemaal gemeenschappelijk dat gemotoriseerd verkeer er 50 kilometer per uur mag rijden, maar fietsers een geheel afgezonderde plaats op de weg hebben. Dit zorgt voor een score van 9,1.
9. Het merendeel van de wegen in het centrum van Groningen, de eenrichtingswegen waarbij het gemotoriseerd verkeer een snelheidslimiet heeft van 30 kilometer per uur, scoort een 5,0 en is daarmee erg laag, voorbeelden van deze wegen zijn: Heresingel, Haddingestraat, Oude Kijk in Het Jatstraat, Oude Boteringestraat en Coehoornsingel.
10. De bevindingen uit dit onderzoek zijn alleen van toepassing in een ideale situatie. Waarin iedereen de regels kent, zich daaraan houdt en zich op de juiste manier in het verkeer gedraagt.

Tom Moekotte

Responses from the e-mail interview (in Dutch).

From: Catelyn
To: Tom Moekotte
Date: July 27, 2015

Beste Tom,

1 en 2. Je onderzoeksresultaten lijken me allemaal heel logisch. Verrassend is wel dat soms een situatie als minder veilig wordt ingeschat terwijl die in de praktijk veiliger blijkt. Dat ouderen eerder onveiligheid dan jongeren ervaren verbaast me niet. Ik ben 71 en merk dat ik langzamer ben en trager reageer dan vroeger, eerder paniekerig ben en minder risico durf te nemen in het verkeer. Dat vertaalt zich natuurlijk in mijn veiligheidsbeleving.
3. ja, mee eens
4. Oversteek spoor begin Helperzoom. Iedereen doet maar wat waar over het spoor de weg de bocht om gaat; Damsterdiep/Schuitendiep: auto's gaan met de bocht mee en rijden door richting Oosterhaven terwijl fietsers daar met de bocht mee de pas wordt afgesneden.
5. Weet ik niet zo
6. nee, veel succes verder.

Groet, Catelyn

From: Robert
To: Tom Moekotte
Date: July 19, 2015

1. Eigenlijk zijn er weinig dingen die me verbazen. Misschien de verschillende uitkomsten waar het gaat om leeftijd, maar daar kan een groter
leeftijdsverschil aan ten grondslag liggen. Iemand van begin 50 heeft wellicht meer overzicht in het verkeer dan iemand van eind 70.
2. Zie hierboven, de uitkomsten zijn redelijk naar verwachting.
3. Ja, eens. Met name de onder 5 genoemde wegen. Die ervaar ik als dusdanig onveilig dat ik ze liever mijd. Onder 9 wordt de Heresingel genoemd. Volgens mij wordt daar vaker sneller gereden dan 30km/u.
4. Naast de onder 5 genoemde, vooral ook de Grote Markt oostzijde.
5. Zuiderdiep Noordzijde, afgezien van de kruising met de Herestraat.
6. Tip voor een volgend onderzoek: Fietsers en voorrang van rechts. Het lijkt alsof weinig automobilisten weten dat fietsers van rechts voorrang hebben. En dat al sinds mei 2001.

From: Jaime
To: Tom Moekotte
Date: July 26, 2015

1. het verbaasd me dat De slechtst scorende weg is een eenrichtingsweg waar automobilisten 50 rijden en er voor de fietsers geen fietsvoorziening aanwezig is. Met een 4,1 is deze optie de hekkensluiter. Straten in Groningen die deze infrastructuur hebben zijn bijvoorbeeld: Schuitendiep, Turfsingel, Spilsluizen, Lopendediep en Noorderhaven, de verkeersstroom gaat dezelfde richting op en als de fietsers zich aan de regels houden en niet overal kris kras lang over en onder elkaar inhalen naar links wenken etc. is dit niet echt een slechte oplossing.
2. ik had veracht dat de situatie op de Vismarkt en Grote markt ook niet echt veilig ijn met overal voetgangers met name op marktdagen oversteken onder echt te kijken of er een fietser aankomt.
3 gedeeltelijk wel maar niet zoals gemeld bij vraag 1.
4 Brugstraat en Zuiderdiep vanaf Stationsstraat tot Heretraat waar auto,s rijden en inparkeren en de weg eigenlijk te smal daarvoor is.
5. Paterswoldseweg en Hereweg
6 Geen toevoegingen verder

From: Lysa
To: Tom Moekotte
Date: July 17, 2015

1. Nummer 9 verbaast mij, ik vind die straten aardig veilig.
2. De rest vind ik volgens verwachting.
3. Mee eens, afgezien van bevinding 9.
4. a. Van Kreupelstraat naar Sint Walburgstraat, daar ben ik in de bocht eens afgesneden door een harmonicabus.
b. Als je vanuit het Noorderplantsoen naar de Korreweg gaat, kruis je het Boterdiep. Daar komen bussen van rechts, terwijl het lijkt alsof de rijrichting van links is en je dus niet naar rechts zou hoeven kijken.
5. Folkingestraat en A-weg.
6. Succes hoor. Goed zo!

From: Rodrik
To: Tom Moekotte
Date: July 23, 2015

Beste heer Moekotte,

Ik vind het moeilijk om puntsgewijs alles te beantwoorden wat u vraagt.
In het algemeen ben ik niet verbaasd over de uitkomsten.
Ik wil nog even kwijt dat ik de gevaarlijkste situaties die kruisingen vind waar alle fietsers van alle richtingen tegelijk kunnen rijden,
Verder de rotonde aan de Korreweg, waar , als ik er per auto langskom, bijna alle fietsers menen voorrang te hebben, ook als ze komen aanrijden. Vanzelfsprekend als ze al op de rotonde zijn!
Te weinig handhaving van regels voor fietsers. Bellen, oortjes, verkeerde kant vd weg fietsen. Zonder licht.

Succes met uw onderzoek.
Rodrik

From: Jon
To: Tom Moekotte
Date: July 18, 2015

Bedankt voor deze info. De meeste van de 10 conclusies vind ik in de lijn van de verwachtingen liggen. Alleen resultaat 7 over het Gedempte Zuiderdiep had ik niet verwacht. Ik zelf ervaar het aan de Noordzijde niet echt als onveilig, maar de onoverzichtelijkheid van de straten die er op uitkomen, gecombineerd met het gladde wegdek bij regen zouden voor mij op een lagere score uitkomen.

Ik merk dat er in de situaties die jij hebt voorgelegd in het onderzoek geen rekening gehouden is met de invloed van het wegdek op de ervaren veiligheid, en ook waren de kruisingen met andere wegen niet opgenomen. Het gelijktijdige groene licht voor alle fietsers zorgt in mijn beleving voor onveiligheid- zeker tijdens spitsuur. (geen idee of daar veel of weinig incidenten ontstaan).

Verder heb ik de afgelopen periode een paar keer door Nijmegen gefietst. En daar merkte ik dat de breedte van de fietspaden vaak groter is dan hier in Stad, en dat heeft een positieve invloed op mijn gevoel van veiligheid.

From: Myranda
To: Tom Moekotte
Date: July 28, 2015

Dag Tom,

De bevindingen die zijn gedaan had ik wel verwacht.
1. Mensen boven de 65 vinden infrastructurele situaties eerder gevaarlijk dan mensen in de leeftijdsgroep van 50 +. Eén van de oorzaken kan zijn, dat de noodzaak om de weg op te moeten niet meer zo aanwezig is. Als je wat langere tijd niet op de fiets zit wordt het inderdaad gevaarlijker, je raakt wat van de routine kwijt. Mensen moeten in beweging blijven en blijven fietsen.
2. Ook het feit dat mensen zich meer onveilig voelen wanneer niet beschikt kan worden over gescheiden rijbanen is goed te begrijpen. Je zou kunnen zeggen dat hoe meer het langzame verkeer gescheiden is van het gemotoriseerde verkeer hoe veiliger het is voor de fietser.
3. Ook het gegeven dat een lagere snelheid een meer veilig gevoel geeft.
4. Ik ben het eens met de scores die sommige wegen krijgen (de punten 5 tot 9).
5. De weg die ik onveilig vind is de Ebbingestraat, waar het vaak erg druk is. Verder de kruising van Korreweg en Boterdiep en de verkeerssituatie bij het Hoofdstation, waar veel taxi's rijden en personenauto's met fietsers. Ook daar is het erg druk en onoverzichtelijk. Dan nog de situatie in de Boteringestraat richting de Grote Markt. Daar steken mensen zomaar de straat over zonder uit te kijken. Alles rijdt en loopt door elkaar heen, evenals op de Grote Markt. Je moet daar altijd erg oppassen. Het zou goed zijn wanneer er meer wordt gehandhaafd, maar dat heeft voor de gemeente Groningen helaas geen prioriteit.

Wat gaat er met de uitkomsten van dit onderzoek gebeuren? Ik hoop dat de gemeente er haar voordeel mee gaat doen. Ik wens jullie veel succes met de voortgang van het onderzoek.

Hartelijke groet,
Anneke Bos

From: Sam
To: Tom Moekotte
Date: July 26, 2015

Hallo Tom,

De uitslagen en beoordelingen van de veiligheid van de verschillende wegen verbaast mij niet. Ik heb dan ook geen aanvullingen of meningen over deze uitslag

groeten,
Sam

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9. REFERENCES

A View from the Cycle Path, (2009). 'How Groningen grew to be worlds number 1' [online] Available at: http://www.aviewfromthecyclepath.com/2009/02/how-groningen-grew-to-be-worlds-number.html [Accessed on: 18 Jun. 2015]

Aldred, R. (2012). Incompetent or Too Competent? Negotiating Everyday Cycling Identities in a Motor Dominated Society. Mobilities, 8(2), pp.252-271.

ANBO, (2015). *'Over ons | ANBO'* [About us | ANBO] [online] Available at: www.anbo.nl/de-vereniging/over-ons [Accessed on: 21 Jun. 2015]. (Dutch).

Bampton, R. & Cowton, C. J. (2002). The e-interview [27 paragraphs]. Forum Qualitative Sozialforschung / Forum: Qualitative Social Research [On-line Journal], 3(2), Art. 9. Available at: http://www.qualitative-research.net/fqs-texte/2-02/2-02bamptoncowton-e.htm [Accessed on: 5 Jun. 2015].

Banister, C. (1990). Planning for cycling. Planning Practice and Research, 5(1), pp.27-29.

BBC News, (2013). Why is cycling so popular in the Netherlands?. [online] Available at: http://www.bbc.com/news/magazine-23587916 [Accessed on: 20 Aug. 2015].

Beecham, R. and Wood, J. (2013). Exploring gendered cycling behaviours within a large-scale behavioural data-set. Transportation Planning and Technology, 37(1), pp.83-97.

Bicycle Dutch, (2013). Car Free Sundays, a 40 year anniversary. *NL Cycling* [online] Available at: https://bicycledutch.wordpress.com/2013/12/01/car-free-sundays-a-40-year-anniversary/ [Accessed on: 20 Aug. 2015]

Bike-EU, (2015). 'Speed E-bike sale accelerating in the Netherlands' [online] http://www.bike-eu.com/sales-trends/nieuws/2015/5/speed-e-bike-sale-accelerating-in-the-netherlands-10124020 [Accessed on: 18 Jun. 2015]

Bogdan, R. and Biklen, S. (2007). Qualitative research for education. Boston, Mass.: Pearson A & B.

Bootsma-Van der Wiel, A., Westendorp, R. and Knook, D. (1997). Dagelijks functioneren en zorggebruik onder personen van 85 jaar en ouder. Nederlands Tijdschrift Geneeskunde, 141(45), pp.2170-2176.

Cavill, N., Kahlmeier, S., Rutter, H., Racioppi, F. and Oja, P. (2008). Economic analyses of transport infrastructure and policies including health effects related to cycling and walking: A systematic review. Transport Policy, 15(5), pp.291-304.

CIA Factbook, (2014). Europe – Netherlands. *The World Factbook*. [online] Available at: https://www.cia.gov/library/publications/the-world-factbook/geos/nl.html [Accessed on: 20 Aug. 2015]

City Clock Magazine, (2013). Cycling Mode Share Data for 700 Cities. [online] Available at: http://www.cityclock.org/urban-cycling-mode-share/#.VG4BvsnaITZ [Accessed on: 20 Nov. 2014].

City of Copenhagen, (2002). Cycle Policy. Copenhagen: City of Copenhagen.

CityLab, (2013). 'City where bicycles rule the road' [online] Available at: http://www.citylab.com/commute/2013/10/city-where-bicycles-rule-road/7202/ [Accessed on: 18 Jun. 2015]

Clifford, N. J., & Valentine, G. (2003). *Key methods in geography*. London: SAGE

CROW (1993a)., Cycling in the city – pedalling on the polder. Centre for Research and Contract Standardisation in Civil Engineering, The Netherlands.

CROW (1993b)., Sign up for the bike – design manual for a cycle friendly infrastructure. Centre for Research and Contract Standardisation in Civil Engineering, The Netherlands.

Cyclorama, (n.d.). Cycling in Older Age. [online] Available at: http://www.cyclorama.net/viewArticle.php?id=236 [Accessed on: 15 Feb. 2015].

Dill, J. and Voros, K. (2007). Factors Affecting Bicycling Demand: Initial Survey Findings from the Portland, Oregon, Region. Transportation Research Record, 2031(-1), pp.9-17.

Duijvendak, M.G.J. & Feenstra, H. (2008). *'Geschiedenis Groningen: 1. Prehistorie en Middeleeuwen'.* [History of Groningen: 1. Prehistory and Middle Ages] Publisher: Waanstra, Zwolle. p. 393. (Dutch).

Dunn, K. (2005). Interviewing. Qualitative research methods in human geography, pp.79-105

Dutch Daily News, (2010). 'Netherlands Bicycle Capital of the World' [online] Available at: http://www.dutchdailynews.com/netherlands-bicycle-capital-of-the-world/ [Accessed on: 18 Jun. 2015]

Fiets Filevrij, (n.d.). *Bereikbaarheid door snelle fietsroutes*. [Accessibility through fast cycle routes] [online] Available at: http://www.fietsfilevrij.nl/ [Accessed on: 20 Aug. 2015]. (Dutch).

Fiets, (2015). *'Meer Gewonden bij Fietsongelukken'*. [More injuries with cycling accidents] [online] http://www.fiets.nl/2015/03/02/meer-gewonden-bij-fietsongelukken/ [Accessed on: 17 Jun. 2015]. (Dutch).

Fietsersbond, (2014). *Over de verkiezing – Fietsstad 2014*. [About the election – Fietsstad 2014] [Online] Available at: http://fietsstad.fietsersbond.nl/archief#.VdXfIpejAZM [Accessed on: 20 Aug. 2015]. (Dutch).

Forsyth, A. and Krizek, K. (2011). Urban Design: Is there a Distinctive View from the Bicycle?. Journal of Urban Design, 16(4), pp.531-549.

Furness, Z. (2010). One less car. Philadelphia: Temple University Press.

Google Pattents, (1895). 'Electrical Bicycle' [online] Available at: http://www.google.com/patents/US552271?dq=552,271 [Accessed on: 16 Jun. 2015]

Greenbaum, T. (1993) The Handbook for Focus Group Research. Lexington, MA: Lexington Books.

Groningen Bereikbaar, (n.d.). *Slimme fietsroute*. [The smart route] *Onderwijs.* [online] Available at: http://www.groningenbereikbaar.nl/onderwijs/slimme-fietsroute/ [Accessed on: 20 Aug. 2015]. (Dutch).

Hennink, M., Hutter, I. and Bailey, A. (2011). Qualitative research methods. London: SAGE.

Hull, A. and O'Holleran, C. (2014). Bicycle infrastructure: can good design encourage cycling?. Urban, Planning and Transport Research, 2(1), pp.369-406.

Institute for Sustainable Mobility, (2015). Summary Cycling. [online] Amsterdam: IvDM/TNO. Available at: http://www.amsterdam.nl/publish/pages/423843/ivdm_tno_samenvatting_fietsen_eng.pdf . [Accessed on: 15 Feb. 2015].

Kampen, van, L. (2007). *Gewonde fietsers in het ziekenhuis*. [Injured cyclists in the hospital] Stichting Wetenschappelijk Onderzoek Verkeersveiligheid. (Dutch).

Kivits, Joëlle (2005). Online interviewing and the research relationship. In Christine Hine (Ed.), Virtual methods; Issues in social research on the Internet (pp.35-50). Oxford: Berg.

Knuts, S. and Delheye, P. (2012). Cycling in the City? Belgian Cyclists Conquering Urban Spaces, 1860–1900. The International Journal of the History of Sport, 29(14), pp.1942-1962.

Kruier, H., Den Hertog, P., Klein Wolt, K., Panneman, M., and Sprik, E., (2012). Fietsongevallen in Nederland: Een lis Vervolgonderzoek naar Ongevallen met Gewone en Elektrische Fietsen [Bicycle Accidents in the Netherlands: A Survey Among Injured Bicyclists who Have Been Treated in Hospitals After an Accident with a Traditional Bicycle or After an Accident with an E-bike]. VeiligheidNL, Amsterdam. Lansdown, T.C., Brook-Carter, N. (Dutch).

Kulmala, J., Viljanen, A., Sipila, S., Pajala, S., Parssinen, O., Kauppinen, M., Koskenvuo, M., Kaprio, J. and Rantanen, T. (2008). Poor vision accompanied with other sensory impairments as a predictor of falls in older women. Age and Ageing, 38(2), pp.162-167.

Levine, J., Grengs, J., Shen, Q. and Shen, Q. (2012). Does Accessibility Require Density or Speed?. Journal of the American Planning Association, 78(2), pp.157-172.

Lihavainen, K., Sipila, S., Rantanen, T., Sihvonen, S., Sulkava, R. and Hartikainen, S. (2010). Contribution of Musculoskeletal Pain to Postural Balance in Community-Dwelling People

Aged 75 Years and Older. The Journals of Gerontology Series A: Biological Sciences and Medical Sciences, 65A(9), pp.990-996.

Lindenberg, S.M. (1986). The paradox of privatisation in consumption. In: Diekmann, A. & Mitter, P. (eds.) *Paradoxical Effects of Social Behaviour*. Heidelberg, Vienna: Physica-Verlag

Lindenberg, S.M. (1993). Framing, Empirical Evidence, and Applications. In: Herder-Dorneich, P., et al. (eds.) *Jahrbuch fur Neue Politische Okonomie. Vol 12.* Tubingen: J.C.B. Mohr. pp.11-38

Lindenberg, S.M. (1996). Continuities in the theory of social production functions. In: Ganzeboom, H.B.G. & Lindenberg, S.M. (eds.) *Verklarende Sociologie: opstellen voor Reinhard Wippler*. pp.184-196

Litman, T. and Steele, R., (2011). Land use impacts on transport. Victoria, B.C.: Victoria Transport Policy Institute.

MacEachren, A.M. (1994). Some Truth with Maps. Washington, DC: Association of American Geographers.

Morgan, D.L. (1997). Focus Groups as Qualitative Research. Thousand Oaks, CA: Sage, pp. 75–79.

Newton, N., (2010). The use of semi-structured interviews in qualitative research: strengths and weaknesses. Academia. Edu

Nielsen, T., Skov-Petersen, H. and Agervig Carstensen, T., (2013). Urban planning practices for bikeable cities – the case of Copenhagen. Urban Research & Practice, 6(1), pp.110-115.

Nilsen, P., Hudson, D. S., Kullberg, A., Timpka, T., Ekman, R., & Lindqvist, K., (2004). Making sense of safety. *Injury Prevention : Journal of the International Society for Child and Adolescent Injury Prevention, 10,* 2, pp.71-3.

OOG Radio en Televisie, (2014). *Binnenstad niet veilig voor fietsende oudere*. [City centre not safe for cycling older adult] [online] Available at: http://www.oogtv.nl/2014/05/binnenstad-niet-veilig-voor-fietsende-oudere/ [Accessed on: 25 Nov. 2014]. (Dutch).

PCOB, (2015). *'Over de PCOB'* [About the PCBO] [online] Available at: www.pcob.nl/uw-vereniging/de-pcob/ [Accessed on: 21 Jun. 2015]. (Dutch).

ProRail, (n.d.). *Ruimte voor de fiets*. [Space for the bicycle] [online] Available at: http://www.prorail.nl/reizigers/stations/ruimte-voor-de-fiets [Accessed on: 20 Aug. 2015]. (Dutch).

Provincie Groningen [Groningen Province], (2012). *Beleidsnota Fiets* [Bicycle policy document] Groningen: Repro, afdeling Facilitaire Zaken, provincie Groningen, p.6. (Dutch).

Provincie Groningen, (2013). *Meer mensen op de fiets*. [More people by bicycle] [online] Available at: http://www.provinciegroningen.nl/beleid/verkeer-en-vervoer/meer-mensen-op-de-fiets/ [Accessed on: 16 Oct. 2014]. (Dutch).

Provincie Groningen, (n.d.). *Verkeer en vervoer*. [Traffic and Transport]. [online] Available at: http://www.provinciegroningen.nl/beleid/verkeer-en-vervoer/ [Accessed on: 20 Aug. 2015]. (Dutch)

Pucher, J. and Buehler, R. (2008). Making Cycling Irresistible: Lessons from The Netherlands, Denmark and Germany. Transport Reviews, 28(4), pp.495-528.

Pucher, J. and Buehler, R. (2012). Introduction: Cycling for Sustainable Transport. In: J. Pucher and R. Buehler, ed., City Cycling, 1st ed. [online] Cambridge: MIT Press. Available at: http://site.ebrary.com.proxy-ub.rug.nl/lib/ugroningen/reader.action?docID=10614103&ppg=1 [Accessed on: 15 Feb. 2015].

Rantakokko, M., Mänty, M. and Rantanen, T. (2013). Mobility Decline in Old Age. Exercise and Sport Sciences Reviews, 41(1), pp.19-25.

Reid, C. (2012). Why is cycling popular in the Netherlands: infrastructure or 100+ years of history?. [online] Roads Were Not Built For Cars Available at: http://www.roadswerenotbuiltforcars.com/netherlands/ [Accessed on: 20 Aug. 2015].

Rejeski, W. and Mihalko, S. (2001). Physical Activity and Quality of Life in Older Adults. The Journals of Gerontology Series A: Biological Sciences and Medical Sciences, 56(Supplement 2), pp.23-35.

Rijksoverheid, (2014a). *Meer fietsroutes, minder files*. [More cycle routes, less traffic jams] [online] Available at: http://www.rijksoverheid.nl/onderwerpen/fiets/meer-fietsroutes-minder-files [Accessed on: 20 Aug. 2015]. (Dutch).

Rijksoverheid, (2014b). *Fiets en verkeersveiligheid*. [Cycling and traffic safety] [online] Available at: http://www.rijksoverheid.nl/onderwerpen/fiets/fiets-en-verkeersveiligheid [Accessed on: 20 Aug. 2015]. (Dutch).

Rijksoverheid, (2014c). *Fietsdiefstal tegengaan*. [Preventing bicycle theft] [online] Available at: http://www.rijksoverheid.nl/onderwerpen/fiets/fietsdiefstal-tegengaan [Accessed on: 20 Aug. 2015]. (Dutch).

Rijksoverheid, (2014d). *Meer fietsenstallingen bij stations*. [More bicycle racks at train stations] [online] Available at: http://www.rijksoverheid.nl/onderwerpen/fiets/meer-fietsenstallingen-bij-stations [Accessed on: 20 Aug. 2015]. (Dutch).

Rissel, C., Passmore, E., Mason, C. and Merom, D. (2013). Two Pilot Studies of the Effect of Bicycling on Balance and Leg Strength among Older Adults. Journal of Environmental and Public Health, 2013, pp.1-6.

Rosen, P., Cox, P. and Horton, D. (2007). Cycling and society. Aldershot, England: Ashgate.

Sallinen, J., Stenholm, S., Rantanen, T., Heliövaara, M., Sainio, P. and Koskinen, S., (2010). Hand-Grip Strength Cut Points to Screen Older Persons at Risk for Mobility Limitation. Journal of the American Geriatrics Society, 58(9), pp.1721-1726.

SkatesCool, (2009). 'Inline skating in Groningen'. [online] Available at: http://www.skatescool.com/inline-skating/gronigen/ [Accessed on: 17 Jun. 2015]

Slimme Route [Smart Route], (2014). *De Slimme Route*. [The smart route] [online] Available at: http://www.slimmeroute.nl/ [Accessed 16 Oct. 2014]. (Dutch).

SOOG, (2015). *'Over ons'* [About us] [Online] Available at: www.soog.nl/over-ons/ [Accessed on: 21 Jun. 2015]. (Dutch).

Statistics Netherlands, (2007). Mobility Dutch population per region for motive and means of transportation. Den Haag: CBS.

Statistics Netherlands, (2014a). *Bevolking; kerncijfers*. [Population key figures] [online] Available at: http://statline.cbs.nl/Statweb/publication/?DM=SLNL&PA=37296ned [Accessed 20 Aug. 2015]. (Dutch).

Statistics Netherlands, (2014b). *Mobiliteit in Nederland; persoonskenmerken en vervoerwijzen*, regio's. [Mobility in the Netherlands; personal characteristics and transport modes, regions] [online] Available at: http://statline.cbs.nl/Statweb/publication/?DM=SLNL&PA=81128ned [Accessed 20 Aug. 2015]. (Dutch).

Statistics Netherlands, (2014c). *Prognose intervallen van de bevolking; leeftijdsgroep, 2015-2060.* [Prognosis intervals of the population; age group, 2015-2060]. [online] Available at: http://statline.cbs.nl/Statweb/publication/?DM=SLNL&PA=82682ned [Accessed 20 Aug. 2015]. (Dutch).

Statistics Netherlands, (2014d). *Regionale prognose 2014-2040; bevolking, regio-indeling 2013.* [Regional prognosis 2014-2040; population, regions 2013]. [online] Available at: http://statline.cbs.nl/Statweb/publication/?DM=SLNL&PA=82172ned [Accessed 16 Feb. 2015]. (Dutch).

Statistics Netherlands, (2015a). *Bevolking; geslacht, leeftijd, burgerlijke staat en regio, 1 januari.* [Population; sex, age, marital status en region]. [online] Available at: http://statline.cbs.nl/Statweb/publication/?DM=SLNL&PA=03759ned [Accessed 20 Aug. 2015]. (Dutch).

Statistics Netherlands, (2015b). *Bevolkingsontwikkeling; regio per maand.* [Population development; region per month]. [online] Available at: http://statline.cbs.nl/Statweb/publication/?DM=SLNL&PA=37230ned [Accessed 20 Aug. 2015]. (Dutch).

Stenholm, S., Sainio, P., Rantanen, T., Koskinen, S., Jula, A., Heliovaara, M. and Aromaa, A. (2007). High Body Mass Index and Physical Impairments as Predictors of Walking Limitation 22 Years Later in Adult Finns. The Journals of Gerontology Series A: Biological Sciences and Medical Sciences, 62(8), pp.859-865.

Stinson, M. and Bhat, C. (2003). Commuter Bicyclist Route Choice: Analysis Using a Stated Preference Survey. Transportation Research Record, 1828(1), pp.107-115.

SWOV, (2009). Cyclists. Den Haag: SWOV Institute for Road Safety Research, Fact Sheet.

Tacken, M. (1998). Mobility of the elderly in time and space in the Netherlands:An analysis of the Dutch National Travel Survey. Transportation, 25(4), pp.379-393.

Taylor, D. and Mahmassani, H. (1996). Analysis of Stated Preferences for Intermodal Bicycle-Transit Interfaces. Transportation Research Record, 1556(1), pp.86-95.

The Urban Country, (2013). ‘Groningen the worlds cycling city’ [online] Available at: http://www.theurbancountry.com/2013/10/groningen-the-worlds-cycling-city.html [Accessed on: 17 Jun. 2015]

Tsubohara, S. (2010). Democracy through political parties and public participation the case of the planning history of Groningen. Groningen: Rijksuniveristeit Groningen.

Tufte, E.R. (1983). The Visual Display of Quantitative Information. Am. J. Phys., 53(11), p.1117.

Unie KBO, (2015). *'Unie KBO: Krachtig, bewust én ondernemend!'* [Union KBO: Powerful, conscious and venturous] [online] Available at: www.uniekbo.nl/unie-kbo/ [Accessed on 21 Jun. 2015]. (Dutch).

Veiligheid, (n.d.a). *Mobiliteitsongevallen 55plussers.* [Mobility accidents 55 year up]. [online] Available at: http://www.veiligheid.nl/cijfers/mobiliteitsongevallen-55plussers [Accessed 12 Feb. 2015]. (Dutch).

Veiligheid, (n.d.b). *Fietsongevallen 55plussers.* [Cycling accidents 55 year up]. [online] Available at: http://www.veiligheid.nl/cijfers/fietsongevallen-55plussers [Accessed 12 Feb. 2015]. (Dutch).

Viljanen, A., Kaprio, J., Pyykko I., Sorri, M., Koskenvuo, M. and Rantanen, T. (2009). Hearing Acuity as a Predictor of Walking Difficulties in Older Women. Journal of the American Geriatrics Society, 57(12), pp.2282-2286.

Witness, (2013). [TV programme] BBC World Service: BBC.

World Health Organization (1998). Safety and Safety Promotion: Conceptual and Operational Aspects.

Ziegler, F. & Schwanen, T. (2011). 'I like to go out to be Energized by different people': an exploratory analysis of mobility and well-being in later life. Ageing & Society, 31, pp.758-781

Zorgatlas, (2014). *In steden een lagere demografische druk*. [Lower demographic pressure in cities] [online] http://www.zorgatlas.nl/beinvloedende-factoren/demografie/levensfase/demografische-druk-per-gemeente/ [Accessed on: 16 Jun. 2015]. (Dutch).