A possible solution to the mobility problem: a shared bicycle system

An exploration of a shared bicycle system for different user groups

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Picture by Marijn_ Diepens, Mobycon

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by

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Preface

After postponing my thesis for a year, this January it was time to start and finish the final chapter of my master's: the thesis. It has been a ride. The writing was a process and I have to say, I got to know myself a lot better, but it was an (educational) experience. And with this experience, I will finish my master Complex System Engineering and Management, and end a phase in my life: my student time.

I would like to thank a few people, who helped me through the process and who I am grateful for: first of all, I would like to thank Mirjam de Bok, my company supervisor, thank you for your positive mindset and for sitting with me every week to talk about the progress of my thesis and responding to my thoughts, and giving me the push I sometimes needed. Even though I believe I could be hard to coach sometimes, I hope you enjoyed the last few months as much as I did. As I said in every meeting at the end, time flew by, thank you for that! The experience to work in both Den Bosch and in Delft was actually a really nice experience, thanks to the good atmosphere and the Mobycon colleagues. Then I would like to thank my commission, Jan Anne Annema and Lisa Scholten, you both have been important in keeping me on track and staying positive. Being able to share my ideas and sometimes find out that some ideas didn't work has helped me immensely in this journey. Thank you for your support and feedback!

Then Annelot, I was happy you were my fellow intern and the one I could share my thoughts during our walks. I am looking forward to seeing you after the internship still and going to (a lot Dutch) movies. Then my family, thank you for listening, and Dad for reading my thesis and giving your feedback. Then I would like to thank my roommates, especially Dimka, who helped me through the end and was in the same final chapter of her study. The motivation playlist on Spotify and motivation post-its were amazing!

As I mentioned before, I am actually grateful for the experience I had during the process and I am looking forward to the next chapter. I hope you have fun reading my thesis and that I could add anything to your knowledge about bike sharing systems and their users! To finish this preface, when I started this thesis, I was convinced that Rotterdam had few share bikes available. I was wrong, they are everywhere. So, to close off, I want to end my preface with the words of my mom's favorite person to quote, Johan Cruijff:

'Je gaat het pas zien, als het doorhebt'

M. L. J. M. Bruggink
Rotterdam, August 2023

Summary

Car ownership and dependency remain high in the Netherlands, and despite the decrease of traffic during the COVID-19 pandemic, traffic congestion has actually worsened in recent times. As the streets become more congested, and there is more demand for space, finding effective ways to optimize space becomes increasingly important to accommodate growing needs. Innovative solutions like shared mobility could offer a solution to these spatial challenges by reducing individual ownership. However, a significant challenge for shared mobility lies in the absence of a well-defined and general municipal strategy and a clear understanding of what shared mobility aims to achieve or for whom. Identifying a distinct user group or potential users for shared mobility proves to be a complex task and should be investigated.

Various forms of shared mobility are in operation throughout the Netherlands, with shared bicycle systems being one of them and having an established history. During the COVID-19 pandemic, there was a noticeable shift in people their travel behaviour, more people turned to the use of their own bicycles. Given this transformation, its important for the Netherlands to respond quickly to this travel behaviour change, as there exists a window of opportunity to shift intentions and travel habits towards increased cycling and potentially towards shared bicycle systems. Behaviour often plays a role, when a change needs to be made. As visualised in Figure 1, someone's reaction or opinion about sharing, will influence their use.

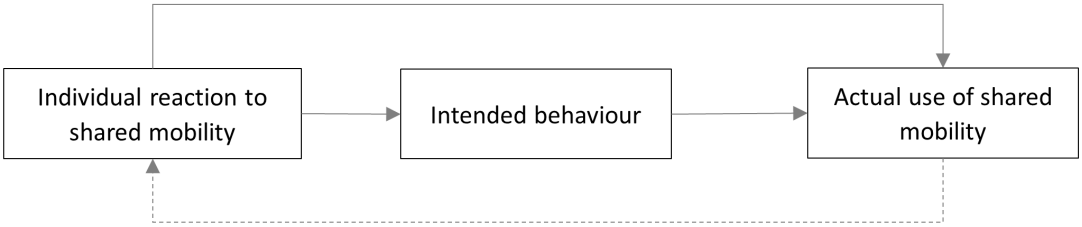

Figure 1: Behavioural principle, based on Venkatesh et al. (2003)

Therefore, to stimulate change, it is important to connect behavioural change theories and ways for implementing shared bicycle systems. The societal importance of this research lies in highlighting the inconveniences posed by existing systems and pinpointing the advantages for the groups (interested in such a system), along with the essential requirements. The scientific relevance lies in the importance to understand shared bicycle systems and the factors driving behavioral changes. While research predominantly delves into shared car systems, there's a lack of clear information about shared bicycles. To unlock the system's potential, the first step involves clearly identifying the potential user groups and establishing the conditions under which they would engage with such a system.

In this research, the focus will be on user behaviour, user groups, the factors influencing users, and the possibility of a shared bicycle system being a replacement for other modes, especially the potential for the car. The research question prepared for this study was: *Who are the current groups open to using shared bicycle systems and which factors influence their use in the Netherlands?*. This research question was answered by three different sub questions.

The research methodology adopted a combination of a literature review, qualitative and quantitative methods also knows as a mixed-method approach. This approach integrated both qualitative and quantitative data to comprehensively address the research question, recognizing that solely relying on one method would not give the same comprehensive results achievable through their combined results. This process is visualised in Figure 2.

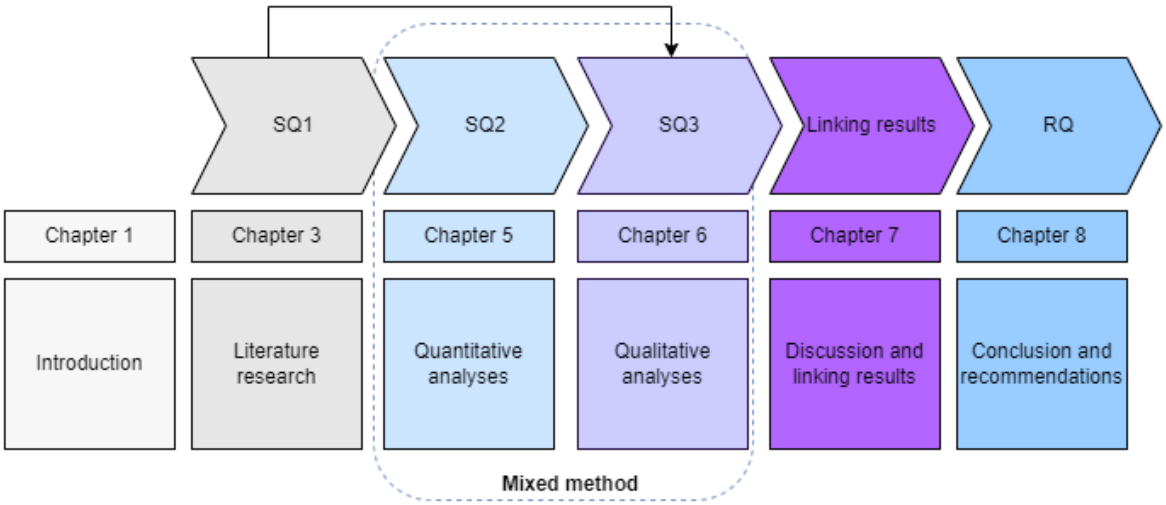

Figure 2: Research flow explanation

The first step was a literature review that sought to identify personal variables influencing bicycle system usage and the development of a new framework to fit behaviour in a shared bicycle system. While literature encompasses both personal and situational factors, this study focused solely on personal factors. A total of 32 papers were examined, resulting in a range of variables. Secondly, these variables were brought together in the quantitative phase of the research, using panel data obtained from Mobycon. This data was collected in November 2022, and featured 1574 respondents recruited via the online platform Jambo. In this data set, the variable 'openness to use' (a shared bicycle system) was designated as the dependent variable. The third aspect of the analysis employed a qualitative approach, involving interviews, a focus group, and the evaluation of open panel data. This methodology encompassed the coding of responses, focusing on the identification of diverse factors influencing usage and the contexts wherein respondents and participants would use the system. Data for these analyses were collected by utilizing the Doodle scheduling tool within the researcher's personal network and via email correspondence with municipalities, system providers, as well as experts in the fields of behaviour and cycling. This effort resulted in the assembly of an eight-member focus group and the execution of four different interviews. The open panel data was drawn from the same data set employed for quantitative analyses, ensuring consistency and coherence of respondents throughout the research process.

The different methods used in the Methodology, chapter 2, resulted in various results per sub question. The literature review resulted in a new theoretical framework for a shared bicycle system, based on the original framework of Venkatesh et al. (2012). In this framework seven factors influencing the intention to use a shared bicycle system and its corresponding found personal factors were introduced. These personal variables are *income, age, urbanisation, frequency of travel, bicycle and car ownership, knowledge about sharing* and *gender*.

Quantitative analysis (Chapter 5) findings demonstrated that the anticipated user groups, in line with the literature, predominantly consisted of urban residents and younger individuals. Logistic regression and cross tabulations unveiled the heterogeneous distributions across the Netherlands of individuals open to adopting shared mobility modes. The quantitative results showed that individuals with higher interest were typically younger, possessed higher incomes, and resided in more urbanized regions. The significance of knowledge about sharing emerged as an important factor in influencing the willingness to be interested in a shared bicycle system. However, the analysis of gender did not show significant relations.

The qualitative analysis (Chapter 6) gave insights into the circumstances and limitations people saw in a shared bicycle system. The focus group discussions illuminated the diverse perceptions individuals hold regarding the system's utility and purpose. Shared bicycles primarily served ad-hoc trips or in situations where personal vehicles were unavailable. Varied trade-offs were made clear per respondent, as users prioritized different aspects. The interview with the shared bicycle providers showed that the current user base encom-

passed tourists, expats, students, and to a lesser extent, local residents. Utilization patterns were influenced by the facilitation of the system and the "design of the operation". Notably, some participants in the focus group expressed a preference for no system rather than a free-floating one. Availability and flexibility were highly valued and mentioned multiple times. Insights extracted from the open panel data highlighted price as a highly important consideration, frequently individuals' own benefits of vehicle ownership were weighted against sharing. Interviews highlighted the significance of familiarity, infrastructure quality, and latitude in designing and managing the system, including decisions regarding hub locations.

The combination of the different analyses led to different discussion points (chapter 7). From the found and included personal variables *gender, car ownership*, and *income* the expected effect from the literature were not found. The influence expected from literature from *bicycle ownership, knowledge about sharing, age, travel frequency* and *urbanisation level* was confirmed. The research results also highlighted some extra effects, such as familiarity with the concept, situational factors, such as availability and distance, and costs. Some limitations of the research focused on the chosen independent variables, the number of focus groups, the substitution effects of the system, the fit of the theoretical framework and data and the data and the research in general.

The conclusion (Chapter 8) to the research question is that the current interested group can be compared to the current users. Knowledge about the system often plays an important role and only gender is not significant from all tested variables. Connecting the framework to the results, showed that facilitating conditions, if the person knows how the system works, has a positive influence on use and is both seen in the qualitative and quantitative analysis as highly influential. The price aspect also seemed to be an important factor that should be considered when implementing future policies. The general conclusion of the research is that from the panel data, both the open answers as the analysis, people often fall in a 'not interested' or 'not interested at all' group in the dependent variable 'openness to use'. From this, it can be concluded that a high percentage of the respondents are not open to use the system yet, and implementing a shared bicycle system will mostly be for people who already use the system.

Three kinds of recommendations were done, for policy, for research, and for Mobycon. The first policy recommendation focuses on decreasing costs. Lowering the costs could help convince more people to use the service. This could be done with for example subsidies, as also provided for busses. The second policy recommendation focuses on achieving uniformity in the operational framework or design of the operation. From the interviews and open panel answers it became clear that there is too much difference in how the shared bicycle systems work. The last policy recommendation focuses on measures to discourage car usage (for short trips). If new systems need to be stimulated, the current travel behaviour needs to be changed. The research recommendations focus on redoing the research but then with specific groups, for example, employees. The second research recommendation focuses on also including situational factors, besides personal factors. The third research recommendation focuses on investigating indirect effects, besides the direct effects of the variables on the dependent variable. All analyses are now using the found literature variables as direct effects, but there is a possibility that some variables have indirect effects on each other. The last research recommendation focuses on the theoretical framework and data fit. When redoing the research, the panel data should be based more on the theoretical framework or the other way around. The recommendations for Mobycon focus on redoing the panel data over a few years to get a clear image of how people their opinion changes over the years or not; looking into substitution effects for what a shared bicycle would be a replacement for, by adding questions for public transport use; and the reason some people do not want to use shared mobility anymore, even after using it before.

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Introduction

In 2019 the COVID-19 crisis happened. Caused by this pandemic the number of cars on the road decreased (CBS, n.d.), and the effect on public transport was a 90% decrease in check-ins seen at the beginning of 2020. The COVID-19 pandemic has drastically disrupted people's travel behaviour and habits. It showed that when the circumstances demand it, people can and are open to changing their travel behaviour. Now, 3 years later, the number of cars is increasing again and even higher than before the pandemic (RTL Nieuws, 2022), but public transport is still not at its original 2019 level (Hamersma et al., 2022). Especially in the 'office sectors', the economic sectors with the opportunities to work from home, have digital meetings, and pursue digital education, commuting mobility has decreased the most (Bakker & Moorman, 2021). These sectors were the ones making heavy use of public transport.

The increasing number of cars on the road again could be explained by the research by the Kennisinstituut van Mobiliteit (KiM). This research showed that the dependency on the car is high in the Netherlands (Faber et al., 2020). It showed that often when people own a car, they will not part with it quickly (Zijlstra et al., 2022). The need for less car dependency is explained by the research of Ecorys (2022). This research conducted commissioned by the Ministry of Infrastructure and Water Management states that in the coming years, the Netherlands will face multiple challenges including demand for more housing, challenges related to sustainability, and the emergence of new mobility services (p. 48). But there is limited environmental and physical space to accommodate this growth. The Dutch population should become less dependent on the car to accommodate for this growth. And it should be possible, since a car, on average is standing still for 23 hours a day (Mobycon & Reframe, 2021).

The pandemic gave room to new innovations such as the increase in sharing mobility modes. According to Bojković (2018) each form of shared mobility removes a certain number of cars from the road. According to Meng et al. (2020) connecting public transport with shared mobility options, could reduce social inequality and increase accessibility, but collaboration between service providers and the government is needed. This could be a solution to the increasing pressure on the road and the demand for space. The exact definition of shared mobility also differs in various papers. Different meanings are conceptualized of shared mobility by many researchers. Three meanings from literature were chosen:

> *"our context implies that physical assets such as bicycles and cars, are to be used by multiple users, rather than singly owned by individuals"*
>
> (Papaix et al., 2023, p. 156)

> *"(semi-) publicly accessible vehicles that can be rented at any time and for any length of time for a fee and used by interchanged individuals."*
>
> (Mobycon, 2022, p. 4)

> *"providing access to a destination, instead of owning the vehicle that takes you to that destination"*
>
> (Roukouni & Correia, 2020, p. 2)

The different definitions focus on the transport mode being interchangeable, not your own, and which can be used to reach a destination, this definition will also be used for the rest of this research.

Different forms of shared mobility modes exist, including, among others, the shared car, scooter, bicycle, and step (Roukouni & Correia, 2020; Shaheen, 2013). The question of why some do not use or do not want to use the available shared mobility modes is still unanswered. Adding shared mobility modes to existing travel habits could release pressure on the public transport system and the road network. It could be bringing people back to public transport by strengthening the chain journey, and with that indirectly contribute to less car use (Rijkswaterstaat, n.d.). For this research, it was chosen to only focus on the shared bicycle system, since the Netherlands has a cycling culture and the infrastructure is fitted for such a system. Cycling is one of the most common transport modes in the Netherlands and is also not limited to any income group according to van Kuijk et al. (2022). A shared bike system should give more flexibility and access to bicycles for those not able to have their own. Depending on the provider, unlike the shared scooter, a driving license is not necessary for the bicycle. This means it does not exclude any groups, which counters inequalities. The mismatch in age, income group, and employment status could be countered, due to bikes being easier accessible for more people since they know the concept longer.

A bicycle system can consist of a station-based, a hub-based, or a free-floating system (Roukouni & Correia, 2020; Shaheen, 2013). Both a hub-based and free-floating system, give the user more flexibility in where they could leave their bicycle after their renting period, while a station-based system, has only one place to return the bicycle to. The existing shared bike system consists of 75% of NS station-based public-transport bicycles (Jorritsma et al., 2021). As seen in the literature, the free-floating and hub-based bike has the potential as a shared mobility mode, but only a certain group is currently using it (Jorritsma et al., 2021), and that while the sharing bike system has been known in the Netherlands for a long time.

1.1. Bikes sharing history and the current regulations

Bike sharing started in mid-1960s in the Netherlands, with the so-called “white bikes” (Chen et al., 2020; O’Sullivan, 2022; Roukouni & Correia, 2020; van der Zee, 2016). The white bike plan was meant to stop pollution and the rise in the number of cars in the city. The bike sharing concept did not last for long but was introduced again in Amsterdam in 1999, after the successes in Copenhagen (van der Zee, 2016). Nowadays, bike sharing systems are getting more popular. According to Chen et al. (2020) and Fitt and Curl (2020) this popularity can be explained due to the adoption of Information & Communication Technology (ICT). But not only the free-floating or hub-based systems are becoming more popular, but also in the past few years, the ov-bike (public transport bike) has also become more popular. After the dip in the use of the ov-bike in 2020, the number of trips made in 2022 is even higher than in 2019 (NS, 2022a). In a survey conducted by the Rijkswaterstaat (n.d.), 6700 people were asked if they used public transport more often due to the availability of the ov-bike, 52% responded that this was the case. This shows that more people are also getting more familiar with the concept, and using it.

The introduction of the shared bike system, even though already big in other countries (e.g. Paris, Beijing), would not grow as fast in the Netherlands. A reason for this could be the regulations and requirements in the Netherlands before it can be implemented. Smaller implementation in some locations would work (e.g. Amsterdam, Rotterdam), but one big system applicable all over the country, could not be introduced yet. As de Weger et al. (2018) mentioned, this could also be caused by the bad publicity that the shared bike concept received, after some Asian providers implemented the new systems in the Netherlands which led to controversy within the population. The lack of regulations caused ’scatter bikes’ (*strooifietsen*), which caused bad publicity in the media. Even though, when looking at the success of the ov-bike, a shared system should have potential (de Weger et al., 2018; Jorritsma et al., 2021). But "a clear concept with an adequate direction, which is exactly what is lacking so far in the new shared bike concepts" (de Weger et al., 2018, translated from p. 21). The user, the municipality, and the provider should work together to get to a working system.

1.2. Travel behaviour

Behaviour change happens during key events such as relocation of your job, having children, buying a car or moving. The increase or decrease of public transport or the entry or exit for sharing services are also seen as key events according to Doody et al. (2022). During the times when habits are interrupted, a window of opportunity is created. This window of opportunity can lead to behavioural change (Busch-Geertsema

& Lanzendorf, 2015; Corcoran et al., 2014; Doody et al., 2022). In the Netherlands, the change of working situation and conditions due to COVID-19 could be a reason for the change in behaviour and the reason people disappeared from public transport. According to Venkatesh et al. (2003) behaviour can be subdivided into intended behaviour, so what the person would like to do, and the actual behaviour, so what the person actually does. A person can have the intention to do something, but eventually not do it. The actual use also indirectly influences the individual's reaction to shared mobility and with that its intended behaviour. This can be visually seen for shared mobility in Figure 1.1. When someone had a bad experience when using a shared mobility mode, chances are high, this will change a person's reaction towards it, and then change their travel behaviour to not use the mode again.

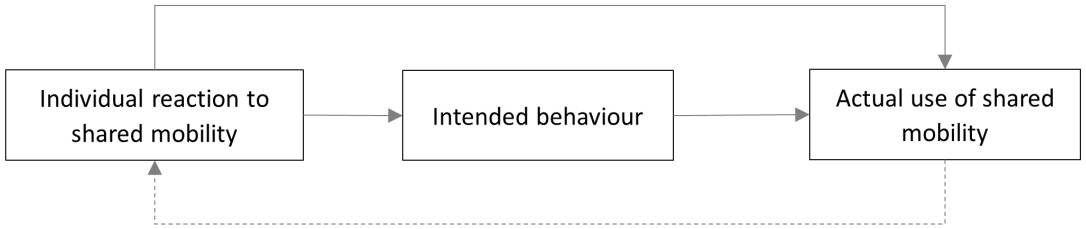


Figure 1.1: Behavioural principle, based on Venkatesh et al. (2003)

1.3. Knowledge gap

Research still lacks substantiation in travel behaviour studies associated with shared bike systems. Shared mobility is mostly used by young, high-educated people (Bijlsma, 2022; Roukouni & Correia, 2020), who care about the climate and live in denser neighbourhoods and have good connections with public transport. There is little knowledge about the perception of other user groups in the population and which factors would influence them to switch to shared mobility modes. The research available for the Netherlands is still little, and mostly or case studies or based on the different bike system providers instead of focusing on the user (Ma et al., 2020). The knowledge about the potential of behavioural measures on people and their mode choice is mostly fragmented and a clear framework which is applicable for a shared bike system is still lacking.

1.4. Problem statement

As mentioned before a current problem is that the car has an increasing share on the road again, while the municipalities and government want to reduce dependence on the car (Rijksoverheid, 2019). The number of public transport trips is not back to its original level, and also here the stations become more crowded due to decreasing lenghts of the trains and a shortage of NS ('Nederlandse Spoorwegen') staff. The demand for more space, asks for other solutions. A solution could be looking into shared mobility options more, and getting more people motivated to switch to these modes. A downside of motivating more people to use shared mobility is according to the research of KiM (Faber et al., 2020) that the phenomenon of mobility as a service now takes away a share from public transport instead of the car. Not all research confirms these findings (see theoretical framework in Chapter 3).

A problem with free-floating and hub-based shared scooters and bicycles is that they seemed to be implemented without a clear plan by municipalities (Jorritsma et al., 2021; Roukouni & Correia, 2020). Data about the shared mobility modes seem to be hard to gather without clear set rules with the providers. And since the free-floating and station-based systems are still new, it can be hard to get insight into the system for policymakers. It is not always clear what the general opinion is about sharing and which groups (income, gender, etc) are using the modes and what influences it. Therefore a step back needs to be taken, to get insight into who is using it and under which conditions, to be able to develop a better applicable policy for the Netherlands.

1.5. Focus and goal of the research

The focus of this research will be on:

1. User behaviour;
2. User groups;
3. Influencing factors for use;
4. Possibility of using bike sharing systems as part of the travel choice or chain journey.

The need for change is even higher in the coming years, because of the Climate agreement. The Netherlands stated in the agreement the wish to decrease car use and promote active travelling by bike. Research by CROW (2021) showed that almost half of the short trips consist of commuting trips. These trips are responsible for the vast majority of problems in terms of urban accessibility. A reduction in these trips has an influence on aspects such as urban accessibility, decreases rush hour and has a positive effect on the quality of life (Eren & Uz, 2020; Machado et al., 2018).

As AM (2018) wrote in their white paper, the focus in a transport system should be on the end user. As mentioned by Ronald Huikenhoven (AM, 2018, translation p.3) "After all, mobility is and remains an outcome of human behaviour". Only the users are responsible for the use of the new mobility forms and they are the only ones who can change their travel behaviour. Most of the time travel behaviour is ingrained in people. As also mentioned by AM (2018), flexibility is a key aspect for a lot of people. The e-bike, speed-pedelec and bicycle can offer the same flexibility as a car, since they can get close to the destination, and are often seen as an important alternative for commuting. Bikes can be used for different purposes, but are mostly used for recreational trips. A small increase in work-related trips by bike has been observed (Harms & Kansen, 2018). The scaling down of buses makes people more dependent again on other transport modes such as the car. Deploying shared mobility precisely at these moments can use the 'window of opportunity' optimally. Often while restructuring a city or living area, shared mobility is not taken into account yet. Precisely at these moments of change, efforts should be made to change behaviour and rethink the chain journey of people. Changing people's travel behaviour in both rural and urban areas could possibly lead to the discarding of (the second) car and make room for more public space.

The goal of this research is to find the users and the factors which influence users to use shared bicycle systems. Often, municipalities were overwhelmed by the high numbers of rising sharing systems suppliers, and the supply was often regulated by the suppliers of shared mobility. The supply and demand sides did not match, so the sharing system did not get off the ground. Looking at the problem from the demand side should give more insight into which factors influence use.

1.6. Research question and sub questions

The research question which should give an answer to the knowledge gap and both relevance is:

Who are the current groups open to using shared bicycle systems and which factors influence their use in the Netherlands?

This research question focused on different parts: the conditions, so when would someone change their behaviour towards shared bike use; for whom is the system useful, focus on the user groups and defines a specific target group; and be an alternative to the private car, should focus on if it could reduce car use. This research question will be answered using sub questions.

1.6.1. Sub questions

The sub questions formulated to answer the research question:

1. What demographic and general factors influence shared bike systems in other countries?
2. How do the factors influence people open to shared bicycles in the Netherlands?
3. What preconditions influence current travel behaviour in favour of a shared bicycle system?

These three questions are answered by using the panel data of Mobycon and interviews with experts. Demographic are specially defined because the focus will be on user groups and not specific circumstances of living area.

1.7. Social relevance

The social relevance of this research is being able to conclude who is using the shared bicycle, who is open to using the shared mobility mode, but is not using it yet, and under which conditions to be able to make recommendations for new policies and groups that need to be the target. This should help decrease the nuisance of bicycles that are not parked correctly and increase the knowledge about bicycle sharing. The general relevance of pushing more bicycle use is the health benefits, environmental benefits and meeting the climate targets set in the Climate Agreement.

Taking the bike or taking the train is healthier and less stressful than going by car (den Hertog et al., 2018). People travelling by PT reach their recommended exercise time per day rather than car drivers (de Haas & van den Berg, 2019). The research of den Hertog et al. (2018) also showed that changing the mobility form from car to another mode, can have a positive influence on a person's health. If people do not have the possibility to bike to their job, maybe there could be potential for those people to make use of shared mobility more to improve their chain journey. And the car does not have to be used as often as it is used now: half of the car journeys are less than 7.5 km (de Haas & van den Berg, 2019), distances which could also be done by bike.

The planet is also positively affected by less car dependence and more shared use. More shared mobility and more bike systems use could have a positive impact on: environmental pollution, difficulties with parking, loss of public space and high traffic congestion (Roukouni & Correia, 2020). In the before mentioned Climate agreement ('klimaatakkoord') the goal is to have 'carefree mobility' in 2050. The emissions should go to zero, locations should be accessible to everyone and areas should be liveable (Rijksoverheid, 2019). One of the mentioned goals to achieve this is to stimulate the use of PT and facilitate more bicycle(connections) and to decrease ownership (mostly in urban areas) (Rijksoverheid, 2019, p. 47).

1.8. Scientific relevance

The scientific relevance of this research mainly focuses on the lack of information related to behavioural change and shared bicycle systems in the Netherlands. Research and papers available in the Netherlands are more focused on the car than other shared mobility modes. The bike is less investigated, and research is mostly focused on station-based systems instead of free-floating bicycles (Roukouni & Correia, 2020) or hubs. More research on shared mobility could help authorities, municipalities, and decision-makers get insight into the impacts of shared mobility (Roukouni & Correia, 2020).

Another scientific reason to conduct this research is the fact that a sharing system does work in other countries but does not get off the ground in the Netherlands. In Paris, for example, the bicycle sharing system is much more used. This could be for example explained by the high private bicycle ownership in the Netherlands, but this correlation is not investigated (often) yet.

1.9. Link to master program

In the master Complex System Engineering and Management different design principles are covered. In these design principles the managing of diverse stakeholders is important. In the issue of a shared bike system, different stakeholders are involved such as the municipalities, the suppliers of bikes and the users. In the research a framework will be designed which tries to cover the connection between behaviour, shared mobility and different aspects influencing the shared system use. Therefore this is a good fit between the master's and master's thesis.

1.10. Thesis guide

In the second chapter of this research, the methodology used to answer the sub and main research questions is explained. In the third chapter, the literature review and theoretical framework are introduced. This chapter will help give more insight into the current situation and the literature that is available. In the fourth chapter, the descriptive statistics of the panel data by Mobycon are given. In this chapter, it is explained if the panel data fit the population of the Netherlands. In the fifth and sixth chapters, the results from both the qualitative and quantitative analyses are given. The link and interpretation of both can be found in chapter seven, where the limitation and discussion are written. In the last chapter, the conclusion and recommendations of this research are given. The sources used in the research can be found in the bibliography at the end. The elaborate tables and information on the analysis can be found in the appendix.

2

Methodology

In this chapter, the methodology used to answer the research question is explained. The used data and data collection method are explained and summarized. The advantages and disadvantages of every method are listed and why the method fits the research questions and the research. The methods are discussed and will be elaborated on in every section.

2.1. Introduction to the research approaches

For this research, different research methods are used to answer the sub questions. For the first sub question, a literature review is done. For the second and third sub question, a mixed method is executed. The sub questions are all connected; the first sub question leads to input for the second sub question, and the outcome of the second sub question partly leads to the outline for the third research question. The process is visualised in Figure 2.1.

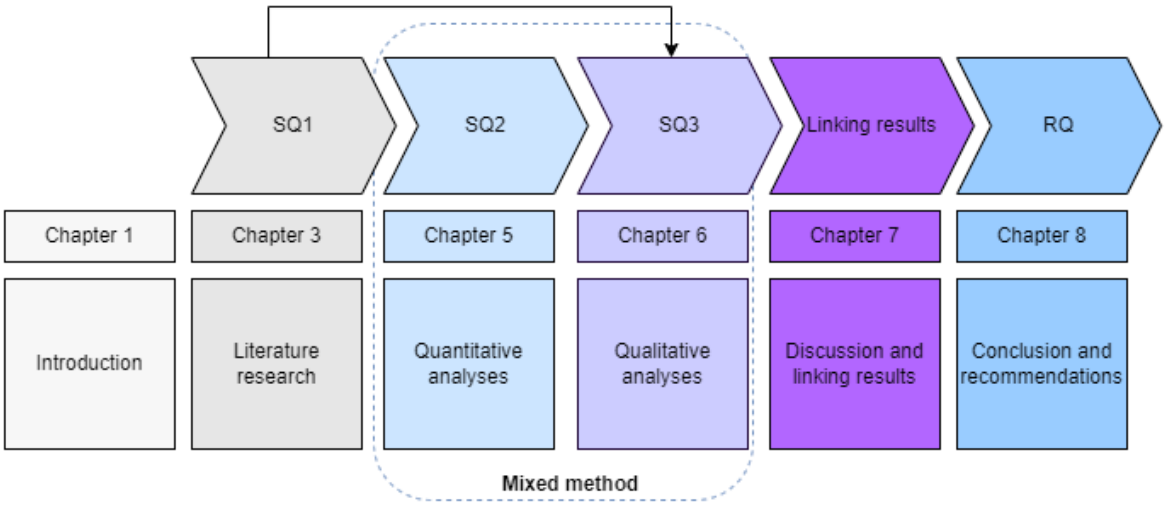


Figure 2.1: Research flow explanation

In chapter 1 the knowledge gap was introduced. It highlighted an expected user group of shared mobility, however, there's still uncertainty regarding a specific group of new users who are open to using a shared bicycle system. Research has indicated that people's behavior plays a role in determining their willingness to adopt this system. Various sources pointed out that several factors such as age, income, or living location can play a role in the openness for people to use the system, but specific factors and openly available analyses of these factors are lacking. A clear framework that combines behaviour and specific factors is still missing in

the literature.

Two different approaches will be used to answer the sub- and research questions: a literature review and a mixed-method approach. Literature research is a method to find the state-of-art in a certain research area. It can help to get a well-structured and current overview of the data (van Wee & Banister, 2016) and limited experimental bias (Baumeister, 2013). It is a way to find areas where more research is needed, to find the current research gaps and the current research available. It is also a good way to build the theoretical framework on (Snyder, 2019). The literature review aims to identify existing frameworks, analyze them, and subsequently develop a new framework that's relevant to shared bicycle systems and encompasses a range of influencing factors. A literature review is a fitting method for sub question one: *'What demographic and general factors influence shared bike systems in other countries?'*, since the literature will show the state-of-the-art in other countries where sharing bicycle systems are bigger than in the Netherlands and point out existing influencing factors in other countries.

The mixed method approach is a way to use multiple methods in one research. The flow of this method is shown in Figure 2.2. As stated by Jick (1979), combining qualitative and quantitative data in a mixed method can help lift the disadvantages of the qualitative or quantitative method. Often this method is chosen when the combination of both methods gives a better understanding of the problem than one method alone. This method is chosen since the research question suggests that only qualitative analyses or quantitative data will not fully answer the question. By combining the two methods, both the second and third sub question can be answered. The mixed method approach can help explain found quantitative relations by adding qualitative data. Often the two types are labeled differently, but try to explain the same thing (Mahoney & Goerts, 2006). The mixed method is often seen as a good method for eliminating the disadvantages of a single method (Creswell et al., 2003; Jick, 1979). Also for this purpose, to conclude from the user's perspective, adding a qualitative approach to the quantitative data analyses, the results can give more insight into people their opinion about shared bicycle systems. By combining the two methods to answer the research question, the credibility of the research increases, this is also called 'triangulation', the concept that the validity of the research conclusions becomes higher by combining the methods (Adams & Cox, 2018; Jick, 1979).

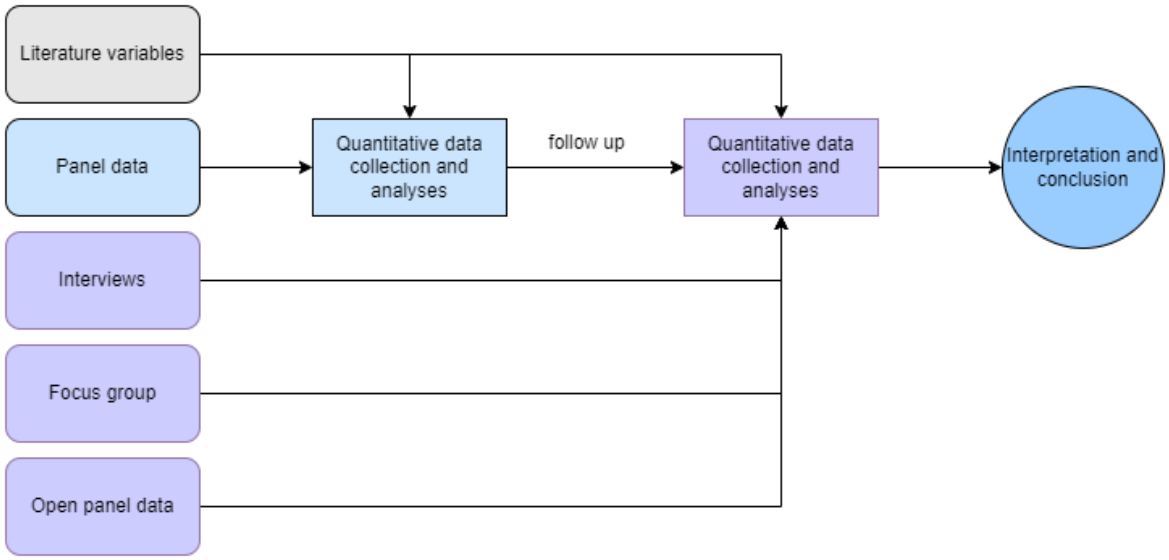


Figure 2.2: The flow of the mixed method approach

Since data about shared bicycles is scarce, the dataset of Mobycon is used. This dataset is used to answer the second and third sub question. The data will be elaborated further in the next sections. Per sub question a method is explained. Validation of the data is done by making a comparison to the sample and CBS data in chapter 4.

2.2. Literature review

As mentioned before, the literature review is conducted to answer the first sub question. The literature review aims to find the current variables and factors influencing shared bicycle use and behaviour. Since this research asked for a new theory and link diverse strands of work, the 'narrative method' is chosen mentioned by Baumeister (2013). In the narrative method, the results of papers with different used methods are combined into a new theory (Baumeister, 2013). This method is chosen since the concept of shared bicycle systems is researched to a smaller amount in the Netherlands, and by combining papers which use different methods, more sides of the subject can be highlighted.

2.2.1. The data

The data for the literature review is collected by using different search methods: ScienceDirect, Scopus, Technische Universiteit Delft Library, and Google Scholar. In these search engines different strings are combined to find the most applicable papers. The data used is mostly based on existing data sources of literature. The data needed to fulfill a few assumptions: only English papers are selected and which are cited more than 25 times are included. The paper of van Wee and Banister (2016) recommends a threshold of 30 cited papers, but since it is quite a new subject, which is still being researched, the threshold was chosen to be a bit lower. No papers older than 10 years were included for shared transport papers, for behavioural change theories, this limitation was released, since applicable theories exist for a longer time period.

2.2.2. The method

The method was carried out by first outlining the key concepts of the problem. The research and sub questions were divided into three concepts: *shared bicycles, travel behaviour* and *factors influencing shared bicycle systems*. The concepts are investigated by looking at papers from other countries than the Netherlands and the existing papers from the Netherlands. To find the papers applicable to the definend concepts, different search strings are defined: bike sharing; sharing; factors; demographic; influence. For the behavioural theories, other search terms were used: behaviour or behavior; framework; shared; mobility. These concepts are combined in the search engine by OR and AND commands to find the papers best fitted for the research problem. These search strings were added to the earlier defined search machines. Besides the approach of searching in existing databases with the search string, the snowballing approach, where the researchers search for related papers by looking into found papers, helped in finding more applicable papers.

The found papers and theory were evaluated by the author, and the abstract, title, keywords, and conclusions were scanned. the literature papers are scanned on language, and on the citation level. If these did not fit the purpose of the research the papers were excluded. The snowball method and expert knowledge also helped find the included papers. The search is visualised in Figure 2.3

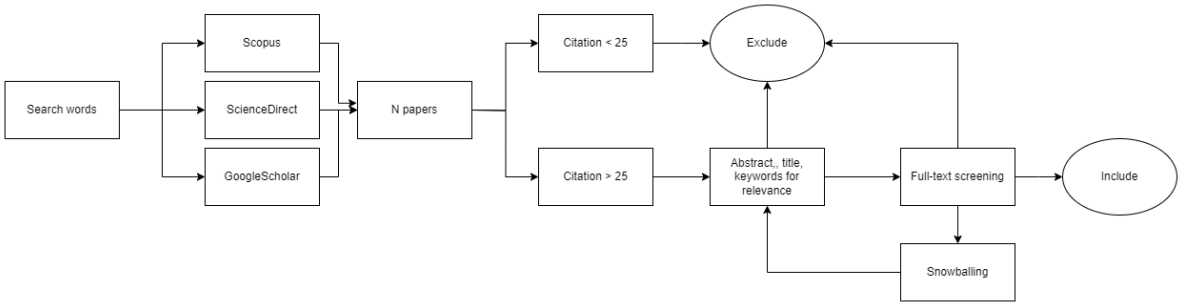


Figure 2.3: Literature search process

An example of the search for behavioural theories in the Netherlands is given in Figure 2.4. Those 5 papers left, are scanned and fully read and included when applicable.

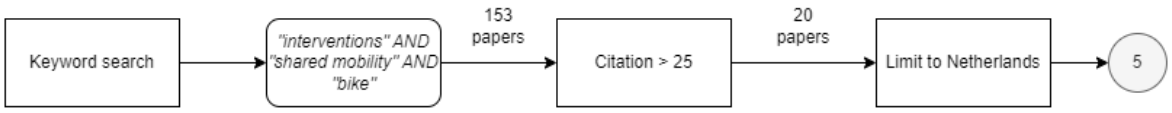


Figure 2.4: Example of search in Scopus

2.2.3. The output

The search by combining before mentioned search strings resulted in a final count of 32 papers for the literature research. These papers were included in the literature review and combined contributed to the new theoretical framework.

The variables and new theoretical framework were used as input and outline for the qualitative and quantitative part of the research. During the search for the papers, it was important to only include papers that mentioned influencing factors. Papers that only outlined what a shared mobility mode or shared bicycle system was, were not included. This lead to a list of variables and factors that influences the openness to use shared bicycle modes and a list that could be tested on the available panel data of Mobycon.

2.3. Quantitative method

The goal of the quantitative method used was to answer sub question two: *'How do the factors influence people open to shared bicycles in the Netherlands?*. To answer this question, the panel data of Mobycon was used. The factors are the variables found in the literature review and were tested on the dataset.

2.3.1. The data

The received panel data of Mobycon consisted of 1574 respondents and was conducted in November of 2022. The survey was administered online via the platform Jambo and included and was distributed to participants from all over the Netherlands. The data can help give more insight into the characteristics of the user group, the characteristics of the potential user group, and the characteristics of the non-user group. The panel output contains qualitative and quantitative data. The dataset explanation of distribution can be found in chapter 4. The data can be requested at Mobycon since it is not available online. The general subjects tested in the panel data were:

- Mobility choice (current use of modes and dilemmas about mobility)
- Shared mobility (perception about shared mobility and current use)
- Participation (until which level, municipality or street level, do people want to be reached out to)
- Demographic characteristics (age, gender, income, etc).

Not all of the asked topics will be used for the research. This research will mostly focus on shared mobility and related demographic characteristics. The number of vehicles in the households will also be tested with the perception of shared mobility use.

For the panel data, the data set with 1574 participants was already cleaned by Mobycon. The data source was chosen since it consisted of a big sample and asked the general knowledge about bike sharing and use. In general, data is hard to gather about shared mobility use, since it is only available on a limited basis. Often, providers do not share the data, or an account is needed to log into, as with the 'Deelmobiliteitsdashboard' of CROW (2023). Often the providers cannot access general information such as age, income, or household conditions of their users. Therefore the data source of Mobycon can give more insight into these factors.

Inclusion and exclusion criteria

In the panel data, the excluded cases consisted of not finished questionnaires, which were deleted. Mobycon weighted the data, based on income and gender. They also added the urbanisation levels defined by CBS (2023). Some response times were seen by the author as quite short or very long. Ranging from 67010 seconds to 58 seconds. These numbers were discussed with Mobycon colleagues and decided to not exclude this from the data set. The reason for this was that people could close their survey, and finish it later, but the timer would go on. The open answers of these short-timed surveys were checked by the author on their credibility. If the open answers were filled in with plausible answers, these were not excluded. Therefore these outliers

were kept in the data set. For the regression analyses, some of the variables are recoded. The exclusion criteria are discussed in the results chapter (5).

Missing values panel data
In the dataset some values are missing, in most of the cases, the answers were not filled in in the panel questionairre and coded in SPSS as missing. Since the dataset is large enough and only in the case of Urbanisation the percentage of missing cases is higher than 1%, these missing variables are not recoded. The missing variables are visualised in Table 2.1. These variables were chosen based on the literature.

Table 2.1: Summary panel data (valid, missing and total cases)

	Openness to bike sharing					
	Valid		Missing		Total	
	N	%	N	%	N	%
Use bicycle	1562	99.2%	12	0.8%	1574	100.0%
Use shared bicycle	1563	99.3%	11	0.7%	1574	100.0%
Income	1563	99.3%	11	0.7%	1574	100.0%
Urbanisation	1430	90.5%	144	9.5%	1574	100.0%
Gender	1561	99.2%	13	0.8%	1574	100.0%
Age	1560	98.1%	14	0.9%	1574	100.0%
Availability car	1562	99.2%	12	0.8%	1574	100.0%
Availability bike	1561	99.2%	13	0.8%	1574	100.0%

Assumptions panel data
Some assumptions were made: the occupation of people was recoded when given an open answer in: Jobless; Disqualified (WAO, WIA, disabled); Stay-at-home-mom/dad in unpaid jobs. Missing values are recoded in 999 in the dataset of Mobycon, these were for example found in the answers for 'openness of use'. When no answer was given and the space was blank, these cells were coded as missing. The given options (strongly agree to strongly disagree) are as mentioned before recoded to a Likert scale, this was done so it could be better interpreted with SPSS. The data was checked and outliers were deleted. An example of an outlier was the car ownership of 50 normal cars. The chances that this value was accurate, were estimated as low.

2.3.2. The method
The quantitative analyses were done in SPSS and Excel. The original data file by Mobycon was recorded in Excel, and for the analyses of this research transferred to SPSS. Some of the qualitative data were given numerical values, to fit on a Likert scale. From the literature and Mobycon data, the dependent variable 'openness to using shared bicycles' ('openness to use') is chosen. This variable had originally five answer options: *not interested at all, not interested, neutral, interested* and *very interested*. Three different metrics are used to evaluate the data.

Cross-tabulations
Cross-tabulations are often used to find or test a (significant) effect between two or more variables. In this research, the method is used since most of the variables are ordinal variables. These variables cannot be interpreted using a mean, since they have no numerical variables. By conducting this analysis, the spread in the data set could be found between two variables.

To use this method, a few assumptions have been met to be able to execute the analyses (Morgan et al., 2004): the data should be independent, which means that every subject needs to be only assessed once. In the dataset of Mobycon this was done by giving every respondent an unique ID-code. The data is treated as nominal, even though most of the independent variables are just like the dependent variable 'openness to use' of the ordinal scale. And the last assumption that should be met is the assumption of expected frequencies of the chi-square. To make sure this assumption was met and the cross-tabulations could be interpreted the answer options of the groups '*very interested*' and '*interested*' were combined into one new answer option: *'(very) interested*'. This was done since the Chi-square, often used to demonstrate significance (Aljandali, 2016), could not be interpreted caused by the too small number of observations per group in the *very interested* group.

The selected variables from the literature could be tested on the data set and resulted in significant or insignificant relations. When a variable was insignificant this meant a relationship between the variables could

not be stated with certainty. The metric used to state significance was the chi-square or Linear-by-linear metric. A higher chi-square value shows a bigger difference between the expected and observed data. A higher chi-square also gives a higher probability that the significant relationship is correct. When an expected count of a cell is lower than 5, the chi-square is less reliable, and the Linear-by-linear metric could conclude significance.

The method was conducted in SPSS by selecting the chosen dependent variable 'openness to use' and crossing it with one of the selected predictor variables (the independent variable). This led to a clearer image of how the groups within the variables were divided over the different groups in the dependent variable.

Logistic regression
The Mobycon data is evaluated using logistic regression analyses, since the dependent variable 'openness to use' is an ordinal variable. For conducting an *ordinal* logistic regression a few assumptions should be met (Harrell, 2015): the dependent variable 'openness to use' should at least be measured on an ordinal scale and should have more than two levels (Liu, 2009). This assumption is satisfied. The chosen independent variables should be measured on a continuous, ordinal, or categorical (nominal) scale. This assumption is also satisfied. There should be no multicollinearity. This happens when multiple independent variables are highly correlated (Molin, 2020). The problem of high correlation between predictors is that the sign can change, the standardized coefficient is higher than 1 and the standard error is high, which can lead to unreliable estimates for the parameters. In Appendix E in Table E.16 the correlation matrix is shown. None of the variables have extremely high correlations with each other and most of the signs are as expected with the variable 'openness to use' and the theory. For the correlation matrix Spearman's rho test is used to test the correlation since most of the variables are ordinal. The last assumption of the proportional odds is not satisfied. When assumption 4 of the parallel lines is not met, and the p-value is significant (<0.05), this means that the effect of the predictor is not the same across the different categories of the 'openness to use' variable (Liu & Koirala, 2012). For the model, this means that chance (the odds) of being at or below a category are not the same. An option if this assumption is not met is multinomial logistic regression. In this analysis method, the ranks of ordinal data are not taken into account anymore. A multinomial logistic regression is conducted in this research. The analyses were done in SPSS by selecting the dependent variable, and the independent variables as factors and covariates. The exact test, which variable was selected for what and the underlying tests to verify the outcome will be explained further in chapter 5.

Independent sample tests
To compare the answers of the different groups in the data set, two different non-parametric tests were used: the Mann-Whitney U test and the Kruskal-Wallis test. When choosing a method to compare different groups in a dataset, a one-sample t-test or ANOVA test is normally used but since the dependent variable '*openness to use*' is an ordinal variable, the assumption that the dependent variable follows a normal (scale) data distribution is violated (Morgan et al., 2004). Therefore only non-parametric tests can be used.

The Mann-Whitney is often used when there are two levels of the independent variable, such as gender. The Kruskal-Wallis test is often used when there are more than two levels of the independent variable. The different variables found in literature are tested via these tests, to find the mean distribution between the different groups. The mean distribution shows how different groups differ in opinion about the dependent variable 'openness to use'. Ad hoc tests after finding the significant differences in the means, show what the exact distributions are in the data set. An assumption to do this is that the categories are coded in a continuous manner.

2.3.3. The output
The panel data collected by Mobycon resulted in three test being executed. Since the dataset is not online available, getting access to the dataset, Mobycon should be contacted. The three analyses in SPSS result in different outputs per variable. Various aspects of the dataset are being highlighted. These outputs are used for the qualitative part of the research. After the analyses, the second sub question could be answered.

2.4. Qualitative method
The main goal of the qualitative method was to answer the third sub question. Three different ways were used to reach this goal: analysing the open answers, interviews, and a focus group. These ways were used to find the circumstances when people are more open to using a shared bicycle system. The goal of the methods is

to investigate behaviour, therefore different methods could be used. According to BIN NL (2019), when trying to stimulate a behaviour change in the exploratory or policy development phase, surveys, focus groups, and interviews could be helpful.

2.4.1. The data

The different methods used were looking at the open answers in the panel data, four different interviews, and conducting a focus group where eight people were present. The data collection differs for all three methods but is all focused on looking at the respondents and looking into their (verbal) open answers. The outcomes from the literature search and the different variables tested in the quantitative part led to the selection of participants and selections on the open panel data.

Open panel data

For the open panel data, the data was already collected by Mobycon. The data consisted of 1574 responses, the same as for the quantitative data. Participants got the open question under which circumstances they would switch to a shared mobility mode. All respondents answered this question, but some responses were recoded. Responses such as '.' or a combination of letters that did not make sense and form a word, were recoded and assumed to be 'unusable'. It could be discussed that these answers could also be seen as 'not interested under any circumstances'.

The data was split into different selections, which were evaluated. For every selection people were excluded if they were not interested, or not interested at all in the shared bicycle system, unless other specified during the analyses. People who were not interested under any circumstances are also excluded. Only answers that met the selections were included and analysed. The following three selections on the data were made:

1. The first selection was based on people who owned a car, used their car daily or more than once a week, and were open to the concept. The selections were distributed among the incomes. This selection was made to get more insight into if people who own a car, would prefer a bicycle system. The first step in changing people their travel behaviour is to find out what their current behaviour is that is aimed to change and to find out if they are open to changing it to other behaviour.
2. All respondents, who answered to be open to a shared bicycle system. This selection was made to see what the general opinion was about sharing and using a shared system.
3. Respondents who are users, but are not interested anymore. This selection was made to find the reasons why people tried to concept but did not want to use or invest in the system anymore.

The interviews

Four different interviews were conducted: a behavioural specialist, a shared bicycle system provider, a (bigger) municipality, and a bicycle promoter. The interviewers were selected based on their characteristics. The supplier of shared bicycle systems was chosen since they are the biggest in the Netherlands in addition to the ov-bike. The behavioural specialist was talked to, to get insight into what drives people to change behaviour. This person was chosen since the company is also active in the transport area and works in shared bicycle project themself. The municipality was chosen since they just changed their shared mobility policy. For the other municipalities where sharing bicycle systems are active, more about the pilots could be found online. The Fietsersbond was chosen, since they are active in stimulating bicycle usage, and could give insight in which conditions play a role in stimulating the use.

Another assumption made for the interviews was that every interviewee had enough knowledge about the process behind sharing bicycles, that they could be assumed as experts. The data of the interviews are the summarized interviews.

The focus group

The participants for the focus group were found by selecting people who use the bicycle more often, are less dependent on the car, and preferably know the sharing concept. The choice was to find a more homogeneous group, which can help to facilitate more discussion and experiences (Lazar et al., 2017) since it is seen that knowledge plays a part in being open to using a shared bicycle system.

The data set of respondents in the focus group consisted of the following eight people and characteristics:

Table 2.2: Focus group respondents

Attendee	Age	Gender	Bicycle use	Car owner	Experience ov-bike	Experience other provider
1	23	Female	More than 3 times/week	Yes	Yes	No
2	Unknown	Female	More than 3 times/ week	No	Yes	No
3	25	Female	More than 3 times/week	No	Yes	Yes
4	37	Male	1-3 times/week	No	Yes	Yes
5	29	Male	More than 3 times/ week	No	Yes	Yes
6	20	female	More than 3 times/ week	No	No	Yes
7	28	Female	More than 3 times/week	No	Yes	No
8	27	Male	More than 3 times/week	No	Yes	No

The participants of the focus group consisted of people between 20 and 37 years. They were all familiar with the concept of shared bicycles and used a station-based, free-floating, or hub-based form of sharing before. A more extended explanation per person can be found in Appendix I. For the focus group, the assumption is made that everyone who participated and interviews provided honest and accurate information.

2.4.2. The method

The qualitative analyses were done with Atlas.ti, both the focus group, open answers and interviews were coded using the program. Excel was then used to count the coding and summarize the data. The course of the coding process and evaluating qualitative data is shown in Figure 2.5.

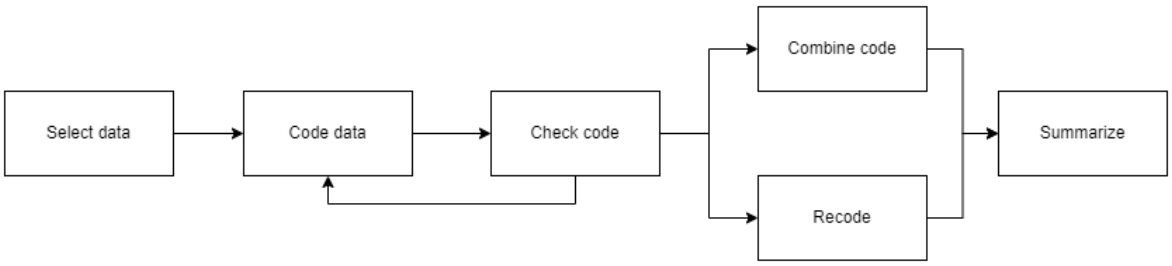


Figure 2.5: Process of coding qualitative data

The goal of the coding is to conclude found data and make it easier to link the found outcome to an emerging theme (Auerbach & Silverstein, 2003; Onwuegbuzie et al., 2009; Swanson & Holton III, 2005). As stated by Onwuegbuzie et al. (2009), there are three rounds of coding. The first round is where the data is divided into smaller units, in the second part, where the code is combined or recoded, categories are made. In the last part themes are developed, where groups fit into. This coding is also used to guarantee a process that can be repeated for every data source.

The open panel data

In the panel data, an open question asked for the motivation of the users to switch to shared mobility. These answers are evaluated, coded, and recoded to get insight into what factors and circumstances influence people their use. The method used for this is first making different selections of what the research needed to investigate. After making this selection, all available answers per selections were uploaded in Atlas.ti.

First, analysing the data automatically was tried via the AI logarithm. Unfortunately, since this feature is quite new in Atlas.ti, this was not possible. Therefore, the researcher needed to hand-code all the input. This was time-consuming but eventually led to a group of codes per answer category. The codes were evaluated per selection and combined where possible. This led to a smaller number of code groups, which made it easier to conclude and summarize the answers of the respondents.

The interviews

The method for the interviews was based on finding different people who are on the supply side of policy side of the shared bicycle system, to illuminate the other side than the demand side researched in the quantitative method and literature research. As a method, semi-structured interviews were conducted. This method is applicable since there was the possibility to ask for more explanation where necessary in comparison to

structured interviews where the interviewee needs to stick to the before-made questions (Almeida et al., 2017; Anderson, 2010). Invites were sent to different parties, with an explanation of the research. From these invites, four people responded and four interviews were planned and done with different parties.

All interviews were done in similar circumstances on Teams. Every interview was recorded after the interviewee had given oral consent to this. After the interview, the interviews were summarised and sent back to the interviewee. The interviewee could still change and provide feedback on the summary, to make sure the validity and reliability of the research stays high. The interviews were coded after checking the summary with the interviewee and included in chapter 6.

The focus group
The participants for the focus group were found by sending around a Doodle, a scheduling assistant website, in the personal network of the author. In total, the Doodle was shared with over 40 people. The people invited could fill in their availability on the Doodle website and the date was chosen when most people were available. The number of people included was chosen, through literature recommendations. For focus groups, sources give a different minimum number of respondents to include, ranging between three to a maximum of seven by Adams and Cox (2018). A variety of authors cited in the paper by Onwuegbuzie et al. (2009) state that a group session containing between six to twelve participants is optimal. For this research, a focus group of eight people was selected.

The focus group was conducted for a bit more than an hour. A focus group between an hour to two hours is seen as well-designed research (Nyumba et al., 2018; Onwuegbuzie et al., 2009). The focus group was recorded after oral consent of all participants. During the focus group, a Mentimeter was used to collect people their answers. A Mentimeter is a tool to collect people their opinions via their phones. After everyone filled in the question, the participants were asked to elaborate on their answers and explain why they gave them. After the session, the focus group was summarized and linked to the theoretical framework and factors influencing bicycle use. A more specific explanation and the links per method can be found in chapter 6. The questions asked in the focus group can be found in Appendix I.

2.4.3. The output
The qualitative analyses led to different inputs from both the side of the supplier, municipality, behavioural specialist, bicycle specialist, and current users. This gave a better picture of different sides of the population. With the interviews several confirmations of statements in the literature and quantitative analyses could be tested. The focus group tested the opinion of people and built on the factors found in the open-ended responses in the panel data. The output is different summarized interviews and a focus group. The output led to the answer to the third sub question.

2.5. The advantages and disadvantages of the methods
The advantage of a literature search is that it gives insight into the current state of the art, and available theories (Baumeister, 2013). A disadvantage of a literature search is that often the method used is often not made explicit (van Wee & Banister, 2016). The findings are also dependent on the kind of search (Snyder, 2019).

The quantitative method chosen, a survey, has a few general advantages and disadvantages: a survey often represents the population well, but the reliability and accuracy are highly dependent on the respondents (Almeida et al., 2017). The qualitative part of interviews, a focus group, and the open panel data, also have some advantages and disadvantages: in-depth interviews or semi-structured interviews give the opportunity to ask more follow-up questions to the interviewee but are also time-consuming and non-generalizable to the population (Almeida et al., 2017; Anderson, 2010). The advantage of a focus group is that more people respond to each other, which can lead to a more natural conversation and input gathering (Almeida et al., 2017). A disadvantage can be that motivating people to participate in a focus group is also harder, and can cause non-users to be underrepresented (Almeida et al., 2017). Some sources even say that a focus group is less adequate as a stand-alone method, and needs other methods to be more reliable (Kidd & Parshall, 2000). Also, the individual skills of the researcher can be influenced by their own bias and opinions (Anderson, 2010).

A disadvantage of a mixed method, where qualitative and quantitative research are combined, is that it is labor-intensive (Jick, 1979). Since the data is already collected by Mobycon, this takes away a big part of this limitation. Another limitation is conflicting results, which will be discussed when happened in the discussion

section at the end of the research.

3

Literature review and development of theoretical framework

In this chapter, the current state of the art is given. An overview of the most important concepts and existing research for this thesis, derived from the (sub-)questions are explained. The literature review and development of a new theoretical framework are based on the concepts specified in the research and sub questions. It focuses on two aspects: 'who would be open to changing their travel behaviour' and 'when would people change their travel behaviour towards shared bicycles'. The concepts defined are: *shared bicycles, travel behaviour* and *factors influencing shared bicycle systems.*

3.1. Shared mobility

As mentioned in the introduction, shared mobility is a relatively new phenomenon, which is still being researched by many. Due to traffic, the increasing number of people, and the lack of space, there is a need for innovation and the creation of more space (Roukouni & Correia, 2020). Shared mobility is hailed as a last-mile solution, bridging the problem of inaccessible locations and giving an alternative to the car (McKenzie, 2020) and is consistent with the newer approaches in research more focused on accessible locations and services instead of only vehicle transit (Litman, 2022). Since there is a big chance that people do not want to give up their flexibility (of their own vehicle), the concept of shared mobility can provide relief in transport systems (Bojković, 2018; Machado et al., 2018). Different opinions of enthusiasm and skepticism exist about this new phenomenon in the population and within different groups (Papaix et al., 2023). It is important to first clearly understand the concept of shared mobility, before diving deeper into the problem of the concept. As mentioned in the introduction, behaviour plays a big part in mode choice. To understand the likelihood of the shared bike system and shared mobility being a success, it is important to understand the attitudes and travelers' choice behaviours towards it, few studies have focused on these aspects (Fan et al., 2019; Fishman, 2016) in combination with shared bike systems.

3.2. Behavioural models and their explanation

Acceptance needs to happen before people will change their behaviour. There are a lot of models discussing individuals' acceptance of new technology. The literature research of Venkatesh et al. (2003) discusses some of these models which are also discussed by Busch-Geertsema and Lanzendorf (2015). According to Busch-Geertsema and Lanzendorf (2015) travel behaviour is dependent on different factors, which influence the individual's mode choice:

1. Situational factors: space, time and facilities;
2. Personal factors: socio-demographic characteristics and psychological variables.

Situational factors can be divided in factors based on *land-use* including the quantity and spatial distribution of locations, *the way of transport* such as the transport infrastructure, and *temporal components* such as business hours. Personal factors can be divided into *external* and *internal factors.* External factors can be

income and socio-demographic factors. These factors can be observed and measured in most cases. Internal factors can be seen as norms, attitudes, need, and preferences. These factors are harder to measure since they are subjective and different for everyone. For this research, there will mostly be a focus on personal factors before focusing on situational factors, since the researcher first wants to find the factors influencing the user before finding location-specific (situational) factors.

The Theory of Planned Behaviour (TPB) of Ajzen (1991) is often used to translate travel behaviour into a model. The Theory of Planned Behaviour (Ajzen, 1991; Venkatesh et al., 2003) is a follow-up on the Theory of Reasoned Action. The most important central factor to the Theory of Planned Behaviour is 'intention', influenced by attitudes towards the behaviour, perceived control over the behaviour, subjective norms, and perceived control over the behaviour. The framework can be found in Appendix A.1. According to Ajzen (1991) intentions are "assumed to capture the motivational factors that influence behaviour; they are indications of how hard people are willing to try, of how much of an effort they are planning to exert, in order to perform the behaviour." (p. 181). Another added factor in the Theory of Planned Behaviour is the perceived behavioural control, which is according to Ajzen (1991) "strongly influenced by someone's confidence in their abilities to perform" their behaviour (p. 184). It can be easier to predict future behaviour if you know past behaviour, but if the circumstances stay the same. The Theory of Planned Behaviour is being criticized by some. They argue that the moral dimension is missing within the framework (Busch-Geertsema & Lanzendorf, 2015; Si et al., 2020) and concepts such as habit, impulsivity, and emotional processing are not included (Michie et al., 2011). Another adaption of the TPB is the Triad Model, in which equal determinants as the ROA model are used (Busch-Geertsema & Lanzendorf, 2015). In the Triad Model by Morel et al. (1997), three determinants are used: motivation, opportunity and capacity. This theory focuses on complaint theories but could be useful to find more determinants that explain behaviour. In their paper, it is discussed, that the three determinants need to reach a certain level simultaneously to be able to engage in a certain behaviour. One important aspect missing in these frameworks is the concept of habits (Adjei & Behrens, 2012). The theory of Michie et al. (2011) stays close to the variables introduced in the Triad Model and also names them Capacity, Motivation and Opportunity. The advantage of the framework of Michie et al. (2011) is that it already takes into account policy recommendations and tools, which could be useful for designing a better bike system for municipalities and suppliers.

The model introduced by Venkatesh et al. (2003) after the research of eight different behavioural models, is the UTAUT model (see appendix: A.2), which stands for User Acceptance and Use of Technology. UTAUT has outperformed the suggested models in the data but is now mostly focused on new technologies and their acceptance in IT context. The model is also gaining attention from other sectors, with a new paper of Jahanshahi et al. (2020) being one of the newest in the transport sector. A limitation of the model is the inability to explain behavioural intention in other settings than the IT world (Marikyan & Papagiannidis, 2023). The external validity is lower, and therefore it is motivated to extend the model by adding more determinants of behaviour (Marikyan & Papagiannidis, 2023).

3.2.1. Theoretical framework for behaviour

This research will focus mostly on people their attitudes towards shared bike use and their preferences for shared mobility use. Since existing data of Mobycon is used, it is harder to connect the full framework to the research, therefore a final framework will be introduced in section 3.4 which will be used to explain behaviour towards a shared bicycle system. The intention aspect mentioned by Ajzen (1991) which is assumed to contain the motivational factors influencing behaviour, will show how much effort the user would want to perform to achieve the intended behaviour.

In this framework the components divined by Venkatesh et al. (2012) are included as basis. The components of Michie are defined in the model but not directly included. All the components will be explained below, starting with the components of Michie et al. (2011):

- Capacity: this included physical and psychological skills. Is the user able to engage in the behaviour.
- Motivation: this contains automatic and reflective components. Automatic processes involve emotions, desires and drives. Reflective processes involve plans and evaluations.
- Opportunity: this includes physical and social aspects. The physical refers to the situational factors mentioned by Busch-Geertsema and Lanzendorf (2015). Social processes include cultural norms and the way people think about subjects.

The framework of Venkatesh et al. (2003) and the updated version of Venkatesh et al. (2012) are included with its aspects. The different aspects, also known as the influencing factors, can be explained as follows for the shared bike system:

- Performance expectancy: what use does a shared bike create for the user?
- Effort expectancy: how much effort does it take to use the shared bike.
- Social influence: what do other people in the users surroundings say about the shared system?
- Price value: does the user feel that the amount of money asked is of good use?
- Facilitating conditions: does the user know how to use the shared system?
- Hedonic Motivation: does the user get satisfaction out of the use of the shared system?
- Habit: can the shared system be included in the person's habit?

The original framework developed by Venkatesh et al. (2003) was expanded with three new constructs: *hedonic motivation, price value* and *habit*. The improvement of the framework added an improvement of explained variance in the behavioural intention of 18% in comparison to the original UTAUT model (Marikyan & Papagiannidis, 2023). The added values of age, gender, and experience are mentioned by Venkatesh et al. (2012) and are to be expected to have an influence on the key concepts. The lighter arrows show the relation with the concepts. With this, the goal is to in the end find the predictors which are not investigated well, and which should be invested in.

3.3. Shared bicycle factors

There are different forms of shared bike systems as mentioned before (Machado et al., 2018; Shaheen, 2013). The focus will be on free-floating, hub-based, and station-based. In the Netherlands, the station-based NS bicycle is the most known (NS, 2022a). Free-floating is available to a lesser extent in the Netherlands, and for hub-based the key player is Donkey Republic in the Netherlands.

3.3.1. The advantages of the bike

The personal bike is used for different purposes of travel, but an increase was found for commuting and education in 2021, compared to leisure and shopping trips (de Haas & van den Berg, 2019). This increase can be found in bicycle use of younger generations, but even a steeper increase within the population groups over their 60s (Harms & Kansen, 2018). Litman (2022) who stated that lower-income populations often own fewer vehicles and are therefore more reliant on non-auto modes. Although the research is still little, shared (e-)bikes seem to be attractive as bus replacements (Campbell et al., 2016). Multiple studies already proved that travel by bicycle or walking has a high influence on people their emotional well-being (Fan et al., 2019) and their overall health (Fishman, 2016; Shaheen, 2013). According to van Kuijk et al. (2022) and Fan et al. (2019) from all tested shared mobility options the shared electric bicycle is preferred.

3.3.2. The limitations of the bike

The impact of bike sharing was mostly found as a substitute for walking and public transport, instead of being a substitute for the private motor vehicle (Campbell et al., 2016; Chen et al., 2020), but influences all of the transport modes (Ma et al., 2020). Research of de Haas et al. (2022) showed that the expected substitution effects of the bike compared to the car or public transport is less significant than expected in other earlier investigated papers. According to Shaheen (2013) study in North America showed that in highly urbanised areas, most riders are taken off crowded buses, while in lower urbanised cities it was helping improve access to bus lines. In the higher urbanised cities the use of rails decreased, due to the faster travel speeds and lower costs of using a bike sharing system (Shaheen, 2013).

The study of Chen et al. (2020) showed that more traditionally disadvantaged groups do not have the same access to (dockless) bike sharing, as younger, more educated, and affluent groups. This could also explain the increase in commuting and education trips seen in the past years (de Haas et al., 2022). The bike sharing system relies on GPS and smartphone application (Chen et al., 2020; Roukouni & Correia, 2020), which could potentially block certain groups, but these services also became more accessible for more diverse and bigger groups (Dadashzadeh et al., 2022), so the real impact on certain groups is yet to be determined.

3.3.3. Factors influencing shared bike use

Brendan et al. (2022) noted that shared services are used on the weekends and off-peak hours. The sharers often rely more on walking, cycling, and public transport. van Kuijk et al. (2022), focused their research on multiple shared mobility options, they concluded that e-bikes and bikes did not have a significant difference between the constants, which suggests that there is no preference between these modes. E-bikes have higher maintenance costs than bikes (de Weger et al., 2018) but can reach higher speeds and therefore be used for further distances. The study by McKenzie (2020) showed as well that shared bicycle trips were often associated with longer trips and they were often used during commuting hours. The limitation of this study was that only one bicycle-share provider could be included (Lime). Also, availability and accessibility were not analysed within the study. The study of Campbell et al. (2016) showed that the choice for shared bikes is mostly sensitive to the variables of comfort and effort, while the choice for shared e-bikes is more sensitive to the heterogeneity's of the user. Ma et al. (2020) showed that the preference for bicycle sharing is also dependent on the provider.

Different variables are mentioned to influence bicycle use in other countries than the Netherlands. The different factors influencing mode choice, as defined by Busch-Geertsema and Lanzendorf (2015), as personal and situational factors, can also be found in the factors influencing bicycle use.

The personal factors influencing bicycle use:

- **Gender**. Men seem to use shared bikes more often than women (Bergantino et al., 2021; Guo et al., 2017). The literature study done by van Kuijk et al. (2022) in Utrecht showed that men make more use of the shared bike, but the effect was negligible. In Londen, found in a research of Goodman and Cheshire (2014), women and populations in deprived areas made use of shared bicycle systems more, than other groups in the population. Eren and Uz (2020) reviewed different papers and found that being a male has a strong positive impact, and being a woman has a low positive impact. In general, from these sources, it can be concluded that men are more likely to use a shared bicycle system. The gender found in Londen could be explained by the distribution of cyclist in the UK, which is already more woman-focused. For the Netherlands, since more people already have a bike, there could be a possibility that this variable may be seen less in practice.
- **Age**. Age has an influence on shared mobility use. Age and acceptance had a correlation, the younger the person, the higher the chance that the person will make use of the shared service and accept the phenomenon in the case study of Utrecht (van Kuijk et al., 2022).
- **Travel frequency and time**. If the citizen travels more than 6 times, the shared bicycle is already preferred according to Fan et al. (2019). This could be explained by the few number of parking spaces in Beijng around public transport stops. Since in the Netherlands the bicycle infrastructure is better, there is a possibility this variable will be less applicable. The current cycling behaviour, when a person bikes at least 4 times a week, has a big influence on people their preference and makes it more likely that they are open to using an bike (van Kuijk et al., 2022).
- **Household vehicle ownership**. Reck et al. (2022) study showed that there was a correlation found between ownership of the vehicle and shared vehicle usage. People who own an bike are more likely to also use a shared one. The ownership of cars also has a positive influence on bike-sharing mentioned in the paper of Mouratidis (2022) and Shaheen & Guzman (2011). These findings were done in Poland and China. Eren & Uz (2020) showed that car and bicycle ownership has a positive impact on sharing bike systems, while diving licenses have a negative impact on shared (e-)bike systems.
- **The user his perception of bike-sharing**. Study by Guo et al. (2017) showed that familiarity with bike-sharing is a significant variable for usage. And in the paper of Mouratidis (2022) it was mentioned that bike-sharing use is higher when the stops are located close to public transport stops. In the paper of Van Kuijk et al. (2022) a few conclusions were listen for shared e-scooters in the Netherlands: previous experience is a significant factor for using shared e-scooters. This assumption should also be tested for the bicycle, to see if this has the same influence.
- **Household income**. Users of systems often have a high income, high education status and work full or part-time (Fishman, 2016). Lower-income households, their usage depends on the affordability of the shared bicycle in comparison to other modes (Goodman & Cheshire, 2014). The costs of shared mobility are also a significant factor in its use. People with higher incomes than average make more

use of shared mobility than lower incomes and are more influenced to get rid of their own vehicle (AM, 2018; Machado et al., 2018; van Kuijk et al., 2022).

The situational factors influencing bicycle use:

- **Helmet obligation**. According to Fishman (2016) when helmets are compulsory, use decreases. In the Netherlands, the helmet obligation is compulsory on the 25 km/h e-scooters since 2023 (Rijksoverheid, 2022), so the effects are not clear yet. For some e-bikes, the helmet is also compulsory. For this research, since in most cases, the helmet is not obligatory for the bike, this will not be taken into account.
- **Weather conditions**. Colder temperatures and bad weather conditions could influence people their choice for biking (Campbell et al., 2016; Machado et al., 2018). The time of shared bike use is normally when the weather is good and the temperatures are not too low and bikes are mostly used during commuting hours (Reck et al., 2022). The bike is a seasonal product, which means when the weather improves, more people will get on the bicycle.
- **The availability of the bikes**. Bicycle availability is not significant in all studies, in the study of Fan et al. (2019) the variable is not significant due to the widely available bicycles and sharing network in China. In the Netherlands, this could be more important, since the sharing economy is smaller than in China. AM (2018) their research showed that availability is a determining factor for the use of the mobility form.
- **Bike sharing station locations and access distance**. The probability to use a shared e-bike, increases by 11.18% when a bike-sharing station is available within 500 meters (Guo et al., 2017). Mostly for middle-aged groups, gender and access distance are important variables to make use of a shared bicycle (Fan et al., 2019). In the study of Reck et al. (2022) it was shown that the users are willing to walk between 60 to 200 meters to a shared mode. This is way less than mentioned by Guo et al. (2017).

The literature can be mostly found in China, this can be explained since most research is done here since the majority of the shared bikes are located in China (Richter, 2015; van der Zee, 2016).

Since this research focuses on the user perspective, only the personal factors will used in the next analyses, these variables will also be introduced in the framework. Another component, partly connected to situational factors, the location of the user, will also be included. This choice is made since literature by KiM (Jorritsma et al., 2021) showed the importance of the current user and their living location. The living location of the user has an influence on the Effort expectancy by Venkatesh et al. (2003) and the availability of shared bikes. Age and gender were already included in the framework of Venkatesh et al. (2003), but the other factors will be added.

3.4. Final theoretical framework

The final framework used for this research is based on the original framework by Venkatesh et al. (2012). The different factors defined by Venkatesh et al. (2012) will be moderated to fit the issue for the shared bicycle system and the factors will be added which also fit the panel data of Mobycon.

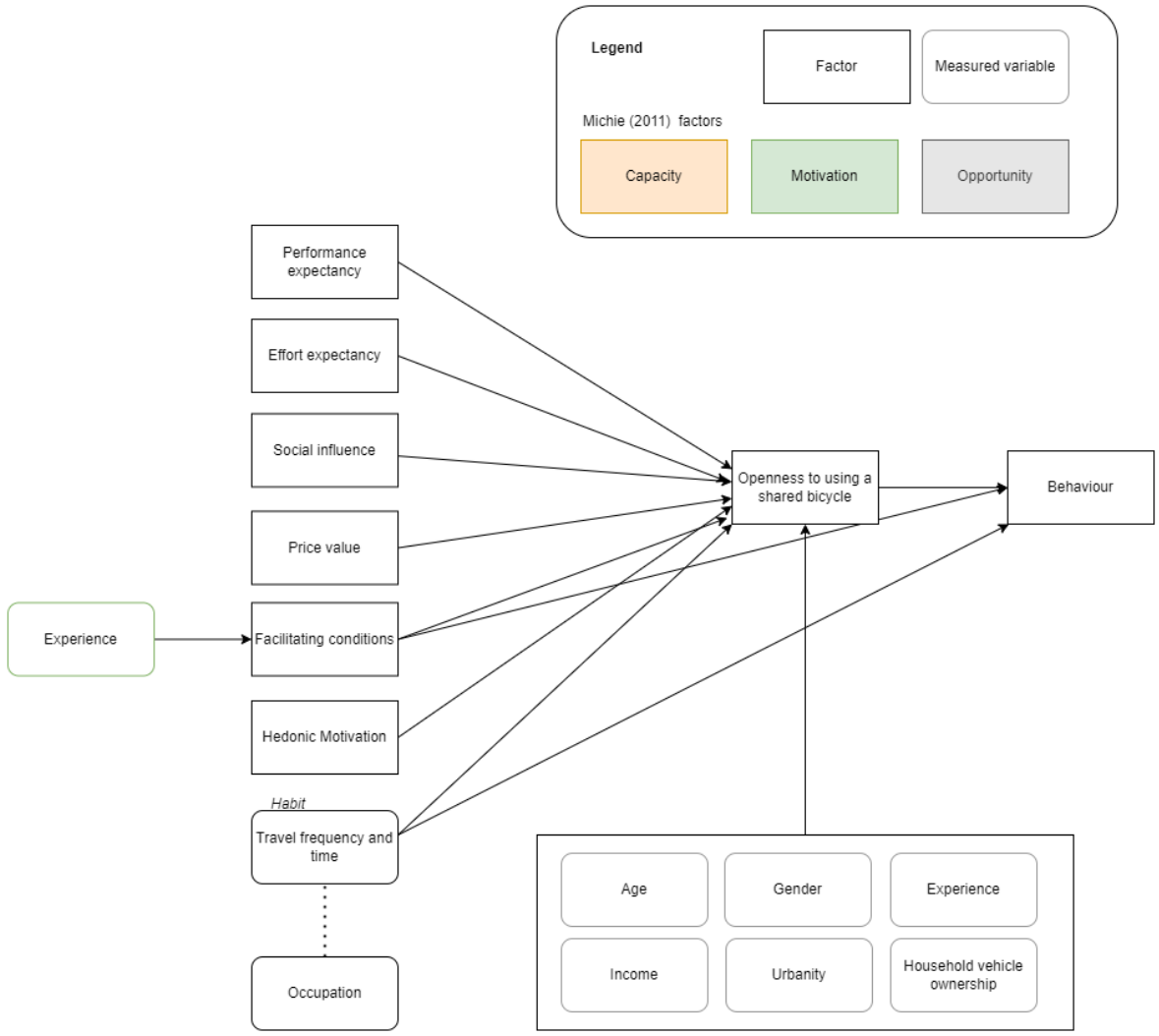


Figure 3.1: Final framework for behavioural change in bike systems

3.4.1. Additions to the framework

A few changes to the original framework of Venkatesh et al. (2012) are made, which are listed below:

- The original factor 'facilitating conditions' can be seen as *'knowledge about sharing'*. The concept of 'facilitating conditions' referred to if the user knew how to use the new technology.
- The factor 'behavioural intention' was replaced by *Openness to using a shared bicycle,* also referred to as *'openness to sharing'*. The concept of *'openness to sharing'* will be seen in the research as the most important aspect which is the intention of the user to change his or her behaviour and the dependent variable.
- The personal factors found in the literature are added to the framework. Gender and age were already defined by Venkatesh et al. (2012), the other factors defined in section 3.3.3 are included and assumed to have a direct influence on 'openness to use'. Therefore the arrow is directly connected to the *'openness to sharing'* dependent variable. These factors will be tested with analyses and their influence on *'openness to sharing'*.

3.4.2. Assumptions of the links

The assumptions behind the links is be explained in the following itemization.

- Occupation has an influence on someone's habits. If someone still works, the habits of the person can

be different than when someone does not work and is a student or retired. This could have an influence on the *openness to sharing*.

- Travel frequency and time is coded as someone's travel habits. When someone travels more often, according to the literature, they would be more open to sharing and this could have an influence on their 'openness to sharing'.
- Age, gender, experience, urbanity, and income have an influence on someone's openness to use a sharing system. In the introduction, it was already introduced that often, younger people are the users of the system currently. It could be possible that age, gender, urbanity, income, and experience influence people their motivation to be open to using shared bicycles.

The final framework included the extra factors of travel frequency and time, household vehicle ownership, income, and user perception. These variables were connected to the already included variables of age, gender and experience. The final framework will be used to test the panel data of Mobycon and will help explain the attitude of the behaviour of user groups.

3.5. Conclusion literature review

The first sub question is a descriptive question, which can be answered by the theoretical framework and literature.

'What demographic and general factors influence shared bike systems in other countries?'

The factors influencing shared bike systems are divided into personal and situational factors which are explained in subsection 3.3.3. The personal factors influencing shared bicycle systems are *age, gender, household vehicle ownership, the travel frequency and time, the perception of sharing* and *income,* the situational factors are *helmet obligation, weather conditions, the availability of the bike* and *the location and access distance to the sharing stations.*

In other countries, it can be concluded, that men use shared bicycles more than women. Most younger people are also more open and accepting of a new mobility mode. The travel frequency also has an influence on people their openness to use the shared bicycle system. Most people who use their own mode more, are also more open to using a shared system. Household ownership also had an influence on using the system, both car and bicycle ownership could have a positive influence on the openness to use a shared bicycle system. When people have used the system before, it is more likely they will also be open to using a shared system sooner. The last personal factor found was a higher income, which has a positive influence on shared mobility use.

Most research is based on bicycle systems in China, which could influence the outcome of the factors. Therefore these factors will also be tested on the Mobycon panel which is conducted in the Netherlands and via interviews and focus groups.

4

Descriptive statistics

In this chapter, the statistics and the general information of the data set are given. These give a general overview of what is included and given in the data. The interpretation of the data will be given and compared to general data from the Dutch population given by CBS. This data and its derivations can be found in Appendix D.

4.1. Socio-demographic characteristics

Table 4.1 gives the general overview of the data. Based on gender and age, Mobycon has already weighted its data. The unweighted data, the data with the weight factor applied to all included variables, and the data source (CBS) are shown.

The questions of the panel data used for this analysis can be found in Appendix C. Under the shared bicycle system the following suppliers were given as suppliers: the public transport bicycle, Donkey Republic or Bondi. The given median is dependent on the coding done by the author, but the median will still be the same, if the 'i do not know' variable is coded as last.

4.1.1. Descriptive table

Table 4.1 gives a general overview of all included variables from the data set. These variables were chosen from the data set since they play a role in the theoretical framework introduced in Chapter 3. The median in the data set is coded blue, which means this is the middle of all observation. Adding the mean or maximum or minimum descriptive did not add extra value to the tables, since most of the variables are ordinal and are coded by the author.

Gender
The gender in the data was measured by giving the respondent the choice to pick between women (W) and men (M). In SPSS this was coded as W=0, and M=1. The outcome is compared to the CBS dataset of 2022. In the original dataset, the distribution was 50% women, 50% men. The current distribution after applying the weight factor, is a bit closer to the actual distribution in the Netherlands of 50.3% women, and 49.7% men. Although the distribution in the panel data and the actual distribution from 2022 are close.

Urbanisation
The Netherlands can be divided in five categories of urbanisation according to the CBS data (Appenix D). It goes from extremely urbanised to non-urbanised, or also known as rural areas. Table 4.1 shows that the highest group is located in the 'Strongly urbanised' category. The group is a bit higher than expected, based on the CBS data source. In the panel data is 29.5% located in this group, while in the CBS data this is 24.9%. The non-urbanised group is a bit bigger than in the CBS data source. Table D.1 (Appendix D) shows the categories of CBS data and their explanation. .

Age
The age of the respondents was also measured on a scale level. The different age groups were coded, so they could be analysed in SPSS. At some point, the weight variable makes the distribution more even, at some

Table 4.1: Descriptive panel data set, source: Appendix D

Variable	Category	Unweighted Valid %	Weighted Valid %	Data source %
Gender	Women	50.0%	50.6%	50.3%
	Men	50.0%	49.4%	49.7
Urbanisation	Extremely urbanised	21.2%	21.4%	24.6%
	Strongly urbanised	29.5%	29.1%	24.9%
	Moderately urbanised	19.1%	19.3%	16.9%
	Hardly urbanised	17.0%	17.1%	16.8%
	Non-urbanised	13.3%	13.0%	16.8%
Age	16 - 25 years	10.3%	14.8%	12%
	26 - 35 years	19.8%	15.5%	13%
	36 - 50 years	21.9%	22.4%	18%
	51-65 years	29.1%	23.5%	21%
	66 years and older	18.9%	23.8%	19%
	Do not want to say	0.4%	0.4%	*unknown*
Income	Less than 1000 euro	4.3%	4.9%	14%
	Between 1000 - 2500 euro	30.8%	30.7%	41%
	Between 2500 - 5000 euro	39.6%	38.8%	42%
	5000 euros or more	8.1%	7.8%	3%
	Do not want to say	17.1 %	17.8%	*unknown*
Car household	None	17.7%	18.5%	26%
	1 or more	81.5%	79.6%	74%
Bicycle household	None	29.0%	29.5%	
	1 or more	71.0%	70.5%	
Bicycle usage	Rarely or never	29.7%	30.5%	
	A few times a year	6.6%	6.6%	
	A few times a month	12.3%	11.4%	
	A few times a week	28.8%	28.4%	
	Daily	22.6%	23.1%	
Knowledge about bike sharing	I do not know the concept	31.8%	31.6%	
	Heard of it once, but don't know exactly	26.8%	27.2%	
	I do not use it, but I know it	35.9%	35.7%	
	I have experience in using it	5.5%	5.5%	
Openness to using shared bicycle	I do not know	5.2%	5.1%	
	Not interested at all	40.9%	40.6%	
	Not interested	25.7%	25.6%	
	Neutral	18.1%	18.5%	
	Interested	8.6%	8.7%	
	Very interested	1.5%	1.5%	

points it makes the distribution less close to the measured data. The biggest age group, is the group of '36 - 50 years old'. This is in line with the average age in the Netherlands of 41 years old.

Income
The income in the panel data set was scaled to five categories. The highest category was '5000 euros or more' and the lowest category 'less than 1000 euro'. The distribution is harder to compare since the option 'do not want to say' was also available. Also, the income distribution for 2022 was not available yet, so the CBS data from 2020 was taken. It is hard to estimate to which group these people belonged. When looking at the ranking of the dataset compared to ranking the income to the source, the biggest group should be the people belonging to the group of 'between 2500 - 5000 euros'. This is the case in the dataset. The median when not taking into account the group who 'do not want to say', lies around the group of 'between 2500 and 5000'. This is not illogical since the average income in the Netherlands is around 3.810 euros. The high amount of people who did not want to share their income class should be taken into account for further analyses.

Ownership of car and bike
One of the criteria found in the literature and theoretical framework (Chapter 3.4) is that ownership in households matters. The variable 'car ownership' from the dataset of Mobycon was recoded, into two variables. The original variable was measured on a scale level for normal car and electric car. People could submit how many car the owner, divided into normal and electric car. This variable was combined, and recoded, so for every household, it can be shown if they had a car (electric or normal). The two new groups: people who own one or more cars, and people who do not own a car. The data set shows that the number of people with a car is a bit higher in the dataset than in the Netherlands in general. This should also be taken into account when analysing the dataset and the influence of car ownership on openness to sharing. The current situation of car ownership in the Netherlands can be defined as follows: 47% of the households have one car, 21% of the households have 2 cars and 6% have 3 or more cars as investigated in the research of KiM. 26% of the households have no car. This can have two reasons: or they cannot own a car due to different 'problems', such as health problems, this group does not necessarily want to be car-less; or they choose to not have a car, this is a quarter of the households. (Zijlstra et al., 2022).

For the fact that there are more bicycles in the Netherlands than people, an unweighted percentage of 29.0% can seem high. This can be explained by the fact that some people have more than 1 bicycle (Harms & Kansen, 2018). What can be concluded from this number, is that 29.0% of the respondents do not have a bicycle. This can also be explained by the fact that they can have an electric bicycle and therefore do not have a 'normal' bicycle anymore. Since this research only focuses on 'normal' bicycles this will not be taken into account (Harms & Kansen, 2018).

Bicycle usage
The bicycle usage cannot be compared to CBS data, since they were scaled by Mobycon. What is striking in the dataset is that a big group of the dataset does not use their bicycle often. 29.7% of the unweighted responses are belonging to this group. This could be explained by the fact that these people use their electric bicycles instead of their 'normal' bicycle. This falls outside of the scope of the research, but should be taken into account while analysing the data.

Knowledge about bike sharing
The unweighted percentage shows that only 5.5% of the people have experience in using a shared bicycle system. More than 50% do not exactly know what the sharing concept entails and 35.9% of the unweighted cases know the concept. What can be concluded from this number, is that a small amount of the respondents used the sharing concept before the Mobycon survey.

Openness to using shared bicycles
The number of respondents open to using shared bicycles has its median in the category 'Not interested'. This shows that a high number of respondents are not willing to use the shared bicycle system (yet). Less than 30% of the unweighted respondents are willing to try a shared bicycle system. When looking at the mode, the value which is mostly occurring in the dataset, the following is concluded in the data set. The most occurring variable is: not interested at all.

4.1.2. Household occupation
In the survey there was the possibility to select an occupation option that applied to the respondent. If the option was not available, the respondent could add an option themselves. These options were recoded and

added. Table 4.2 was generated, which included all 13 different options. The biggest group falls into the group of part-time and full-time jobs. when these categories are added together a total of 65.6% is generated. This number is on average lower than the number generated by the CBS in the Netherlands (72.6%). It is important to keep in mind for further analysis that this number is a bit lower, and that a big part of the survey consists of working people.

Table 4.2: Occupation of respondents

Occupation		
Occupation	N	%
Paid job (full-time)	660	41.9%
Paid job (part-time)	321	20.4%
Retired	278	17.7%
Parttime job	35	2.2%
Studying	62	3.9%
Still in school	5	0.3%
Unpaid work	40	2.5%
Incapable to work	53	3.4%
Unemployed / job seeker	14	0.9%
Self-employed	3	0.2%
Different	5	0.3%
Irrelevant / do not want to say	98	6.3%

4.2. Conclusion descriptive statistics

From the descriptive statistics can be concluded that the survey was filled in by the same number of men as women. The biggest part of the respondents is not open to using a shared bicycle system at all. The median of the respondents lies in the group of *'not interested'*, regardless of how the 'I do not know' group is coded. The modus, the most answered option for being open to using a shared bicycle, was even one category lower: *'not interested at all'*. Most people do know the shared car concept but are less familiar with the concept of the shared bike.

From the descriptive statistics, it can be concluded that the panel data was already close to the actual population. Applying the weights for income and gender on all categories, brought the distribution for some variables closer to the actual distribution in the population.

5

Panel data results

In this chapter, the quantitative research method is conducted. The goal of the method is to answer the second sub question. This is done by first describing the current user group. Secondly, different analyses are conducted and reported. This is done by first conducting a cross-tab analysis between the found variables from the literature and testing them with the dependent variable 'openness to use'. Then, a logistic regression is conducted on the data. Lastly, a non-parametric test is executed. The final sections will conclude the chapter and answer sub question 2. The results are based on the analysis done on Mobycons panel data. The description of this data set is elaborated on in Chapter 4.

5.1. Current user

The current user is outlined by looking at the variable 'Knowledge about bike sharing'. This variable had the following four answer options the respondent could choose from: the shared bicycle concept is not known; the shared bicycle concept is known, but not clear what it entails; The shared bicycle concept is known, but never used; The shared bicycle concept is used.

The categories were coded into two groups: respondents who used the shared bicycle system, and respondents who never used the sharing system. Table 5.1 shows that 5.5% of the respondents used a form of a shared bicycle system before.

Table 5.1: The current users and non-users, tested by the variable 'knowledge about sharing'

	Frequency	**Valid %**
Non-user of shared bicycle	1473	94.5%
User of shared bicycle	86	5.5%

In order to identify specific user groups, a detailed analysis was conducted using a cross-table, with a particular focus on age, income, and urbanization as distinguishing factors. This choice was made due to recent literature and news highlighting the relevance of these variables in relation to shared mobility use also introduced in Chapter 1 and 3. The literature and news showed that younger, higher urbanised places and higher incomes were more inclined to use the systems. The three variables are explained in the next subsections. For every analyses, a more eleborate description of the tables can be found in Appendix E.

5.1.1. The influence of age

The first variable tested on the current users is age. Younger people are expected to be more familiar with the systems and be part of the current user group. In Table 5.2 the variable 'knowledge about bike sharing' and the 'age' variable are crossed.

Table 5.2: The influence of age on current shared bicycle users and non-users

		Knowledge about bike sharing			
		Non-user		User	
Age	Do not want to say	6	100%	0	0%
	16 - 25 years	142	88.8%	18	11.3%
	26 - 35 years	275	89.6%	32	10.4%
	36 - 50 years	317	93.2%	23	6.8%
	51 - 65 years	439	97.6%	11	2.4%
	66 years and older	294	99.3%	2	0.7%

In Table 5.2 the number of people in every group and the percentages are given. This means that 6 people in the variable 'I do not want to say' have never used a shared bicycle before. This is 100% of the people in the age group 'Do not want to say'. The table shows that the highest share of current users is located in the youngest group. From this group, 11.3% have used a shared bicycle before. Substantiated by the literature, this was to be expected. This can mean that they are the most familiar with using the shared bicycle concept and are the current users.

One cell (8.3%) in the cross-tab has an expected count of less than 5. The corresponding chi-square is 47.097, with an asymptotic significance of <.001. Since the chi-square is less reliable when cells counts are smaller than 5, to ensure significance, the Linear-by-Linear association will also be evaluated. This value is 45.125, with 1 degree of freedom and a significance of <.001. It can be concluded that the relation between the variables is significant, and did not occur due to chance.

5.1.2. The influence of urbanisation

The influence of the degree of urbanisation is also tested for the user and non-user groups. Table 5.3 shows the outcome of crossing 'Urbanisation' with 'Knowledge about bike sharing'.

Table 5.3: The influence of urbanisation on current shared bicycle users and non-users

		Knowledge about bike sharing			
		Non-user		User	
Urbanisation	Extremely urbanised	280	90.9%	28	9.1%
	Strongly urbanised	396	95.4%	19	4.6%
	Moderately urbanised	257	94.1%	16	5.9%
	Hardly urbanised	238	97.5%	6	2.5%
	Non-urbanised	174	94.1%	11	5.9%

The chi-square that belongs to Table 5.3 is 12.520, with a significant p-value of 0.014. Zero cells have an expected cell count of less than 5. From Table 5.3 it can be deduced that a greater proportion of the people living in non-urbanised areas used shared bicycles than the people living in hardly urbanised areas. The highest percentage of current users can be found in the extremely urbanised, strongly, and moderately urbanised areas. The highest percentage of users is 9.1% in the 'extremely urbanised' group. The lowest percentage fell into the group of 'hardly urbanised' locations with 2.5%.

5.1.3. The influence of income

The influence of the degree of income is also tested for the defined user groups.

Table 5.4: The influence of income on current shared bicycle users and non-users

		Knowledge about bike sharing			
		Non-user		User	
Income	Less than 1000 euros	276	99.3%	2	0.7%
	Between 1000 - 2500 euro	67	85.9%	11	14.1%
	Between 2500 - 5000 euro	449	94.1%	28	5.9%
	5000 euro and more	114	93.4%	8	6.6%

The biggest group of users is located in the group of income with an income between 1000 and 2500 euros. This group consists of 14.1% users within their income group. This can be explained by the fact that the group of younger people, can be located in this income group. The other income groups are comparable when looking at the percentage of use and non-users.

Since 1 cell has an expected count of less than 5, the Linear-by-Linear association will be used to establish significance instead of the Pearson chi-square. The Linear-by-Linear association has a value of 5.802 with 1 degree of freedom. The p-value is 0.016, which concludes the significant relation.

5.2. Results cross-tabs

All variables from the framework are tested against the variable "openness to use", which is chosen as the dependent variable of the data set. The goal is to find the current distribution and to find if the relation between "openness to use" and the predictor variable is significant.

5.2.1. Significance of variables

The variables 'age', 'gender', 'availability of the bicycle', 'availability of the car', 'frequency of use of the bicycle', and 'income' were tested against the dependent variable 'openness to use'. The results of this analysis can be found in Appendix E. The main summaries per variable are listed below.

- Age: the relationship between 'openness to use' and 'age' is significant with a p-value of <.001. Only for the group of 16 to 25 years old, the highest percentage of responses does not lie in the group of 'not interested at all'. For the group of 26 to 35 years old, the percentage in both not 'not interest at all' and 'not interested' is 30%. It can be inferred that younger generations are more open to sharing bicycles than older people, which was also stated in current literature.
- Gender: the relationship between 'openness to use' and 'gender', is non-significant, with a p-value for the chi-square test of 0.155. The difference in percentages per category between men and women is not big and quite similar.
- Availability of *[vehicle]:* the presence of a car in the household is strongly associated with the inclination to engage in sharing. In both categories, whether a car is available or not, the highest proportion of individuals belong to the 'not interested at all' group. This trend also holds true for bicycle ownership, with the majority falling into the same category.
- Frequency of travel: individuals who travel more frequently tend to exhibit a greater openness towards using a shared bicycle compared to those who rarely or never travel. Among respondents who rarely or never use a bicycle, 54.6% express no interest in sharing. However, among those who travel daily, only 29.4% show no interest at all.
- Income: the relation between 'income' and 'openness to use' is significant. Since the expected cell count in 1 cell is lower than 5, instead of looking at the Pearson chi-square, the linear-by-linear association will be considered. This p-value is also significant which means the relationship is significant, and 'income' has an influence on people their 'openness to use'. Most of the income groups fall in the group of 'not interested at all', only the income group of 'less than 1000 euro' have its highest percentage in the neutral group.

- Knowledge about sharing: in general, the biggest share of the respondents does not know the sharing concept. They also often fall into the group of people who are 'not interested' or 'not interested at all'. The group who do have experience using a shared bicycle system falls in the group of neutral and (very) interested. The chi-square test is significant, which means it can be concluded that there is a relation between 'knowledge about sharing' and the 'openness to use'.
- Urbanisation: from the cross-tab between 'urbanisation' and 'openness to use', a significant relationship can be found. From the distribution of the groups can be concluded that people who live in extremely, strongly, or moderately urbanised are more open to sharing than those in less urbanised places. Still, the biggest share of respondents is located in the 'not interested at all' groups.

5.3. Logistic regression

The use of multiple regression is not possible, since the assumption of a normal distribution is violated (Bürkner & Vuorre, 2019; Liu, 2009). Since the dependent variable is ordinal, ordinal logistic regression could be suitable. 'Openness to use' is an ordinal variable, with five different levels. A regression analysis was performed to estimate the influence of the dependent variables of the predictors (independent variables). It can be used to establish the relationship between the variables. In logistic regression, all missing variables are treated by listwise selection instead of pairwise. To assume an ordinal progression of the levels in the dependent variables, some variables have been recoded. The 'Do not want to say' options from the independent variables 'income' and 'age' are excluded from the analyses.

5.3.1. Testing of assumptions

The independent variables are coded on an ordinal and categorical scale. The assumption of parallel lines was not met, therefore the ordinal regression could not be conducted. Table 5.5 shows that the p-value is significant for the parallel line assumption.

Table 5.5: Parallel line test for ordinal regression assumption

Test of parallel lines				
Model	-2 log likelihood	Chi-square	df	sig
Null hypotheses	2991, 292			
General	2859.324	131.968	54	<.001

Since the parallel lines assumption is significant, this assumption could not be met and ordinal logistic regression is not fit. According to Liu and Koirala (2012) due to sample size or including interaction or continuous covariates in the model, the proportional odds assumption is often violated. An option, when this assumption is not met, is to execute a partial proportional odds model or generalized ordinal logistic regression model (Liu & Koirala, 2012), which relaxes the parallel lines assumption and allows for different relationships between the independent variables and the outcome across categories. A second option is executing a multinomial regression model (MNL), where the ordinal dependent variable becomes a nominal dependent variable in the analysis and the levels of the ordinal variable are not considered anymore.

5.3.2. Multinomial logistic regression

In Appendix F the full multinomial logistic regression is given. In this subsection, a selection of the model is given. For the category 'availability car' and 'availability bicycle' their original continuous variables are used, which means these are numerical values. For the other categories, the variables are coded as ordinal or binary variables.

The model fitting information in Table 5.6 shows that the model has a significant value of $p < .001$. This means there is an improvement in the model in comparison to the model with no predictors. For the regression analyses, the larger the R^2, the better predictive power the regression model has (Molin, 2020). The model fitting information shows if the model has significant improvement when adding the predictors. It needs to be significant in the analyses. The goodness-of-fit should be insignificant since the observed and fitted model should not have differences. Often in behavioural models, the model fit is lower than in other studies.

Table 5.6: The model fitting information of an intercept-only model and the final model

Model	Model Fitting Criteria	Likelihood Ratio Tests		
	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	3063,048			
Final	2720,031	343,017	36	<,001

The goodness-of-fit of the model in Table 5.7 shows that both the Pearson and Deviance metrics are insignificant, which indicates a good fit.

Table 5.7: The model fitting information: Goodness-of-fit of five level MNL

Goodness-of-Fit			
	Chi-Square	df	Sig.
Pearson	3567,674	3648	,826
Deviance	2457,563	3648	1,000

5.3.3. Pseudo R-square

The pseudo R-square is an adjustment on the R-square known from linear regression. This value gives an indication of how much variance can be explained by the predictors. Table 5.8 shows a McFadden pseudo R-square of .102, which indicates that 10.2% extra of the variance can be explained by the model.

Table 5.8: Pseudo R-square of MNL

Pseudo R-Square	
Cox and Snell	,246
Nagelkerke	,262
McFadden	,102

5.3.4. Likelihood ratio test - 5 levels

The likelihood ratio test, show if the variables in the model are significant or insignificant. The outcomes of this are shown in Table 5.9 and show that the only insignificant variable found for the whole model is again gender.

Table 5.9: Significance of effects, the likelihood ratio tests

Likelihood Ratio Tests				
Effect	**Model Fitting Criteria**	**Likelihood Ratio Tests**		
	-2 Log Likelihood of Reduced Model	**Chi-Square**	**df**	**Sig.**
Intercept	2720,031[a]	,000	0	.
Availability car	2736,196	16,165	4	,003
Availability bike	2730,250	10,219	4	,037
Urbanisation	2739,129	19,097	4	<,001
Age	2760,672	40,640	4	<,001
Income	2741,975	40,640	4	<,001
Knowledge about shared bicycle	2895,874	175,843	12	<,001
Gender	2722,560	2,528	4	,640

The interpertation per category and variable will be given in the next subsection. Here it will be clear that some variables are still insignificant, but only for certain groups within the dependent variable 'openness to use'.

5.3.5. Outcome multinomial analyses

The parameters are estimated. In a multinomial regression, the ordinal levels are not considered anymore in the analyses. This means all categories from the ordinal data are considered separately in comparison with a reference category. The chosen reference category for this data is the highest level in the dependent variable: '(Very) interested'. The groups in the variable 'gender' (men and women) and the groups of the variable 'knowledge about sharing' (the shared bicycle concept is not known; the shared bicycle concept is known, but not clear what it entails; The shared bicycle concept is known, but never used; The shared bicycle concept is used) are showed as seperate rows. In the following table the outcome and interpretation of the analyses per category are given:

Table 5.10: Multinomial Logistic regression outcome, including do not know group

Parameter Estimates									
Openness to use		**B**	**Std. Error**	**Wald**	**df**	**Sig.**	**Exp(B)**	**95% Confidence Interval for Exp(B)**	
								Lower Bound	**Upper Bound**
I do not know	Intercept	-4,060	1,329	9,330	1	,002			
	Income	-,715	,267	7,183	1	,007	,489	,290	,825
	Age	,240	,149	2,604	1	,107	1,271	,950	1,701
	Urbanisation	,462	,138	11,121	1	<,001	1,587	1,210	2,082
	Availability car	,554	,252	4,839	1	,028	1,740	1,062	2,850
	Availability bicycle	-,368	,200	3,386	1	,066	,692	,468	1,024
	I do not know the concept	4,235	1,079	15,396	1	<,001	69,034	8,326	572,398
	Heard of it once, but don't know exactly	2,242	1,152	3,789	1	,052	9,416	,985	90,049
	I do not use it, but I know it	1,119	1,161	,930	1	,335	3,062	,315	29,777
	I have experience using it	0b	.	.	0	.	.	.	.
	Women	,329	,376	,767	1	,381	1,390	,665	2,902
	Men	0b	.	.	0	.	.	.	.
Not interested at all	Intercept	-4,262	,739	33,248	1	<,001			
	Income	,008	,160	,003	1	,959	1,008	,736	1,380
	Age	,479	,093	26,709	1	<,001	1,615	1,346	1,937
	Urbanisation	,321	,090	12,649	1	<,001	1,378	1,155	1,645
	Availability car	,462	,181	6,496	1	,011	1,587	1,113	2,263
	Availability bicycle	-,258	,102	6,416	1	,011	,773	,633	,943
	I do not know the concept	3,962	,546	52,664	1	<,001	52,585	18,034	153,329
	Heard of it once, but don't know exactly	3,839	,543	50,056	1	<,001	46,475	16,046	134,612
	I do not use it, but I know it	2,891	,510	32,150	1	<,001	18,013	6,631	48,934
	I have experience using it	0b	.	.	0	.	.	.	.
	Women	,011	,224	,003	1	,960	1,011	,652	1,570
	Men	0b	.	.	0	.	.	.	.
Not interested	Intercept	-3,527	,686	26,449	1	<,001			
	Income	,054	,163	,112	1	,738	1,056	,768	1,453
	Age	,233	,095	6,027	1	,014	1,262	1,048	1,521
	Urbanisation	,315	,092	11,708	1	<,001	1,371	1,144	1,642
	Availability car	,558	,174	10,273	1	,001	1,746	1,242	2,456
	Availability bicycle	-,133	,102	1,727	1	,189	,875	,717	1,068
	I do not know the concept	3,018	,464	42,366	1	<,001	20,456	8,243	50,761
	Heard of it once, but don't know exactly	3,004	,458	43,024	1	<,001	20,169	8,219	49,493
	I do not use it, but I know it	2,240	,417	28,864	1	<,001	9,390	4,148	21,257
	I have experience using it	0b	.	.	0	.	.	.	.
	Women	,203	,230	,778	1	,378	1,225	,780	1,923
	Men	0b	.	.	0	.	.	.	.
a. The reference category is: (Very) Interested.									
b. This parameter is set to zero because it is redundant.									

The Exp(B) in the table are the log odds and refer to the likelihood of a person falling into a category when the specific variable changes and all the other variables are kept constant. The interpretation for all different categories in comparison to the reference category is the following:

I do not know

- Income: in the group 'I do not know' in comparison to the reference category '(Very) interested', it is less likely, a log-odds below one, that higher incomes will fall in this group.
- Age: older people have a higher log-odds to fall into the 'I do not know group', in comparison to falling into the '(very) interested' group. The variable is non-significant, which means this relationship cannot be determined with certainty.
- Urbanisation: the less urbanised a city a person lives in, the higher the chances that the respondent will fall into the 'I do not know' category, in comparison to falling into the '(very) interested' group.
- Availability car: the more cars a respondent has, the more likely is that the person will fall into the 'I do not know group', in comparison to falling into the '(very) interested' group.
- Availability bicycle: the chances that someone will fall into the 'I do not know' category, in comparison to the '(very) interested' category is less likely (logg-odds of 0.672). This relationship is non-significant.
- Knowledge about sharing: the less someones know about sharing, the more likely it is, that the person will fall into the group of 'I do not know' instead of into the '(very) interested' group. Not all of the relationships are significant.
- Gender: women are more likely (log-odds of 1.390) than men to fall into the category of 'I do not know' than in the reference category. This relationship is non-significant.

Not interested at all

- Income: a higher income has little effect on the log-odds (1.008) to fall into the category 'not interested at all' in comparison to the reference category. This relationship is highly not significant, which means the correctness of this estimation cannot be assumed.
- Age: if respondents fall into a higher age category, it is more likely that they will also fall into the 'not interested at all' category than fall into the '(very) interested' category. The estimation is significant.
- Urbanisation: when a respondent lives in a less urbanised area, the respondent is more likely to fall into the category of 'not interested at all' than to fall into the '(very) interested' category. The relationship is significant.
- Availability car: the more cars a respondent has, the more likely he is to fall into the 'not interested at all' category in comparison to falling into the '(very) interested category. This relation is significant.
- Availability bicycle: if a person has more bicycles, the person is less likely to fall into the 'not interested at all' category in comparison to falling into the '(very) interested' category.
- Knowledge about sharing: the log-odds that someone will fall into the 'not interested at all' when there is less to no knowledge about the concept, becomes higher. This means respondents who know less about the concept, are more likely to fall into this category.
- Gender: women are a bit more likely to be in the 'not interested at all' category than men. The relation is highly not-significant. Therefore the correctness of this estimation cannot be assumed.

Not interested

- Income: for the category 'not interested' the income variable is not significant. The estimated log-odd is 1.056, which means there will be little effect for different income groups to have a higher chance to end up in the 'not interested' group instead of the '(very) interested' category.
- Age: the estimated log-odd for the variable age is 1.262, which means elder people, people in a higher category for age, are more likely to be in the 'not interested' category than in the '(very) interested' category. The estimation is significant.
- Urbanisation: people who live in less urbanised areas, have a higher log-odd to be in the 'not interested' category than people who live in denser areas.
- Availability car: for the availability of the car, the log-odds show that if a person has more cars, they have a higher chance to fall into the 'not interested' at all category. The relation is significant.

- Availability bicycle: the estimation is not-significant. The estimation for the log-odds is that if a person has more bicycles in their household, the person is less likely to fall into the 'not interested' category in comparison to '(very) interested'.
- Knowledge about sharing: respondents who know less familiar with the concept are more likely to fall into the 'not interested' group than in the '(very) interested' group.
- Gender: women are more likely to fall into the 'not interested' category than men. But this estimation is not significant.

Table 5.11: MNL for neutral group, including do not know group

Parameter Estimates									
Openness to use		B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B)	
								Lower Bound	Upper Bound
Neutral	Intercept	-1,090	,632	2,980	1	,084			
	Income	-,374	,166	5,053	1	,025	,688	,496	,953
	Age	,148	,098	2,255	1	,133	1,159	,956	1,406
	Urbanisation	,180	,095	3,553	1	,059	1,197	,993	1,443
	Availability car	,594	,174	11,707	1	<,001	1,812	1,289	2,546
	Availability bicycle	-,067	,104	,416	1	,519	,935	,762	1,147
	I do not know the concept	1,371	,409	11,253	1	<,001	3,941	1,769	8,782
	Heard of it once, but don't know exactly	1,573	,395	15,877	1	<,001	4,823	2,224	10,458
	I do not use it, but I know it	1,349	,334	16,311	1	<,001	3,854	2,002	7,416
	I have experience using it	0b	.	.	0	.	.	.	.
	Women	,065	,239	,073	1	,787	1,067	,668	1,703
	Men	0b	.	.	0	.	.	.	.

a. The reference category is: (Very) Interested.

b. This parameter is set to zero because it is redundant.

In Table 5.11 the neutral category in comparison to the reference category is shown. The outcome is given below:

Neutral

- Income: the chance that a higher income falls into the 'neutral' category in comparison to the reference category decrease. The log-odds are 0.688 which is significant.
- Age: when someone falls into a higher age category, the chance that they are in the 'neutral' group in comparison to the reference category, increases. The estimation is not significant.
- Urbanisation: the log-odds of falling into the 'neutral' category, when urbanisation goes a level up, increases. This means people who live in less urbanised areas, are more likely to fall into the neutral category than the (very) interested category. The estimation is not significant.
- Availability car: respondents who have more cars in their household are more likely to fall into the neutral category than people who have fewer cars.
- Bicycle availability: if someone owns more bicycles, the person is less likely to fall into the 'neutral' category. The estimation is not significant.
- Knowledge about sharing: the log-odds to fall into the 'neutral' group in comparison to the '(very) interested' group are all significant. All categories are more likely to fall into the 'neutral' category in comparison to the reference category 'I have knowledge using it'.
- Gender: women are more likely than men, to fall into the neutral category than in the '(very) interested' category. This variable is not significant.

5.4. Non-parametric tests

A Kruskall-Wallis test and Mann-Whitney test are executed to find the different distribution of means across different groups. The summary of the test is given:

Table 5.12: Hypotheses test outcome of Kruskall-Wallis and Mann-Whitney test per variable

	Hypotheses summary				
Variable	**Test**	**Mann-Whitney**	**Kruskall-Walis**	**Sign.**	**Decision**
Availability bicycle	Independent-Samples Mann-Whitney U test	300633.000		<.001	Reject the null hypotheses. There is a difference in distribution across categories.
Availability car	Independent-Samples Mann-Whitney U test	172894.500		.520	Retain the null hypotheses. There is a no difference in distribution across categories.
Gender	Independent-Samples Mann-Whitney U test	308498.000		.544	Retain the null hypotheses. There is a no difference in distribution across categories.
Urbanity	Independent-Samples Kruskal-Wallis test		21.921	<.001	Reject the null hypotheses. There is a difference in distribution across categories.
Age	Independent-Samples Kruskal-Wallis test		95.170	.000	Reject the null hypotheses. There is a difference in distribution across categories.
Use bicycle	Independent-Samples Kruskal-Wallis test		92.080	.000	Reject the null hypotheses. There is a difference in distribution across categories.
Income	Independent-Samples Kruskal-Wallis test		13.978	.007	Reject the null hypotheses. There is a difference in distribution across categories.

Table 5.12 shows that almost all p-values of the distributions are significant, except for gender and car ownership. This means these distributions of answers are the same for all categories.

The tables underlying these assumptions can be found in Appendix E. The main results:

- Urbanisation: A significant adjusted p-value is established between 'non-urbanised' and 'strongly urbanised', 'moderately urbanised', and 'hardly urbanised'. The distribution between is also significant for 'hardly urbanised' and 'extremely urbanised'.
- Age: A significant adjusted p-value is established between 'do not want to say' and '16 to 25 years old'. The group '66 years and older' also has an adjusted significant p-value with all groups except from the '51 to 65 years old' and 'do not want to say' group. The '51 to 65 year old' group also has a significant difference in comparison to all other groups. The distribution between the group '36 to 50 years' and '16 to 25 also has a significant difference.
- Use bicycle: the significant differences in groups lie between the groups: 'a few times a month' with 'daily', 'rarely or never'. The group who use their bicycle daily have a significant difference in distribution with 'a few times a year' abd 'rarely or never'.
- Income: this variable only has one adjusted significant p-value in the between the groups 'do not want to say' and 'between 2500 - 5000'.

5.5. Conclusion quantitative results

This chapter answers the sub question: '*How do the factors influence people open to shared bicycles in the Netherlands?*'. This was tested by conducting different analyses with the found predictor variables and dependent variable 'openness to use'. From this chapter can be concluded that the group 'current users' is still small (5.5%). As also stated in the literature and the media, the current users are mostly located in the group of younger age. The highest percentage of users are located in 'extremely urbanised' areas, but also the category 'non-urbanised' contains people who used the shared bicycle before. Most users are located in the group of income of 'between 1000 - 2500'. This could be correlated with that people who have a lower income, are also often younger people.

When testing the significance of the variables on the dependent variable 'openness to use' via a cross-tab only the variable 'gender' was insignificant. The other variables were all significant after merging the group 'very interested' with the 'interested' group of the variable 'openness to use'. The outcome showed that when crossing the variables with the dependent variable, most people were still located in the groups which were

'not interested at all', or 'not interested' in the system. When looking at the percentages of distribution, people who had a bicycle in their household were more inclined to fall into a higher interest group than people who did not. People who used their bicycles more, were percentage-wise more likely to be open to using a shared bicycle system. When looking at the distribution in income groups, there was not a big difference in people who were neutral or (very) interested, it was quite the same. When people had experience in using the shared bicycle before, they were more inclined to fall into the groups who were neutral or (very) interested than people who did not know the concept before.

The assumption of the ordinal logistic regression of the parallel lines was violated. Therefore, no ordinal logistic regression could be executed in SPSS. A multinomial regression, which releases the order of the ordinal variable was performed. These regressions showed the relation between the predictor variables and the dependent variable. The conclusion from these analyses could be the following: people who live in higher urbanisation areas, have a higher chance to fall into a higher level of openness to use. Younger people are also compared to older people, more likely to fall into a higher category. Women are a bit less likely than men to fall into a higher category. In comparison to having experience with the shared mobility mode, the less knowledge about sharing you have the less likely it is that you fall into a higher category of the dependent variable. If someone owns a bicycle, the chances that they are open to use a shared bicycle, are also a bit higher, than when you own less bicycles. The ownership of the car, which was insignificant, shows that the more cars you own, the chances to fall into a higher category for 'openness to use' decrease.

The Kruskall-Walis test showed that the distribution in age for people from 16 to 35 was more alike and the difference with the elder group was the biggest. For income, the distribution was quite the same across all groups. For 'frequency of travel' it showed that the more often you travel, the more likely it is that the distribution is the same. The availability of a car, split into two groups of people who had the car and people who don't was not significant and showed that there was little difference in the distribution.

6

Interviews, focus group and open panel data results

The goal of this chapter is to get insight in what motivates people to use a shared mobility mode and especially the bicycle. In this chapter, the qualitative research method is conducted. This method focuses on the open panel data, the interviews and the focus group conducted. At the end of the chapter the third sub question is answered.

6.1. Results from panel data

In the panel data of Mobycon, a multiple-choice question was asked. The question asked under which circumstances the respondent would switch to a shared mobility mode. The respondent could pick multiple options in the list. Table G.1 in Appendix G shows all the responses to this question. The three highest-scoring reasons are:

- Never
- Certainty availability vehicle
- Vehicle within 400 meter.

The respondents could also fill in under which circumstances they would switch to a shared mobility mode in an open answer. This question was not specified for only shared bicycles but was a general question focused on all shared mobility modes. On the open data from the panel, a few selections were made in the data set. The selections had the goal to get better insight into the reasons people give to switch to another mode. The selections were made based on the problem introduction in chapter 1, the theoretical framework in chapter 3, and the outcome of chapter 5. The selection were listed in the Methedology, chapter 2. For every selection people were excluded if they were not interested, or not interested at all, unless other specified. People who were not interested under any circumstances are also excluded.

6.1.1. Selection 1: Income and influencing factors

There were a total of 307 respondents who utilized their car either once a week or on a daily basis and expressed openness towards a shared bicycle system. The selection for income was chosen, since the ordering in chapter 4 showed that affordability is important for the groups, and more than once, income was not significant in the logistic regression. Therefore a selection on income is made, to find out how the qualitative outcomes support the quantitative outcome. Table 6.1 shows the distribution in the 'income' group.

In Appendix G all the initial first codes are given. In Table 6.2 the merged codes are displayed. The codes show the different distribution of codes over the different income groups. The codes show in blue which topics for answers were given the most. The top 3 per column are shown. The grey line at the bottom of the table shows the responses that were unusable. These responses were often '.', unreadable answers, or remarks.

Table 6.1: Count of income in panel data

Income	Count
Less than 1000 euros	17
1000 - 2500 euros	93
2500 - 5000 euros	135
5000 and more	24
Do not want to say	38

Table 6.2: Selection 1: recoded results of open answers panel data

Income and most mentioned factors					
	Less than 1000 euros	**Between 1000 - 2500 euros**	**Between 2500 - 5000 euros**	**5000 euros or more**	**Do not want to say**
Application	0%	4%	0%	0%	0%
Availability	6%	5%	4%	8%	3%
Vehicle specifications	0%	8%	12%	24%	17%
Chain journey	6%	3%	3%	0%	0%
Costs vehicle	6%	23%	21%	32%	17%
Costs own vehicle	6%	1%	7%	0%	0%
Influencing factors	12%	10%	8%	0%	14%
Not applicable yet	0%	0%	1%	0%	0%
Information	6%	0%	4%	4%	0%
Infrastructure	0%	0%	2%	0%	3%
Innovation	0%	0%	1%	0%	0%
Investment	0%	0%	0%	4%	0%
Trade-off own vehicle	24%	13%	7%	0%	11%
More benefits	0%	0%	0%	0%	3%
No idea	0%	8%	7%	0%	17%
None	18%	11%	8%	4%	14%
Unusable	18%	14%	15%	24%	3%

It needs to be noted, that the responses per category are not the same and not equal to reality in the population when compared to CBS data. The group of people with an income of below 1000 euros is much smaller in the panel data than in real life and the group of 5000 euros and more is bigger than in real life. Therefore the results should be interpreted with caution.

From Table 6.2 the top-3-mentioned codes, when the unusable answers are excluded, relate to a trade-off with your own vehicle; under no circumstances openness to use; or influencing factors. People who have a higher income, also place a higher percentage value on the cost of alternative transportation. 32% in the group of income above 5000 mentioned a reason related to the cost of the shared mobility mode. People in the group 'do not want to say' are also more inclined to not know under which circumstances they would be open to using a shared mode. The trade-off of the vehicle relates to answers such as: "if I do not have my own vehicle" or "if the costs of my own car are too high", or "if I do now have my own vehicle available. For example when I am on holiday, or away for a day". Influencing factors are recoded from variables such as flexibility, safety, fun, or sustainability. Most groups, except for the group with an income of 'less than 1000 euros', see the price as the most important reason to switch to a shared mobility mode.

6.1.2. Selection 2: All respondents open to using shared bicycles

The selection was made based on the respondents who were open to using a shared bicycle system (521), then the respondents who answered that they would not be open under any circumstances were excluded, and 446 responses remained. 355 of these respondents owned one or more cars. 68 of the respondent used a shared bicycle before.

The respondents could be coded into different code groups. All the codes can be found in Appendix G. Table 6.3 shows the different combined coded answers. When not taking into account the unusable responses (12%), the top three contain the costs (own) vehicle; a selection of benefits; and none. The selection of benefits means the respondents gave more than 1 reason to switch, for example: "That it is close by and I get there faster than by car. And that, of course, the cost are also cheaper than by car". More respondents make a trade-off between ownership and costs, and if owning a vehicle becomes too expensive, then shared mobility would be an option. One of the respondents answered: *High cost of having your own car, a car that sits idle on most days, and switching to an environmentally friendly variant whose cost to carry alone is very high.*

In the responses can be seen, that most respondents answered with the car in mind and the trade-off of not using their own car.

Table 6.3: Section 2: recoded variables

Code	%	Code	%
Accessibility	1%	**Lack of other options**	6%
Ad hoc	0%	**More benefits**	8%
Availability	3%	**No idea**	7%
Chain journey / costs	2%	**None**	11%
Costs (own) vehicle	21%	**Price / sustainability**	2%
Decrease frequency use / ownership	0%	**Proven that it works**	2%
Ease of use	9%	**Sustainability / environment**	4%
Ease of use / price	2%	**To decrease traffic / ownership**	2%
Factors related to speed	2%	**Vehicle specifications**	5%
Lack information / experience	0%	**Unusable**	12%

Under vehicle specification also fall the people who responded, they want 1 application or no application at all. The vehicle specifications are related to the things providers should take care of, such as cleanness of the vehicle.

6.1.3. Selection 3: Factors of respondents not open to shared bicycles anymore

In this section, the responses of the users who are not open to using shared bicycles anymore, but did have experience using them, are evaluated. Of the current users, 16 respondents of the 86 users were not interested anymore. Their responses are summarized in Table 6.4:

Table 6.4: Selection 3: recoded variables

Code	%
Price / speed	6%
Costs own vehicle	6%
Ease of use	6%
None	19%
Speed	13%
Costs	25%
no idea	6%
Sustainability	6%
Unusable	13%

Table 6.4 shows the codes the users who were not interested anymore fell into. Most respondents gave answers related to 'none', 'speed', or 'costs'. One of the respondents answered: *"When a private car becomes unaffordable. But I am against all these shared bikes and shared scooters. Get rid of them."*. This shows that some people make a trade-off in how they answer this question related to the shared bicycle with the shared car in mind.

6.2. Results from interviews

The results from the interviews and focus group were coded using different code words deducted from the framework: performance expectancy; effort expectancy; social influence; price value; facilitating conditions; hedonic motivation; and habit. The goal of the interviews was to get more insight from the perspective of the provider and stakeholders influencing behaviour and bicycle use. The four people were chosen since they all highlight a different side of the sharing system.

Four semi-structured interviews were conducted to get more insights from the side of the selected stakeholders. The four stakeholders were: Donkey Republic (Appendix H.4), a extremely urbanised municipality that just banned some shared mobility mode (Appenidx H.5), a behavioural specialist (Appendix H.2) and a bicycle specialist from the Fietsersbond (Appendix H.3). The interviews are coded and the main outputs have been combined and presented here. The summarized interviews and interview guide questions can be found in Appendix H.

6.2.1. The interview output

The main market leaders in the Netherlands are the ov-bike and Donkey Republic. Donkey Republic is mostly active in the 'The Randstad'. In the interview with Donkey Republic (Appendix H.4), it became clear that one of their advantages is that they only provide normal bicycles. Their prices [code: price value] are therefore lower than their competitors who also provide e-bikes. Their main distinction with the ov-bike is that it can be parked anywhere within a hub. An ov-bike always needs to be brought back to the same station (Appendix H.3), bicycle specialist interview), or the user needs to pay extra to hand it in at another station. From the perspective of a bicycle specialist (Appendix H.3), the most important factors to promote bicycle use, are the preconditions of the bicycle system, which relates back to the infrastructure. Also, the joy of cycling plays a part. According to the bicycle specialist (Appendix H.3, the potential in other shared bicycle systems than the ov-bike is seen less, mostly due to the disruptive character of free-floating bicycles.

A current concern for the shared bicycle system, and then mostly the ov-bike, is the pricing. An option to counter this could be facilitating more subsidies for these modes, more compatible with the subsidies busses receive. "The price would be an important factor in stimulating bicycle usage, along with the availability of ov-bikes and parking facilities at stations." (Appendix H.3). In the interview with the municipality (Appendix H.5), it asked about how subsidies are arranged now, the interviewee answered that it was arranged via a licensing system for shared bicycle systems (except the ov-bike)[price value]. The problem with this is that it

takes away reliability since providers can leave whenever they want (e.g. GoSharing). This problem can be found to a lesser extent with the public transport bicycle. The municipality also introduced more promotions under groups who are more likely to fall under transport poverty. These measurements did not work, and as a municipality, they are researching why this is the case. The municipality also mentioned that the G4 municipalities are researching the potential of shared systems together, to combine knowledge and services. The municipality interview also saw the trade-off between financing shared bicycle systems more and the use of buses, since often these replace each other. The behavioural specialist (Appendix H.2) said costs are often given as a response since costs are often given as an easy-to-answer option. The costs are more of a threshold according to the behavioural specialist (Appendix H.2) than a reason people would switch. A positive approach of facilitating better conditions could help make people switch to another mode and change their behaviour.

The interview with Donkey Republic (Appendix H.4) showed that the users of the system are dependent on the season, but also the 'design of the operation'. The interviewee with the municipality (Appendix H.5) showed that the concept of shared bikes and scooters did not work in their municipality. The market was not demanding these services. This shows that not only the 'design of the operation' but also the demand of the population plays a role.

According to Donkey Republic (Appendix H.4), the users [code: user group] are in Amsterdam mostly expats, tourists, students, and people who are in the city for a day. In Rotterdam for example the local use is higher. This is caused by the freedom the municipality has given Donkey Republic to open and close hubs. Bicycle use is often high around campus and in places where students or younger people use it. They are seen as early adopters. According to the bicycle specialist (Appendix H.3) the user group of non-station-based shared bicycle systems is less divined. Free-floating bicycles are, just like the shared scooters, more for spontaneous (ad hoc) usage. Managing these bicycles in public spaces could also be seen as more problematic since they do not have a specific owner or location they should be placed back in. The station-based bicycle system does have all these specifications. The potential of hubs is higher since they can be placed in strategically chosen places. A main concern of the interviewee was: "The description of the target consumer and how a shared bicycle system provides added value compared to other alternatives is sometimes lacking" (Appendix H.3).

The possibility that a Donkey Republic bicycle could be a replacement for the car was answered with "to some extent, but to a lesser extent" (Appendix H.4). The example was given that in Antwerp, electric bicycles are also facilitated by Donkey Republic and can be used to go outside the city center and that more replacement for the car is seen here. A way to motivate people to use the system is by the location of the bicycle. Also, familiarity plays a role, the fact that the ov-bike and Tier started a partnership, helps to get more attention to the sharing system. The company of the behavioural specialist (Appendix H.2) also did multiple projects for behavioural change to make more people use a bicycle system. The conclusions from these projects were, that people need to have a change in their intrinsic behaviour to be able to maintain a behavioural change. The behavioural specialist mentioned that often unfamiliarity plays a role. It is easier to change people their travel behaviour when they are already inclined to use the mode. The familiarity in some cases is not great, which also decreases people their openness to use a shared bicycle system. The municipality (Appendix H.5) also stated the importance of familiarity with the vehicle, the example of Nijmegen was given, where the use of Felyx and Check was high in the beginning weeks due to familiarity with the product. The behavioural specialist also mentioned the importance of habit and familiarity: "It looks like a difficult system, difficulty in finding a bike, need for a subscription, parking problems, etc" (Appendix H.2). The barriers seem to be high in these cases, so the wished behaviour should be made manageable to change it.

Social influences also play a role but to some extent according to Donkey Republic (Appendix H.4). It is more about "lowering the threshold" by facilitating an application that is easy to use. According to the behavioural specialist (Appendix H.2, social influence has an influence but it is unknown to people that they are influenced by others' behaviour. For the shared bicycle system, this means, the more people around a person use it, to more inclined the person is to have an opinion about it or try it. Social media can also play a role in this, but to a lesser extent.

A hub, which is how Donkey Republic provides their bicycles, helps to control the public space, also since "the philosophy of this is, that in a shared bicycle system, there are more stakeholders involved. For example pedestrians, which should also be considered" (Appendix H.4). The shared bicycle has the most potential when there is another mode involved in the journey [code: performance expectancy] (Appendix H.4). This is also why Tier and the municipality are now working together on stimulating bicycle usage at business parks

[facilitating conditions] (Appendix H.5). Also, the municipality mentioned that they saw that a shared bicycle system cannot serve all population groups. They try to stimulate shared bicycle usage now by creating a higher supply than the demand, so the service becomes more reliable and the availability of a vehicle can be guaranteed. A change is needed, to push people to use the product. The public bus strikes helped to make people change their way of traveling and create for example more users for Tier. The municipality tries to push people to change their travel behaviour through policies and regulations.

According to Donkey Republic, when asked about the potential for non-urban areas, the risk was mentioned that it is used less. To work in these areas, it first needs to be financially sustainable [facilitating conditions]. At this moment, it cannot be. To work in these areas subsidies are needed, or collaboration with other parties (e.g. QBuzz in Dordrecht).

6.3. Results from focus group

For the focus group, the goal was to see what kind of users the system has now and what influences their choices and to create a discussion about these factors. During the focus group, the framework was tested and the factors concluded from the open and coded panel data. The goal of the focus group was to get more insights under which conditions people would use a shared mobility system and facilitate a discussion. The participants were chosen on the basis of knowledge about sharing and age. It was preferred if they at least know what a bike-sharing system entailed since the quantitative analyses and interviews have shown that familiarity plays a role in usage.

6.3.1. The group

The group consisted of 8 people, not including the presenter. The focus group has the following characteristics, collected by a post-focus group questionnaire. The group consisted of people between 20 and 50 years. Seven of the eight participants used an ov-bike. All participants used their bicycles more than two times a week. The respondents were all open to recommending a shared bicycle system to their friends, family, and surroundings. The full explanation per participant can be found in Appendix I.

6.3.2. The focus group output

The focus group tried to focus on the main factors from the theoretical framework and get more explanations for these. The second reason for the focus group was to test the factors found in the panel data and interviews. Most respondents would consider the ov-bicycle as the main bicycle sharing system. The results are divided into different sections. The whole summary of the focus group can be found in Appendix I.

Performance expectancy

By more than one attendee it was mentioned that a shared bicycle system mostly creates value if you need to go to more than one spot. Attendee 1 agreed to this point and added that it has benefits since the public transport is sometimes less connected. Attendee 5 mentioned that he thought it has the most added use if it is connected to other modes. Another positive point about the sharing system was that for example Donkey Republic and Nextbike can be used in other countries as well, which creates added value. The extra use is also created the moment the busses or public transport do not drive anymore. Then the possibility to be able to take a bicycle is convenient. Another participant (7) responded that she thinks: "It is a great system if you use it for the last mile, but I do not think it is a good solution for only your private bicycle'. Attendee 5 responded that according to him, it has the most potential for trips that are below five kilometres.

According to the interview with Donkey Republic, the system is mostly used by expats and fewer locals. The fear was mentioned more that when targeted only for tourists and expats, the bicycles would only be placed at 'tourists' hot spots, which could lead to more nuisance. Another fear was that by placing bicycles at these spots and creating more nuisance, it would also damage the reputation of the general bicycle. Attendee 1 also said she would normally see herself as a tourist, when not in her own city, and would then use it.

Effort expectancy

When someone already used a bicycle system before, the experience was dependent on how much the person likes to bike. One attendee (7) added that she found it quite easy to find a bike, which made the use easier. Another responded they did not find the experience the best, also because there is no possibility to bring their kids. A limitation of the ov-bike was that you needed a Dutch bank account to use one. The good thing about a free-floating or hub-system is that it does not have to be brought back to the same place, which is the case

for the ov-bike.

The effort it takes to use a free-floating system was also summarized in the quote of attendee 3, where people agreed with: *"if you only do a short trip, it is too expensive, or there are so many apps out there for free-floating, that I kind of ignore that because there is too much choice"*.

Social influence
This concept was explored through different scale items given in Figure 6.1.

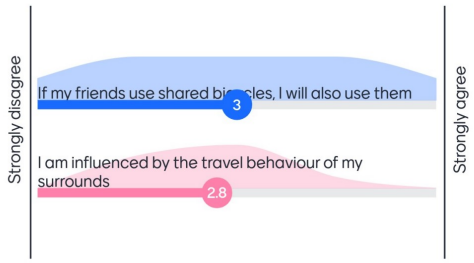


Figure 6.1: Question 3 in the Mentimeter

In general, all the respondents answered they are not influenced by their surroundings. Attendee five said if he would be introduced to the system: *"I'll be more likely to use it, because then I do not have to get over that 'threshold', that step myself'*. More people could find them self in these statements. Another attendee (8) responded: *"if people around you, you see them using bikes more in your city, that wouldn't influence me, but I think if a city has more bike users, the infrastructure becomes better or is good, and that would influence me"*.

On the scales, people responded quite in the middle, with an average score of 3 for the first statement and a score for the second statement of 2.8.

Price value
This question was explored through the scale question 'Price has influence on my use' and throughout the focus group price was mentioned multiple times.

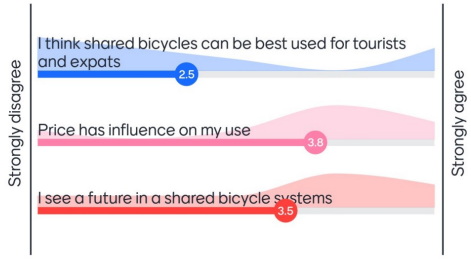


Figure 6.2: Question 4 in the Mentimeter

The statement focusing on price was answered by multiple respondents with a higher score. The average score was 3.8. One of the participants (2) mentioned that price is less important for her, since she does not have a car, and can use the extra saved money for renting a bike. Another responded to this statement, that it is also dependent. The person would pay more now, than when he was still in the student situation of respondent 3. From this could be concluded by the participants that your own current situation has an influence on how important you think the price is. As attendee 5 said: "It is more a price calculation, in my head'.

Facilitating conditions
All respondents had used a shared bicycle system before. The only remark on how to use the system was that information was harder to find. As Attendee 5 said about his answer 'knowing where they are', which was not only cantered around the location, but also the different providers and their conditions "Where do I need to park, do I need to bring it to the same place,..., do I need a credit card,..., its all these factors to me, even one is complicated to know, to know four,..., to have something that tells me all of that, like you can use this one at this place, to go where you need to go, period, would be really easy, but that does not exist...to my knowledge". Other respondents also agreed with this and could confirm they had the same problem.

Hedonic motivation
Of the participants, a few said they do get satisfaction out of the system. As respondent 3 mentioned, she also likes to bike, which also influences her choice. Some respondents also answered that they would rather take the bus, when possible. Also because riding your bike and finding the way on Google Maps can be a hassle. The respondents disagreed on some points when it was about bringing stuff with you. Some responded that not being able to bring stuff with you, was a reason why they would not use the system, others said they did not see this as a problem.

The most potential was seen in the station-based and hub-based systems. This was explained by the fact that free-floating often gives more nuisance. More than one attendee responded they would rather have no system, than a free-floating system. This was also explained by the fact that in the Netherlands all vehicles are actually free-floating in a way, and it would only create more chaos to add more bicycles. Then the sidewalk could be compromised.

Habit

To see if people would break their habit of using their own bicycle or car, the scale questions 'A shared bicycle could be a replacement for car trips/ownership' and 'A shared bicycle could be a replacement of the bike trips/ownership' and what they see as the goal of a bicycle system.

Now most people use it on an ad-hoc basis, or if it connects well with public transport or if the place is unknown. This question was answered by the scale factors. The question is if it can be placed in someone's habit and if they would see it as a replacement for current travel behaviour.

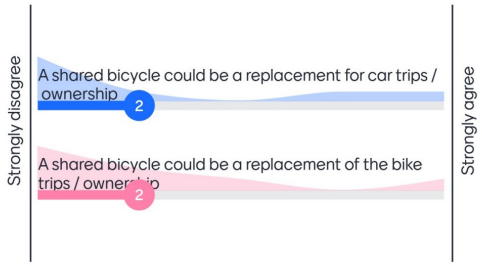


Figure 6.3: Question 7 in the Mentimeter

The participants responded on the scale factors generally low. The average score for all respondents was 2. The reason for this was that it could not be a replacement for *all* car trips, but for some, it could be. For the own bicycle, attendee 3 responded: "*I want to have my own bike because I don't want to be in the position where there are no bikes,..., other than that I really don't care if it is my bike or another bike if I share it or not, but that needs to be covered first*". The other respondents agreed with these words.

General motivating factors

The general motivating factors were asked through the question 'What would motivate you to use a shared bicycle system?'. This question has led to the following answers:

Figure 6.4 shows the different factors influencing the choice to use a shared mobility system. The most answered word was flexibility. When asked about the response 'chipcard working no app' the response was: *"I really like the system of the ov-fiets, that you can tab your card and use it, because I find the apps, well not necessarily difficult, but I had problems with identifying, or even finding one. So that would be very flexible and no time consuming, if it could work, something like that, not necessarily with your chipcard but for example with your ING bankpas"*..

Figure 6.4: Question 6 in the Mentimeter

The focus group showed that in general, the participants were more open to hubs, than free-floating, some even said they would prefer no system, over a system but that they saw the added value of the system when arranged well.

6.4. Conclusion qualitative results

In this chapter, the different factors influencing 'openness to use' and different perspectives were discussed. The third sub question: "*What preconditions influence current travel behaviour in favour of a shared bicycle system?*" can be answered.

From the panel data could be concluded, that the people who are open to using a shared bicycle system, are mostly influenced by the trade-off between the costs of their own vehicle and the costs in general. People would be more open to using shared mobility modes when the price is lower. A high percentage of the respondents also gave a response that there are no conditions where they would switch to shared mobility for. From the panel data, the responses also included combinations of factors, such as price and sustainability, or

price, availability, and speed. People with a higher income also often answered price as the most important factor, besides lower incomes.

The interviews and focus group showed that the trade-offs someone makes, are dependent on the user. The people who found costs more important were also the ones who earned less money (student). This was not seen in the panel data, where the people who earned less, were not responding costs the most. Some people in the panel group find availability and ease of use important. Also, the situation plays a part, for most people the trips when using a shared bicycle, are connected with ad-hoc trips and are often non-work related. Then the system also mattered in the use according to the focus group. Some of the participants mentioned that they would rather have no system than have a free-floating system. In the interviews, familiarity with the system was given by all. They said that more people have an opinion or would be open to using the system if their familiarity with the system increased. The interviews and the focus group also showed that the 'design of the operation' played a part in use, it needs to be convenient to use the system to promote more local use.

From the perspective of the supplier and bicycle promoter, the infrastructure and availability were also mentioned. The supplier mentioned that people need to see it, to use it. The behavioural specialist mentioned that lowering costs was often given as a precondition, but this was also often said to be the solution since it was the easiest answer. This did not mean people would actually change their behaviour when lowering a price. The municipality and the interview with Donkey Republic also mentioned it could be best used in a chain trip, and a system cannot be developed to fit and be applicable to the whole population, since this is not possible. The interview with the Fietsersbond also emphasized that he saw the most potential in a shared bicycle system in combination with another mode. To conclude, familiarity with the system, the costs, and the specific user play a role in the use of the system. Often a trade-off is made, and personal circumstances play a role in the use.

7

Discussion and result integration

This chapter presents the integrated results of the qualitative and quantitative analysis conducted to explore the factors influencing individuals' openness to use shared bicycle systems. By combining insights from both panel data, the interviews, and the focus group, a comprehensive understanding of the subject and potential user group can be discussed, enabling policymakers and stakeholders to make informed decisions regarding the promotion and improvement of shared bicycle systems. The discussion contains the interpretation of the results while looking at the problem statement, the limitations of the research, and the connection between the different methods.

7.1. The combined results

Through the literature review stage, it was concluded that according to Busch-Geertsema and Lanzendorf (2015) behaviour was dependent on situational and personal factors. The research mostly focused on the personal factors of the participants, since the focus of the research needed to be on the user and not on the circumstances of the shared bicycle systems. Ajzen (1991) mentioned that the influence of intention is high on people their behaviour, it is assumed to capture the motivational factors. These factors influencing and motivating people to use a shared bicycle system from the research can be found and summarized in Figure 7.1. In this figure, the limitations, debunked and confirmed factors from the literature and results, and the extra-mentioned variables and effects are shown. The explanation per point can be found in the (sub)sections.

Figure 7.1: Discussion conclusions based on limitations, variables and extra found influences

7.2. Connection to the literature

The research started with extensive literature research about factors influencing the use of shared bicycle systems. This led to different factors influencing current use in other countries and the Netherlands. Different connections between the literature, the quantitative and qualitative results can be made and discussed and arguments found in literature can be refuted.

7.2.1. Connection to the problem statement

The problem introduced in the introduction was that the share of the car on the roads was increasing again. A solution to this problem could be implementing more shared mobility or improving the chain journey. Data

and the general opinion about sharing seemed to be hard to gather.

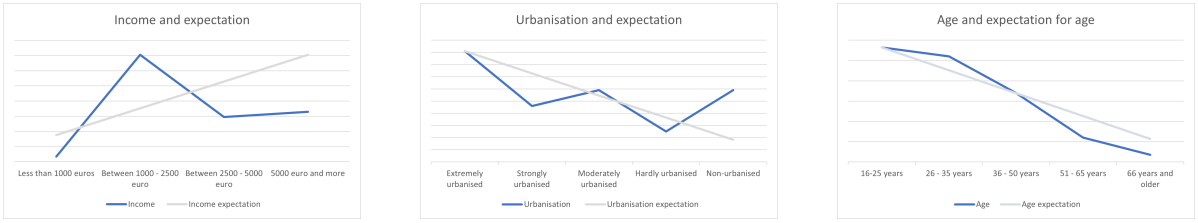
The quantitative research showed that in general, the opinion about shared bicycle systems tends to switch to not interested (at all) in the population. The focus group showed that some also did not prefer a bicycle option, but would rather take a bus when available. In the interview with the municipality, it was also emphasised that a shared (bicycle) system cannot be applicable to every person in the population. The interview with Donkey Republic showed that their users now were mostly limited to tourist, expats, and non-locals, and fewer people locally. A reason for this could be that there is little knowledge about sharing for a big part of the population or the bad media publicity the shared bicycles and scatter bikes *('strooiscooter')* received had a negative influence on people their opinion about the concept.

7.2.2. Connection to the theory and current situation

In the literature review, it was mentioned by Busch-Geertsema and Lanzendorf (2015) that personal factors consist of internal and external factors. The internal factors consist of norms, attitudes, and preferences. The external factors consist often of income and social-demographic factors. The research showed that mostly internal factors were hard to measure, the panel data gave a clear overview of people their income and social-demographic characteristics. Their attitude or preferences for a shared bicycle system were harder to conclude since people did not correctly answer the open panel data questions related to this. The panel data did not zoom into people their preferences or exact attitude toward shared bicycle systems. The reason why most people choose to fall into the 'not interested (at all)' group was unclear. The multiple choice question in the panel data showed that the response 'never' was given the most. The focus group also showed that people have different preferences and make other considerations. The interviews showed that users make different considerations when choosing the shared service. Often the choice towards more openness is made when the familiarity is high.

Chen et al. (2020) and Shaheen (2013) showed that the use of shared bicycle systems is also dependent on the access people have. According to Chen et al. (2020) higher education, younger and affluent groups have better access to these modes. The results showed that in both the qualitative and quantitative results this was confirmed. The education level was not tested, but it was made clear that higher incomes (more affluent groups) and younger people were more familiar with the concept. This was also shown by the found current users. These were seen as respondents from higher income, younger and more urbanised areas.

The expected user group was not fully alike to the user group found in the data set of Mobycon and alike to the conclusions from the interviews. It was expected that high income, higher urbanisation level, and a younger age had a big influence on the current user. Figure 7.2 shows a simplified expectation of linearity for the three variables. It can be explained as follows: the higher the income, the more likely it is that the person is a user. The higher the urbanisation degree, the more likely a person is to be a user and the younger the user group, the more likely the person is to be a user in comparison to the elder generations.



(a) Income and expectation (b) Urbanisation and expectation (c) Age and expectation

Figure 7.2: Current user data and expectation

The outcome of the cross-tabulations in the quantitative results showed that the *current* user is not as expected the one who lives in higher urbanised areas. Also some current users, or the one who used the system before, were located in no to less dense urbanised areas.

7.2.3. Connection to the defined variables

Different personal variables were chosen for the theoretical framework, which would influence the intention to use the shared bicycle system.

Gender

Research of Bergantino et al. (2021), Eren and Uz (2020), Guo et al. (2017), and van Kuijk et al. (2022) all stated that for the variable 'gender', more men used the shared bicycles, only the paper by Goodman and Cheshire (2014) showed that more women used the shared bicycle system. As the paper stated itself as well, this could also be caused by the high number of women using bicycles in England in general. In both the quantitative and quantitative the results showed that gender does not influence people their shared bicycle use in a significant way. The connection found in the literature could not be found in the research results.

Travel frequency

The travel frequency of using the bicycle showed that the more the own bicycle is used, the more likely it is the user is also open to use a shared bicycle system. This was also confirmed in the literature and the results of both the qualitative and quantitative parts of the results.

Household vehicle ownership

The household vehicle ownership had according to Eren and Uz (2020), Mouratidis (2022), and Shaheen (2013) a positive influence on people their openness to use a shared bicycle system. The results of the quantitative analyses showed that there is no difference when the variable is coded as a binary variable, where there are two groups (owners and non-owners), but there is a difference when looking at the number of cars. When someone has a higher number of cars in their household, the likelihood to be open to using a shared bicycle system decreases. So the results of the research debunked this theory for the Netherlands. The theory that the ownership of a bicycle has a positive influence on the openness to use a shared bicycle system is confirmed by both the qualitative and quantitative parts.

User perception

Guo et al. (2017), Mouratidis (2022), and van Kuijk et al. (2022) showed in their papers that the perception of the user influences their intention to use the system. This was confirmed by both the qualitative and quantitative results. The results from the panel data showed that when people knew and used the shared bicycle system, they were more likely to be open to the use of the system. People who were not familiar with the system were more likely to fall into a not interested group. The focus group showed that some were more likely to use the system when they could do it with someone who would explain it to them.

Income

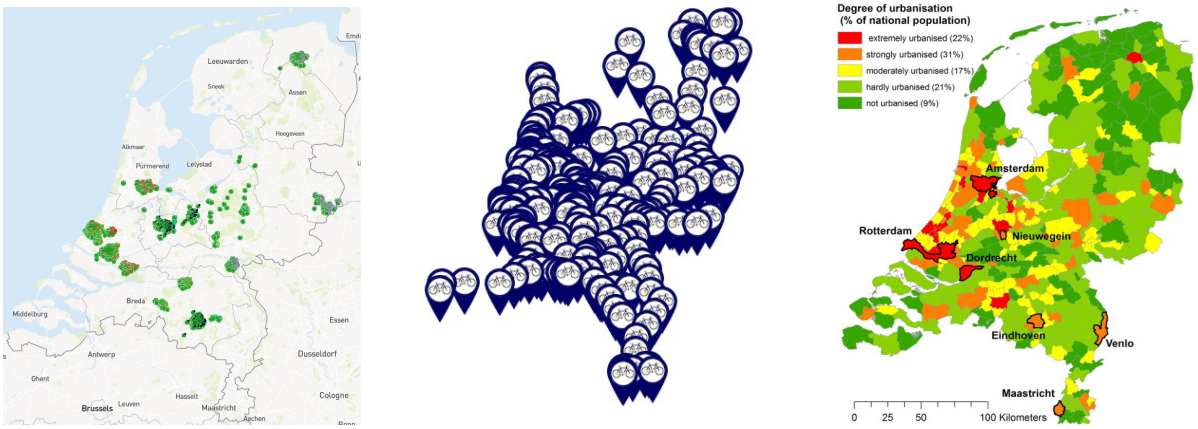
According to AM (2018), Fishman (2016), Goodman and Cheshire (2014), Machado et al. (2018), and van Kuijk et al. (2022) income could play a role in the use. Younger individuals show a higher degree of likeliness to use shared bicycles, suggesting that age influences adoption patterns. This aligns with the qualitative findings, where participants expressed a preference for shared bicycles among the younger population due to their perceived flexibility and convenience, and from the literature where it was mentioned that younger generations are more open to using instead of owning. The open panel data results showed that costs are often a problem and the quantitative results showed that income had a smaller influence than expected. The logistic regression and non-parametric tests showed that income was not as significant as expected. In the focus group and interviews, it was made clear that the costs are often a problem, but that when you have a higher income you make other considerations and trade-offs.

Urbanisation

Less urbanised areas are expected to make less use of the shared bicycle systems and be less open to using the system. The quantitative analyses of the current shared bicycle user was unexpected. The number of people who used a shared bicycle before was unexpectedly high for the not urbanised areas.

The quantitative analyses did confirm the influence of urbanisation on the openness to use a shared bicycle system. The extremely high, moderately and high urbanised areas had a higher chance to fall into a more interested group. From the qualitative open answers from the panel data, some respondents answered that the infrastructure was not there or there was no availability. The influence of urbanisation on the openness to use a shared bicycle system could be explained by the availability of shared bicycles. During the interview with Donkey Republic it was mentioned that the provider is also limited by the rules the municipality has and the profitability of the area.

To visualise the supply in the Netherlands, and give an explanation of why less urbanised areas are less likely to fall into a group interested in the system due to urbanisation and familiarity, can be done by Figure 7.3. This figure shows the availability in the Netherlands. An elaborate explanation of the supply can be found in Appendix B.



(a) Availability shared (e-) bicycles (CROW, 2023)

(b) Public transport availability (ovfietsbeschikbaarheid, 2023)

(c) Urbanity in the Netherlands (Vanham et al., 2016)

Figure 7.3: Supply in the Netherlands and Urbanisation degree

7.3. Limitations of the research

From the literature research, some papers concluded that the shared bicycle system is mostly used for commuting or educational trips and to a lesser extent for leisure or shopping trips (de Haas & van den Berg, 2019). Nonetheless, the motivation of individuals driving them to choose a shared mobility mode remains unclear based on the available analyses. The uncertainty is caused by a gap in the panel data, which fails to give insight into potential connections between the use of a shared bicycle system and other transport modes, such as public transport.

7.3.1. A shared bicycle system as substitute

Campbell et al. (2016), Chen et al. (2020), and Faber et al. (2020) showed that it was expected that shared bicycle systems would have a high chance of being a substitute for walking and public transport, de Haas and van den Berg (2019) implied that this effects was less significant. The results of both the qualitative and quantitative research showed that it was hard to find the mode the shared bicycle would be a substitute for. The qualitative results tried to give insight into this, by asking about it during the interviews and the focus group. It was answered that in the Netherlands the shared bicycles are indeed a substitute for walking and the bus (source: Donkey Republic interview) and that during the focus group it was made clear that only for the shorter distances the shared bicycles could be a substitute for the cars, but people needed to become more familiar with it first, before they consider it. de Weger et al. (2018) and McKenzie (2020) showed that the duration of use would also play a part and the trip distance. This connects with the limitation that there is no clear view of when and with which purpose the system is used.

7.3.2. The data

The panel data set consisted of people from all over the Netherlands. The distribution in the data set was unfortunately not fully linkable to the population, even after using some weights were applied to the data set. Therefore the representation in the sample is not the same as in the population and some conclusions cannot be stated with complete certainty. Another limitation in the panel data set is that conducting an ordinal logistic regression was not possible due to the parallel line assumption. Therefore the original ordinal variable, could not be evaluated as such.

Limitation of the focus group

A limitation of the data (participants) used in the focus group, is that the results from this are only based on

one focus group and only consisted of one person with a car. Therefore, the representation of car owners was low and the results pro using the shared bicycle system could be influenced by this. Only basing the results for the circumstances on one focus group, lowers the validity of the results and research.

7.3.3. The chosen variables

The research was focused on personal factors instead of on the literature-defined situational factors. The situational factors consisted, among other factors, of the variables: the weather, the availability of the bicycles, and access to the bicycle. These factors were not investigated during the research. During the focus group and interviews, it was mentioned that for the respondents, for example, weather and availability did play a role in choosing to use the shared bicycle system.

7.3.4. The fit with the theoretical framework

The last discussion point is the harder-to-fit connection between the existing data and the chosen framework. The framework by Venkatesh et al. (2012), showed the seven different factors influencing intention to change behaviour. The variables found in the literature were added to this framework but the asked data for the factors could not be linked on a one-to-one basis. Therefore, it was harder to draw firm conclusions and make recommendations for future policies based on the specified theoretical framework. The framework used is shown in Figure 7.4.

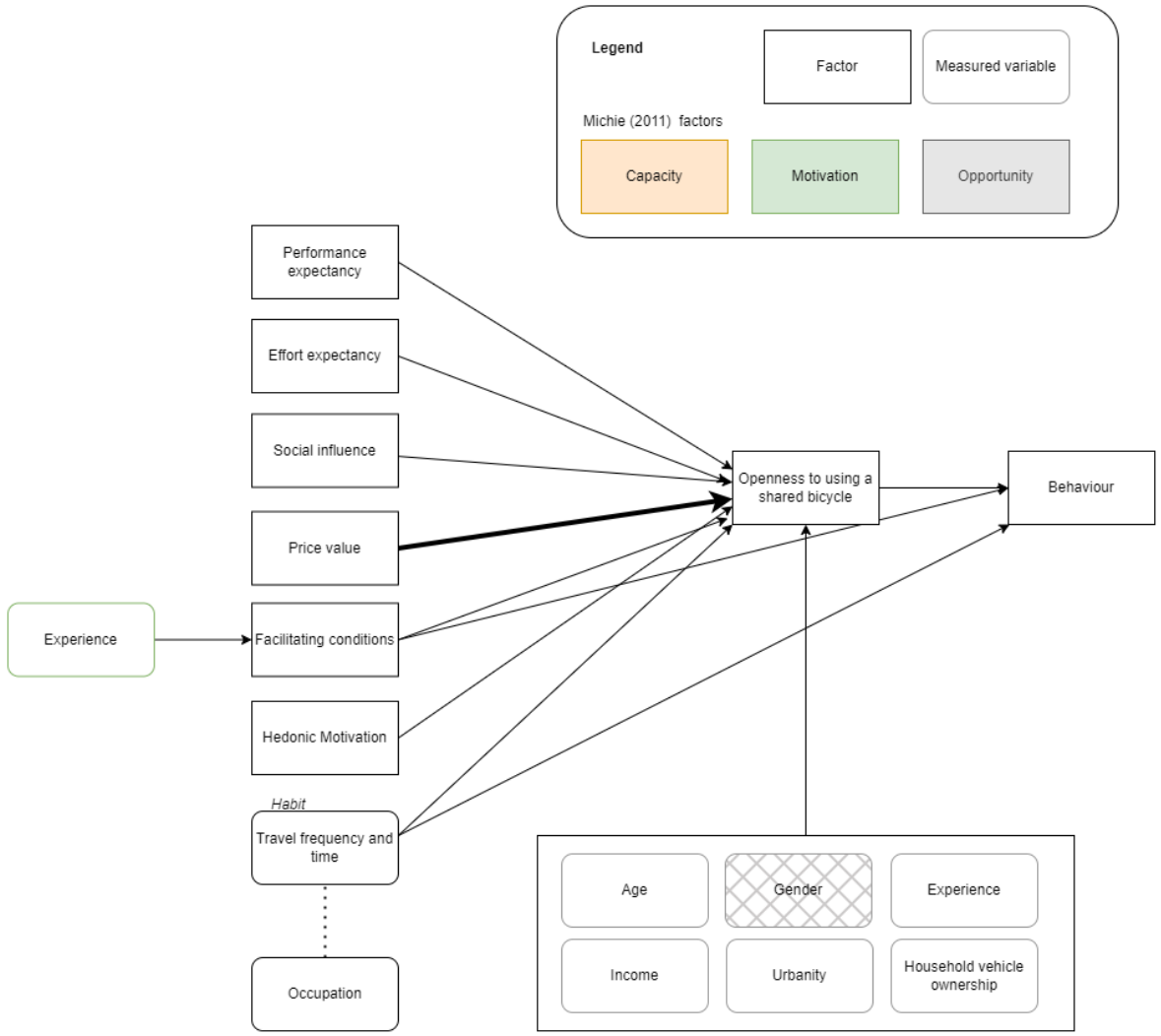


Figure 7.4: Final framework for behavioural change in bike systems

As mentioned before, only gender was not significant and is therefore made grey in the revised framework. From the different analyses, it can be concluded that *performance expectancy* is influenced by the fact that most people use it on an ad-hoc basis. Often the bicycles are used by tourists, expats, or 'day'-people. From the focus group, it could be concluded that people often use shared bicycles when they are going to another city, in the Netherlands, or abroad, and see the need to use the shared bicycles since they do not have access to their own. The connection and the position of the shared bicycle in the chain journey could not be measured with the panel data output and the framework. The *effort expectancy* to take a shared bicycle is dependent on different factors. From the panel data, it was concluded that availability and accessibility are important factors for people. From the focus group, the conclusion can be drawn that if someone used the shared bicycle before, the effort was less. The influence of the surroundings, or the *social influence*, was seen as little. The people from the focus group mentioned that they would not say they are influenced by their friends. The interview with the behavioural specialist mentioned that people are often imperceptibly influenced. The *price value* arrow was made thicker than the other arrows since the price value was something that came back in the panel data, the focus groups, and the interviews. People often make a trade-off between the costs of one vehicle in comparison to the other. Often, when the trip is longer or with more people, another mode than the shared bicycle is a better option. The *facilitating conditions* showed that if people know the concept, they are more likely to be open to sharing. This can be indirectly influenced by their age, urbanisation, or income. The fact that urbanisation is important and connected to knowledge about sharing could be expected since the shared bicycle systems are already the biggest in highly urbanised areas. This is also where Donkey Republic is mostly active. The *hedonic motivation* could also not be measured by the panel data, but was measured in the focus group: some people just like to bike. Therefore they would rather take a bicycle in another city, than public busses or transport. This means that if someone enjoys the shared bicycle more, they are also more likely to make use of it. *Habit* was measured with the number of times someone made use of their own bicycle. In the quantitative analyses it was seen that if someone uses their own bicycle more often, the likelihood that they are open to using a shared bicycle is also higher. This could be explained by the fact that their dependency on the bicycle is already high and they are used to using this mode for going everywhere. The focus group also showed that the people chosen for the group all liked to ride the bicycle. The different variables which were chosen as predictors showed that only gender did not have an influence on people their openness to start using a bicycle system.

8

Conclusion and recommendations

In this chapter, the results from the analyses are concluded and used to answer the main research question. First, the sub questions are repeated before answering the main research question. The final recommendations deduced from the discussion and analyses are given. Both policy, research, and recommendations for Mobycon are summed.

8.1. Conclusion

The research question was built on the knowledge gap, that the users group were unclear and it was hard to make fitting policies fitting on the population. The thought behind this was that often, sharing systems are introduced without a clear plan for who needs to be targeted. The main research question specified is:

Who are the current groups open to using shared bicycle systems and which factors influence their use in the Netherlands?

8.1.1. The answers to the sub questions

To answer the main research question, three sub questions were drafted. The sub questions were answered by both a literature study and a mixed method. The first sub question is:

What demographic and general factors influence shared bike systems in other countries?

To answer this sub question existing current literature was examined. Primarily data from China was found since the shared bicycle system is the biggest there. As stated in the introduction, stimulating more people to use a shared bicycle system, is about changing behaviour and finding the right user groups who are interested in the sharing bicycle system. The literature review revealed that behavior change can be attributed to situational and personal factors. Personal factors identified in the literature encompassed variables such as income, urbanization, age, gender, household ownership, and knowledge. However, the significance and influence of these variables on usage varied across different sources. On the other hand, situational factors, including helmet requirements, weather conditions, and walking distance, were consistently recognized as influential and were more frequently mentioned in the literature. For this research and research question, the focus was mostly on the personal factors, which were tested in the qualitative and quantitative analyses, due to their direct association with the user. Situational factors relate more to the infrastructure and (environmental) conditions. These factors were linked to the framework of Venkatesh et al. (2012). This framework introduced different factors influencing the intention to use new technology. These factors: Performance expectancy, effort expectancy, social influence, price value, knowledge about sharing, hedonic motivation, and travel frequency and time (habit). Overall, the literature search and development of the behavioral framework revealed that numerous factors influence the usage of shared bicycles which could be tested for sub question two and three.

The second sub question was answered by the quantitative analyses. The sub question read:

How do the factors influence people open to shared bicycles in the Netherlands?

From the cross-tab analyses for finding the current user group in the data set, it could be concluded that of the respondents only 5.5% were current users. As is mentioned in the literature and current news articles, people who are younger, have higher income levels, and live in more urbanised areas are more likely to be the current users of the sharing bicycle system. The cross-tab of current users shows, that a high percentage in comparison to the other urbanisation levels, is also located in the non-urbanised areas (5.9%). The result from the logistic multinomial regression showed that gender does not have an impact on the dependent variable 'openness to use'. The other factors of age, income, urbanisation level, frequency of travel, and experience, do influence the level of interest. Respondents located in the higher urbanised areas are more likely to belong to a higher interest group. Similarly, younger individuals are more inclined to have at least a neutral attitude toward the concept of a shared bicycle system.

For the availability of vehicles, the car has a negative effect on the likelihood of belonging to a higher interest group for the dependent variable. If a respondent owns more cars, the respondent is more likely to fall into the category of 'not interested' or 'not interested at all, or the 'neutral' group than in the '(very) interested'. On the other hand, the number of available bicycles has a positive effect on the likelihood to belong to the highest interest group. Those who own more bicycles, are more likely to fall into a higher category of interest. Furthermore, the frequency of travel also influences individuals' openness to use a shared bicycle system. The more a person travels, the more likely it is, he or she belongs to at least the 'neutral' group.

In conclusion, the results suggest that younger, wealthier individuals living in urban areas are more interested in shared bicycles. Gender does not affect this interest. Factors such as age, income, urbanization, car ownership, bicycle ownership, and travel frequency all influence people's openness to using shared bicycles.

The last sub question is used to find the influence of the other factors mentioned in the theoretical framework by conducting a focus group, and interviews and analyzing the open answers of the panel data. The third research question read:

What preconditions influence current travel behaviour in favour of a shared bicycle system?

The answer to this question is that the influencing conditions depend on the person. From the focus group, it is concluded that the participants made other trade-offs within the group. The participant who did not work yet was more open to having less flexibility if her costs would go down, than the person who worked and was open to paying more. Another respondent made clear, that since she did not have a car, she was also open to paying more for sharing. She made a different cost calculation. It also became clear that the opinion about the kind of sharing system influenced the use. Free-floating systems were seen as less likable, and some would rather have no system than free-floating. This means the conditions around the vehicle also play a role in its use.

The analyses of the open panel data showed that below the 20% of the panel respondents, were under conditions open to using a shared bicycle or a shared mobility mode in general. The most influencing factors from the open answers of the panel data were related to the costs of the own vehicle or shared vehicle, more combined benefits such as availability and speed, or answers that related to no interest at all.

The interviews showed that preconditions such as availability, costs, and the accessibility of the bicycle played a part, but also the ease of use, such as the infrastructure should be important. The infrastructure argument was also something that came back in the focus group, where one participant responded that a good infrastructure would influence his use, but that his friends would not influence him. Familiarity was also mentioned by all interviewees, which also related to the concept of knowledge found in the quantitative analyses.

From the focus group and interviews, it became clear that most expats, students, tourists, and 'day'-people use the shared bicycle system. In the focus group, it was emphasised that use was for ad-hoc use. In the focus group, the most mentioned factor was 'flexibility' and 'accessibility' or 'availability' in combination with a train trip. Also, other factors, such as the situational factors, weather, and design of the application were given in the open answers and focus group or no need for a mobile phone.

To make all preconditions work, different parties should work together, to make sure the infrastructure, availability, and ease of use are aligned while considering lowering the costs by subsidies or collaborations. From the interviews, focus group, and panel data it could be concluded that only collaboration, could make sure most of the wished conditions are met. The question remains if the lack of subsidies by the municipalities is due to the number of bicycle owners in the Netherlands, something that according to the logistic regression

has a positive effect on the openness to share. To conclude the third research question, familiarity, costs and no conditions at all, can be seen as highly influential factors from the qualitative anayses.

8.1.2. The answer to the main research question

It was made clear in the analyses that people often wanted to connect a shared bicycle system, with a chain journey and that there is still a big part of the population not open to shared mobility. Knowledge of the system plays a big part in the openness to use as could be concluded from the multinomial analyses. The current users are quite aligned with the people who are open to use in the panel data. Younger people, who live in more urbanised areas, and have higher incomes could be deducted as future users from the panel data. The factors influencing use, are focused on personal factors, but from the focus group, interviews, and the open panel data, it can be concluded that it is about more than that. People want the certainty of a vehicle and its availability. The factor cost is often mentioned, during the interviews, the focus group, and most in the panel data. This shows that people think the factor costs play an important part in the consideration of switching or being open to a shared bicycle system. Familiarity and knowledge of the system seemed to be extremely important and should be focused on as one of the most influential factors to increase users. What could be concluded from doing this research is that there will not be one solution that fits all the different urbanisation and user groups and it can be recommended to increase knowledge about sharing before implementing it in more areas.

As also mentioned in the discussion chapter (Chapter 7), the answer 'never' is most given to the multiple choice question under which the respondents would switch. The quantitative analyses showed that when testing the independent variable with the dependent variable 'openness to use' the vast majority of the respondents fall into the group 'not interested' or 'not interested at all'. The interviews with Donkey Republic showed that the users are currently tourists, expats, or day trip people, not the locals. The interviews with the municipality, the bicycle specialist, and behavioural specialist mentioned that collaborations between provider and municipality or other organisations should be needed and better implementation of the shared bicycle systems in the infrastructure to make it work. The focus group showed that some of the participants would prefer no system over a free-floating system. Some of the participants in the focus group also mentioned they prefer taking public transport over a shared bicycle system. The majority of the panel data and results show that people would not prefer a shared bicycle system and the most mentioned factor was the costs. Often the trade-off was made between the cost of the service and the cost of their own vehicle. As mentioned before, most respondents who would be open to the shared bicycle system fall into current groups of younger generations, who live in extremely, highly, or moderately urbanised areas. this is a confirmation of what is also known in science. For now, this means that implementing such a system for the whole population is not feasible yet for all population groups, since not all groups are open to it yet. Different recommendations can be given for research and policy implementations.

8.2. Recommendations

One of the goals of the research was to get more insight into what kind of policies are needed for the shared bicycle system. These recommendations could be used to provide better policies for municipalities, governments, and providers. Another kind of recommendation can be called research recommendations, and are chosen due to some found gaps in the current research. The last given recommendations are for Mobycon. The recommendations are based on the discussion section, the results, and the learned knowledge.

8.2.1. Policy recommendations

The first policy recommendation aims to decrease costs associated with shared mobility services. This recommendation stems from the observation that the costs of the shared mobility mode serve as a barrier, deterring individuals from choosing the shared mobility mode. The qualitative research showed that respondents often see the high costs of their own vehicle, of the shared vehicle, or in general as problematic, causing them to hesitate to switch to a shared mobility form. The quantitative analyses, accounting for income, similarly show that higher incomes have limited influence on individuals' will towards using these services. For the authorities, service providers, and municipalities a feasible step would be finding strategies to reduce the costs, so the service becomes more widely available for all (income) groups. Both interviews with the municipality, the bicycle specialist, and the service provider pointed towards subsidies as a means to lower the costs. As highlighted by the bicycle specialist, this approach would align with the current provision of subsidies for bus services. Offering the cost-related incentive might encourage individuals to change their behaviour and tran-

sition from their personal vehicles toward shared alternatives. Although this requires further examination, to make sure whether costs represent the primary motive for people to switch to shared mobility modes or not, given that costs tend to be a convenient explanation, according to the behavioral specialist.

The second policy recommendation focuses on achieving uniformity in the operational framework for shared mobility services throughout the Netherlands. The interview with Donkey Republic highlighted that the operational design of the system and the extent of freedom granted to providers significantly impact the success of these services. In Amsterdam, stricter rules apply for Donkey Republic and their service area than in Rotterdam, resulting in higher local use in Rotterdam. The interview with the municipality emphasized the importance of harmonizing collaboration not only between providers and municipalities but also intermunicipally. Such alignment is crucial to encourage widespread recognition of the system's potential, particularly in smaller regions where its viability might otherwise falter. A collaboration such as mentioned in the interview of Donkey Republic between parties, could help make the product more known and easier accessible. This is in line with the current new collaboration of the NS with Check and Tier, this strengthens the chain journey. Achieving uniformity could also help in implementing the system in smaller areas, where the openness to use the system is low, or the service cannot get off the ground.

The third and final policy recommendation focuses on measures that discourage car usage for short trips. For instance, this could be done by discouraging the use of personal vehicles for short journeys by imposing restrictions on parking or usage in city centers could be considered. As highlighted in the focus group discussions and interviews, cars are frequently utilized for brief distances due to the leniency of authorities. In the example of Amsterdam given in the Donkey Republic interview, the shared bicycles are not allowed in the city center (*'the ring'*. This also discourages people to use the shared bicycle when they go to the city center. Ultimately, facilitating this shift from personal vehicles could prove beneficial for municipalities and authorities, aligning with their goals of reducing car dependency.

8.2.2. Research recommendations

The first research recommendation is to select both a specific location and target group for new research. The research showed that there is no one-size-fits-all solution and not all groups can be targeted. A recommendation is to choose a specific group to investigate, for example, employees. This group is often using cars and contains a big part of the population. Notably, numerous companies incentivize employees to cycle to work through mileage reimbursements and bicycle discounts. Research options could be to select a few companies that are highly dependent on the availability of the car and conduct interviews or focus groups to find the factors influencing their use and the regulations that would make them switch to shared mobility or shared bicycles. Expanding the scope of focus groups should assure the accuracy of the results.

A second research recommendation underscores the importance of looking into situational factors besides personal factors. This research only focused on the personal factors and less on the situational factors. The significance of situational factors emerged from focus groups, interviews, and quantitative findings related to urbanization and knowledge. The availability of the bicycles, the trip duration, and how the weather influences the use, could be researched and were currently missing in the panel data. Insights from this new research could inform more tailored policies and recommendations for municipalities concerning regulations governing the locations of hubs and free-floating systems.

The third research recommendation is to investigate indirect effects as well. Currently, all defined personal factors solely focus on direct effects on the independent variable 'openness to use'. However, it can be expected that someone's age can have an indirect effect on someone's knowledge about sharing, and therefore, the person has a lower chance of ever using the system before. For instance, literature implies a positive link between car ownership and the willingness to use shared bicycle systems. Strikingly, quantitative data demonstrates the contrary: car ownership negatively influences the intention to use the system. These outcomes might be shaped by individuals' views on sharing, potentially since they chose to not own a car due to environmental concerns. Analyzing indirect effects can elucidate why individuals lean to specific groups within the "openness to use" variable.

The final recommendation is exploring other theoretical frameworks and data for policy recommendation, which fit more precisely from the beginning. An example of a framework is the before mentioned framework of Michie et al. (2011). This framework is validated and connects the factors to exact policy recommendations. Being able to connect the demand or not of shared bicycle systems and shared mobility, can give a clearer

image of the needed policies. For this, it would be recommended to first develop the framework, before collecting the data. This framework could guide the survey or interview questions, and make sure there would be a better between the two.

8.2.3. Mobycon recommendations

The first recommendation for Mobycon is to redo the panel investigation and start measuring the use of shared mobility over a longer period. By doing this, the opinion can be monitored and the need for implementing these new modes can be investigated. If the data shows that the opinion about shared bicycle systems and shared mobility stays the same, it can be said with more certainty that there is no market for the systems and other solutions need to be found for the increasing car usage.

The second recommendation is to add different questions related to public transport and the purpose of someone's travel. This could also give more insight into the substitution effects. Then it can be investigated if the shared bicycle or a shared mobility mode is an add to people their usage or a replacement. This could be researched by asking what mode they would have used, or what the respondent would have done if the shared bicycle was not available.

The last recommendation is to find out the reason people do not want to use the shared system anymore. The quantitative data showed that there are also people who used the shared bicycle system but are not open to it anymore. It would be interesting to know what the purpose was of their shared bicycle use, if they used it only one time and what influenced their opinion about sharing now.

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A

Behavioural models

A.1. Theory of Planned Behaviour

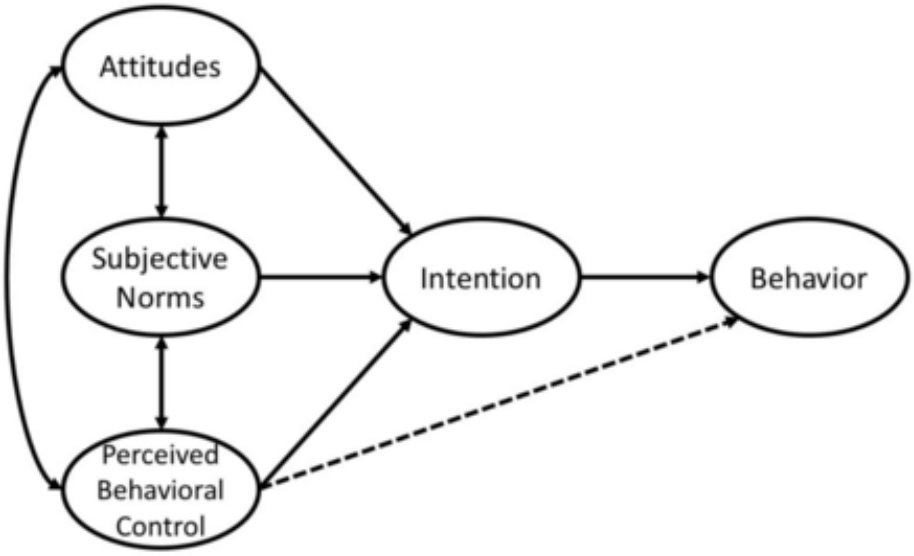


Figure A.1: Theory of Planned Behaviour by Ajzen (1991)

A.2. Unified Theory of Acceptance and Use of Technology model

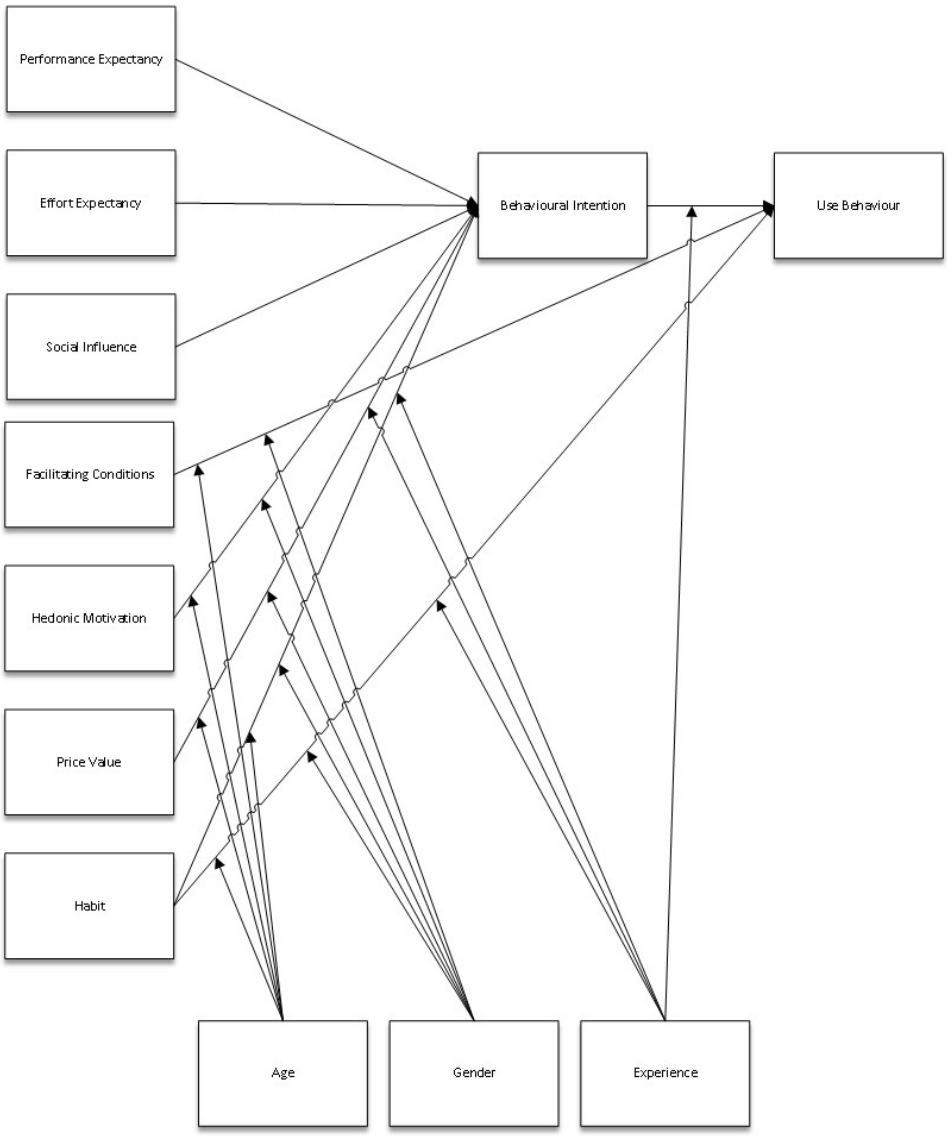


Figure A.2: UTAUT 2 from Marikyan & Papagiannidis (2023)

A.3. COM-B model

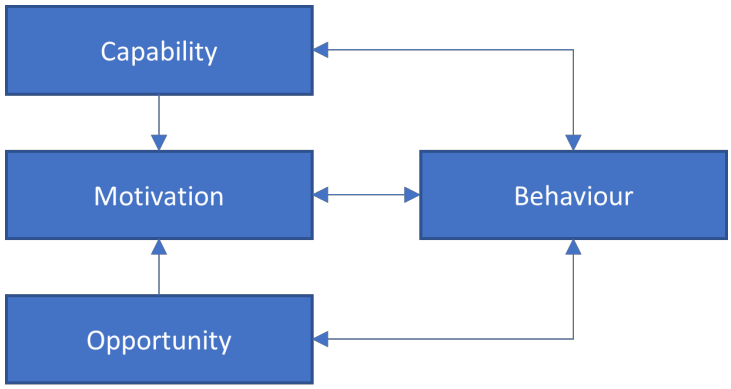


Figure A.3: COM-B model from Michie et al. (2011)

A.4. Michie framework

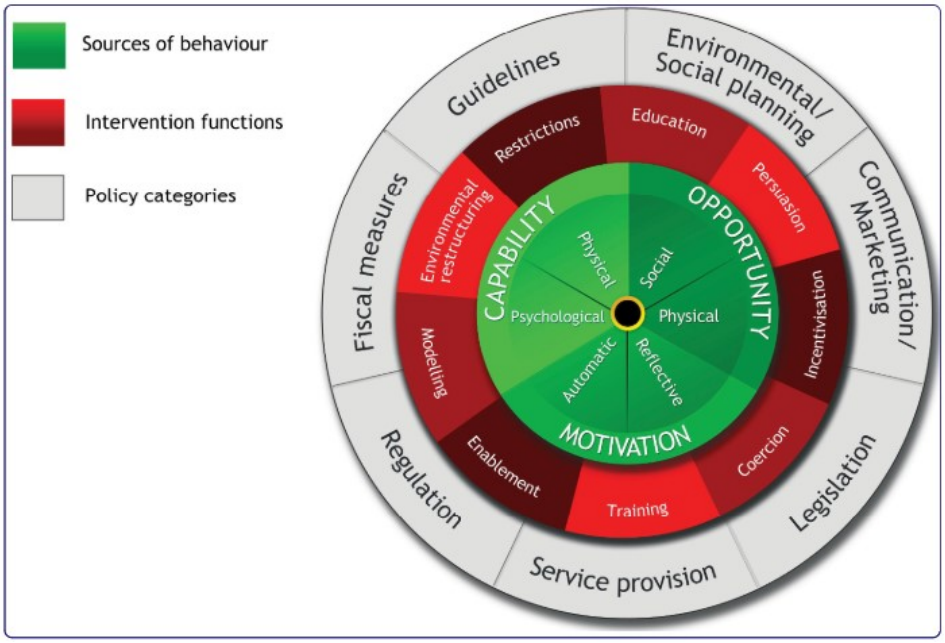


Figure A.4: Behavioural Wheel of Michie et al. (2011)

B

Current projects

B.1. Stakeholders

The main users in the system, and which have influence on the system are shown in Figure B.1:

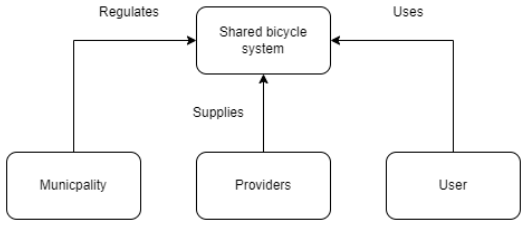


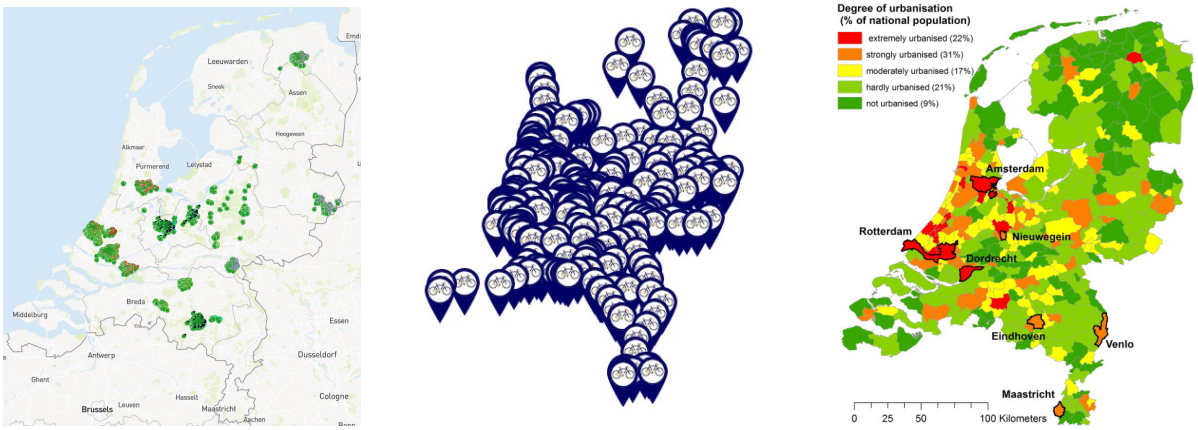
Figure B.1: Simplified stakholder map

The municipality is able to regulate and let people into the system. The providers are the ones supplying the mobility modes, and the user needs to be able to use them. The collaboration between these people is of uppermost importance. In the system there could be more people involved, the goal is to by talking to the municipality, supplier, and users, this framework can be expanded.

B.2. Supply in the Netherlands

There are a lot of different providers active in the Netherlands, on the Dashboard of CROW (2023) it shows 15 different providers, but not all providers have the same size. For example '*uwdeelfiets*' has 8 bikes in total, while *'DonkeyRepublic'* has almost two thousand bikes. CROW (2023) developed a Dashboard for shared mobility. This dashboard shows the different providers and their offers.

Figure B.2 shows the current supply of public transport bikes, the supply of other shared bicycles by CROW (2023), and the urbanisation degree in the Netherlands. For the shared mobility modes availability also e-bikes are included in the Dashboard. The total supply of shared bicycles is therefore lower than shown in the pictures.



(a) Availability shared (e-) bicycles (CROW, 2023)

(b) Public transport availability (ovfietsbeschikbaarheid, 2023)

(c) Urbanity in the Netherlands (Vanham et al., 2016)

Figure B.2: Supply in the Netherlands and Urbanisation degree

The demand for the ov-bike is quite diverse. The annual report of the NS (2022a) showed that there is an increase in bicycles and demand:

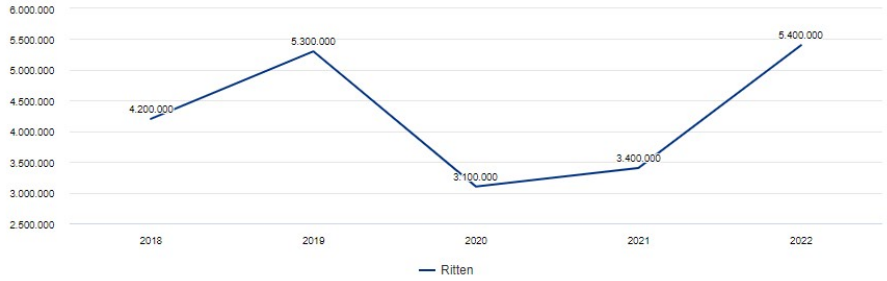


Figure B.3: Ov-bike demand (NS, 2022)

It showed that the demand for ov-bikes has increased in the past years, and is even higher than in 2019. This can show that more people started to use the ov-bike. It can be caused by the introduction of the smart lock in 2022 and the introduction of the electric bicycle (NS, 2022a). At the end of 2022, the ov-bike was rented more than 35 million times as stated on the NS (2022b) website, and most of the users use the bicycle to finish their trip or chain journey. The NS also tries to work together more with shared mobility providers (e.g. Check, GreenWheels, Tier) (NS, 2022b). NS tries to stimulate going to the station by bike, by working together with Prorail and the Ministery of Infrastructure and Water Management, to facilitate better facilities for the bicycle (parking) (NS, 2022a, p. 47)

B.3. Pilots

Three pilots were selected, which could be found in the Netherlands. Amsterdam and Delft can be scaled under the CBS category: extremely urbanised, Amersfoort under highly urbanised.

B.3.1. Pilot Amsterdam (Gemeente Amsterdam, 2022)

The following information and conclusions are from the report of Gemeente Amsterdam (2022). The current pilot by Gemeente Amsterdam (2022) showed that two groups were targeted who could be interested in shared bicycle use: the commuters and the local 'Amsterdammer'. Mostly for the frequent visitor (e.g. the commuter) the system could 'have added value' (translation p.17). A concern, mentioned in the report of their pilot, was if owning one or more bicycles could have an influence on using a shared bicycle system and

what the added value of the system would be.

Since the summer of 2021, Amsterdam is conducting pilots with different systems such as the cargo bike and the shared bicycle. The main goal of these systems and where they could have added value are: 'door-to-door trips, PT use, reducing car trips, and decreasing bicycle parking pressure in the city' (translation p.17).

In Amsterdam, the pilot started with three suppliers of (cargo) bicycles. Cargoroo (for cargo bikes), Donkey Republic, and GoAbout. Not long after GoAbout withdrew from the pilot experiment. In the summer of 2022 Donkey Republic took over the areas of GoAbout. In Amsterdam the system of back-to-many is used, the goal of implementing this system instead of many-to-many is to decrease the nuisance. Since the pilot happened during COVID-19, not all goals of the pilot could be tested.

Some of the main findings from the pilot:

- On average, a shared bicycle is used 0.5 times a day. The time used is quite high, with 246 minutes. An explanation given by the municipality is that the respondents mostly do not live in Amsterdam. This concludes that the user groups are mostly tourists, people who are in Amsterdam for a day, or expats. The targeted audience of commuters and locals are thus not addressed by a sharing system.
- The use of a shared bicycle is per user three times a month. 13% of the of the surveyed give as a reason for use, the connection with PT. 15% the decrease of walking and 16% the shorter travel time. From this, the conclusion that shared bicycles are a substitute for walking, can be emphasized. The small number of use per month may indicate occasional use, instead of commuting travel, which was a goal of the municipality.
- 11% of the respondents would have used their car to travel if the shared bicycle was not available.
- In the survey, 12% of the respondents gave as the reason of use, the possibility of not having to own their own vehicle. This aligns with that the current generation that wants to use but does not have to own mentioned before.
- The pilot also concludes that more than 73% of the respondents would have walked (42%) or taken PT (31%) if the bicycle would not have been available.
- The ownership of vehicles was also investigated. People did respond they would have decreased their vehicle ownership, but to which transport mode this refers is not clear (p.21).

A limitation of the study was the duration, mainly due to the withdrawal of one of the suppliers. The pilot has been extended, to get more insight into the current users and the influence of the shared system on the set targets.

B.3.2. Pilot Amersfoort (Gemeente Amersfoort, 2023)

The pilot for shared bicycles in Amersfoort started at the end of 2021. During this time, five suppliers were active with a total of 1.200 shared scooters and bicycles. In 2023 this is decreased to three suppliers with a maximum of 300 bicycles.

The municipality of Amersfoort concluded a few things from the pilot, which was both for scooters as for the influence of shared bicycles:

- In general people are satisfied with the shared vehicle use.
- The car is left at home in 50% of the cases due to the possibility to take a scooter. The influence of the bicycle in this is not mentioned. The urge to use the car decreased by 40% due to the availability of shared mobility modes.
- The introduction of shared scooters and bicycles has an influence on people their PT use. The respondents to the survey concluded that they walk and bicycle less, and use shared mobility more in connection to PT.
- The high number of suppliers at the beginning of the pilot had a negative influence on the use of the shared mobility modes.
- The user of the systems, were 60% younger than 28 years old.

- The border of the service area affects trip duration. The borders are established by the provider and are influenced by the use in a certain area and the number of permitted vehicles. The vehicles are not available in every part of Amersfoort, and the consequence of this is, that often the bicycles are parked at the borders of the service area. Some locations are excluded from the service area or are limited to a certain area.
- The pilot started as a free-floating principle, but has some restrictions since April 2022. In some areas the number of wrongly parked bicycles was high, therefore some areas got designated fixed parking spaces.
- In Amersfoort the number of bicycles decreased in comparison the the number of scooters in 2022 (p.13).
- In the summer months the use of shared bicycles is higher. Also, the availability in surrounding municipalities or areas has an influence on bicycle use.
- The suppliers indicated that the number of trips was relatively low in Amersfoort. This could be caused due to demographic factors of the population or the high amount of suppliers active in the city.
- The travel motives of the users are time savings (93%), unavailability of own scooter (78%), and fun (73%). These reasons are mostly focused on the scooter, which further proves that the scooter is more known and used in Amersfoort.
- In the AmersfoortPanel 90% of the respondents has filled in that they never used a shared scooter or bicycle. Different reasons influence this choice (p. 15): 88% is due to their own ownership, 34% is due to the bad reputation of the mode, 11% does not want to make the effort to find out how to use it, 10% does not use it due to the price.
- Knowledge and being a user or not has an influence on your perception of sharing. Users see more advantages of shared systems than non-users. Some of the main mentioned advantages are related to sustainability and the mode being an alternative to PT. The disadvantages are related to parking problems and less movement of the user.
- From the panel, people responded to be open to walking a maximum of 200 to 300 meters to an available vehicle. A high percentage of the respondents of the AmersfoortPanel would want designated places for the shared modes.
- From the people owning a car, almost none of the respondents is open to getting rid of their own car. 50% of the users leave their car at home due to the availability of the scooter. The bicycle does not have this same effect.
- Most of the respondents do not combine shared scooter or bicycle use with another transport mode. The scooter and bicycle are in most cases a substitute for the own bicycle or walking.

B.3.3. Pilot Delft (Boor et al., 2019)

Research from Delft from the period of 28th of May until 10th of October was collected. The following can be concluded from the study:

- Data collection was hard. The researchers collected their own, since the provider of the shared mobility: Mobike, did not share their data voluntarily. An in-house data collection was done in consultation with the provider.
- In Delft in general, 1.6 times a day, a trip is made with a bicycle.
- From research could be concluded that docked bicycle systems generate more trips, than free-floating systems.
- Most of the trips were to or from the TU Delft Campus. This concludes that most users are students.
- From unused Mobikes, 80% is located in residential areas.
- Shared bicycles are mostly interesting for the 'second bike', which is located at the station for people who use public transport.

The research shows that most students used shared bicycles in this time period. In 2023, the municipality of Delft only issued licenses for electric bikes and shared scooters (Gemeente Delft, 2023), and the Mobike has disappeared.

C

Mobycon panel data and general information panel data

C.1. Questions panel data - Dutch

- Wat is uw netto maandelijks huishoudinkomen? [Minder dan € 1.000; € 1.000 tot € 2.500; € 2.500 tot € 5.000; € 5.000 of meer; Zeg ik liever niet]
- Wat is uw netto maandelijks huishoudinkomen?
- Wat is uw belangrijkste dagelijkse bezigheid? [Betaald werk (full-time); Betaald werk (parttime); Gepensioneerd; Parttime werken; Studerend; Schoolgaand; Niet van toepassing]
- Wat zijn de eerste vier cijfers van uw postcode?
- Onder welke voorwaarden zou u gebruik willen maken van deelmobiliteit?
  - Meerdere antwoorden mogelijk Ik zou onder geen voorwaarden gebruik willen maken van deelmobiliteit.
  - Meerdere antwoorden mogelijk Als ik de zekerheid heb dat er altijd een voertuig beschikbaar is.
  - Meerdere antwoorden mogelijk Als ik kan reserveren.
  - Meerdere antwoorden mogelijk Als er een fysiek aanspreekpunt is om te helpen bij vragen.
  - Meerdere antwoorden mogelijk Als het voertuig duurzaam is (bijv. rijden op elektriciteit of waterstof).
  - Meerdere antwoorden mogelijk Als het voertuig binnen 400 meter van mijn vertreklocatie staat.
  - Meerdere antwoorden mogelijk Als ik er ook zonder smartphone gebruik van kan maken.
  - Meerdere antwoorden mogelijk Als er één overkoepelende app bestaat in plaats van allemaal losse apps.
  - Meerdere antwoorden mogelijk Als het gemakkelijk is om van deelmobiliteit over te stappen op een andere manier van vervoer, zoals openbaar vervoer of een andere vorm van deelmobiliteit.
  - Meerdere antwoorden mogelijk Als er bij het ophaal/afgeefpunt ook andere voorzieningen aanwezig zijn zoals een pakketafhaalpunt, supermarkt, snackbar, wc etc.
  - Meerdere antwoorden mogelijk Als ik het voertuig overal kan parkeren.

  - Meerdere antwoorden mogelijk Als ik ook buiten de gemeentegrenzen met het voertuig kan reizen.
  - Meerdere antwoorden mogelijk Als de voertuigen ruim verspreid beschikbaar zijn, dus ook in buitengebieden.
  - Meerdere antwoorden mogelijk Ik bent sneller op locatie met een combinatie van openbaar vervoer deelmobiliteit dan met de auto.
  - Meerdere antwoorden mogelijk Ik zou onder geen voorwaarden gebruik willen maken van deelmobiliteit.

- In hoeverre bent u bekend met onderstaande vormen van deelmobiliteit? / (elektrische) Deelfiets (zoals openbaar vervoer-fiets, Donkey Republic en Bondi) [Ik heb ervaring in het gebruik ervan; Ik gebruik het niet maar ken het wel; Wel eens van gehoord, maar precies weet ik het niet; Ik ken het niet]
- Hoe vaak gebruikt u ze? / Fiets [Elke dag; Een paar keer per week; Een paar keer per maand; Een paar keer per jaar; Zelden]
- In hoeverre overweegt u de volgende vormen van deelmobiliteit te gebruiken? / Deelfietsen [Heel erg geïnteresseerd; Geïnteresseerd; Neutraal; Niet geïnteresseerd; Helemaal niet geïnteresseerd; Weet ik niet]
- Wat is uw geslacht? [M; F]
- Welke van de volgende voertuigen heeft u ter beschikking? [Vehicle] [nummer]

C.2. Output open answer questions

When asked what were the most important problems from the past time and future, the following top 3 were given:

1. Prices for gas
2. High prices for public transport
3. Dangerous driving in living areas.

In the open answers problems such as 'none' and answers related to Public Transport, such as lack of time-saving, crowded trains and lack of good connections were given. The 23 open answers can be found in Appendix C.1.

C.2.1. Most urgent problems

In the panel data 23 people left an open answer, by selecting the option "other". The outcome of these variables are printed in Table C.1. Most of the answers are related to not having anything that is an urgent problem. The next three options are related to public traffic. They connection within public transport, the time it saves to go by car, and the overcrowded trains are seen as problems by the respondents in the data.

Table C.1: Most urgent problems - open answers

Most urgent problems - open answer	
None	7
Time in PT (in comparison to the car)	3
Connection PT (train and bus)	2
Too crowded train	1
Distance mall / outside areas	1
Traffic enforcement	1
Easiness of the car	1
Fresh air	1
Lack of government interventions	1
Public space (charging stations)	1
Public space (Infrastructure)	1
Unsafe road users	1

In the table the answers to the open answers are given on the question "... -xxx". Of the 23 open responses, seven were related to not having any issues.

C.3. Codes for variables

Table C.2: Codes of variables in SPSS

Question	Level	Code
Gender	Binary	0: Women 1: Men
Urbanisation	Ordinal	1: Extremely urbanised 2: Strongly urbanised 3: Moderately urbanised 4: Hardly urbanised 5: Non-urbanised
Age	Ordinal	0: Do not want to say 1: 16 - 25 years 2: 26 - 35 years 3: 36 - 50 years 4: 51 - 65 years 5: 66 years and older
Income	Ordinal	0: Do not want to say 1: Less than 1000 euro 2: Between 1000 - 2500 euro 3: Between 2500 - 5000 euro 4: 5000 euro or more
Availability [vehicle]	Binary	0: zero vehicles 1: 1 or more *this variable was recoded by the author to 2 groups*
Bicycle usage	Ordinal	Rarely or never a few times a year a few times a month a few times a week Daily
Knowledge about [vehicle] sharing	Ordinal	1: I do not know the concept 2: I heard of it, but I do not know precisely 3: I do not use it, but I do know it 4: I have experience in using the concept
Openness to using [Vehicle]	Ordinal	0: I do not know 1: Not interested at all 2: Not interested 3: Neutral 4: Interested 5: Very interested
Conditions use	Nominal	1-14

C.4. General descriptive results

Some of the panel data results are not focused on the socio-demographic characteristics but are still interesting to mention. These insights are given in the subsections below. In the panel data, people could choose on a scale from one to five, which of two aspects they thought were most important to them. The four aspects they could choose from:

- Sustainability
- Safety
- Accessibility
- Affordability

When putting these variables against each other, the following order was created from least important to most important:

$Sustainability \Longrightarrow Accessibility \Longrightarrow Affordability \Longrightarrow Safety.$

As can be concluded from the scaling, sustainability is a less common answer or the main concern of the panel data respondents. Safety was seen as one of the most important factors. When developing a sharing bicycle system, these rankings should be taken into account.

D

CBS

D.1. CBS urbanisation density

Table D.1: CBS Urbanisation data

Degree of urbanisation	Number / km2	Code in dataset
Extremely urbanised	2500 addresses / km^2	1
Strongly urbanised	1500 - 2500 addresses / km^2	2
Moderately urbanised	1000 - 1500 addresses/ km^2	3
Hardly urbanised	500 - 1000 addresses / km^2	4
Not urbanised	less than 500 addresses / km^2	5

D.2. CBS urbanisation grade

In Table D.2 the percentages are added by the author self. This is done by dividing the category by the total.

$$Share in the population = Part of total population / total population \tag{D.1}$$

Table D.2: Urbanisation level CBS

		2022	**%**	*Dutch*
The Netherlands	Extremely urbanised	4,325,370	24.6%	*Zeer sterk stedelijk*
	Strongly urbanised	4,380,260	24.9 %	*Sterk stedelijk*
	Moderately urbanised	2,976,730	16.9%	*Matig stedelijk*
	Hardly urbanised	2,960,170	16.8%	*Weinig stedelijk*
	Not urbanised	2,948,150	16.8%	*Niet stedelijk*
Total		17,590,680	100%	

D.3. Age distribution Netherlands

The calculation is done by the author self. The data is from the CBS database 'Bevolking op 1 januari en gemiddeld; geslacht, leeftijd en regio'. CBS, 2023

Table D.3: Age level CBS

		2022	**%**
The Netherlands	0 - 15 years	2,905,186	16%
	16 - 25 years	2,186,334	12%
	26 - 35 years	2,285,550	13%
	36 - 50 years	3,231,885	18%
	51 - 65 years	3,670,378	21%
	66 and older	3,338,148	19%

D.4. Income classes CBS

The calculation for percentages is done by the author. The data source is CBS, 2022, 'Inkomen van personen; inkomensklassen, persoonskenmerken'. The data is from 2020 since the data for 2021 and 2022 were not available yet.

Table D.4: Income classes CBS

		2022 ** 1000*	%	*Dutch*
The Netherlands	Less than 1000 euros	1873,50	14%	*Inkomen: minder dan 10.000*
	Between 1000 - 2500 euros	3204,20	41%	*Inkomen: 10.000 tot 20.000*
		2477,20		*Inkomen: 20.000 tot 30.000*
	Between 2500 - 5000 euros	2030,80	42%	*Inkomen: 30.000 tot 40.000*
		1502,50		*Inkomen 40.000 - 50.000*
		2289,00		*Inkomen: 50.000 - 100.000*
	More than 5000 euros	370,90	3%	*Inkomen: 100.000 tot 200.000*
		57.70		*Inkomen: 200.000 euro of meer*

E

Output Chapter 5

E.1. General recap

The variables selected from the developed theoretical framework are the following:

- Age
- Gender
- Vehicle ownership
- Frequency of travel
- Income
- Sharing perception/knowledge about sharing
- Urbanisation

E.2. Crosstabs from data

In this chapter all cross-tabs on the weighted data is shown. Some of the chisquare tests have a expected count of less than 5. Normally this occurs when cells contain too few cases. A solution to this can be combining cells. This is done by combing 'very interested' and 'interested' into the new variable '(very) interested'.

E.2.1. Age

Table E.1: Crosstable of age and openness to shared bicycles

		Openness to use shared bicycles					
Age		**I do not know**	**Not interested, at all**	**Not interested**	**Neutral**	**(Very) Interested**	% of total
Do not want to say	Count	2	3	0	1	0	6
	% within use	33.3%	50.0%	0.0%	16.7%	0.0%	0.4%
16 to 25 years	Count	12	54	45	74	46	231
	% within use	5.2%	23.4%	19.5%	32.0%	19.9%	14.7%
26 to 35 years	Count	10	72	72	48	38	240
	% within use	4.2%	30.0%	30.0%	20.0%	15.8%	15.4%
36 to 50 years	Count	21	120	99	72	36	348
	% within use	6.0%	34.5%	28.4%	20.7%	10.3%	22.3%
51 to 65 years	Count	18	187	80	54	24	363
	% within use	5.0%	51.5%	22.0%	14.9%	6.6%	23.3%
65 years and older	Count	17	197	103	40	15	372
	% within use	4.6%	53.0%	27.7%	10.8%	4.0%	23.8%

Table E.2: Chisquare test gender (Table E.3)

	Value	**df**	**Asymptotic sign.**
Pearson chisquare	158.967	20	<.001
Likelihood ratio	155.181	20	<.001
Linear-by-Linear association	97.315	1	<.001

5 cells (16.7%) have expected count less than 5. The minimum expected count is 0.31. This warning message is based on the assumption of the chi-square test, which states that the expected count for each cell should be at least 5 for the test results to be reliable. Due to the low count, the validity of the chi-square test can lead to inaccurate conclusions.

From the table can be concluded that the highest percentage in age groups are in the group *not interested at all.*

E.2.2. Gender

Table E.3: Crosstab Gender and Openness

		Openness to use shared bicycles					
Gender		**I do not know**	**Not interested, at all**	**Not interested**	**Neutral**	**(Very)Interested**	% of total
Women	Count	51	309	209	145	77	791
	% within use	6.4%	39.1%	26.4%	18.3%	9.7%	50.7%
Men	Count	30	324	190	143	83	770
	% within use	3.9%	42.1%	24.7%	18.6%	10.8	49.3%

Table E.4: Chisquare test gender (Table E.3)

	Value	df	Asymptotic sign.
Pearson chisquare	6.662	4	0.155
Likelihood ratio	6.724	4	0.151
Linear-by-Linear association	.638	1	.424

0 cells have expected count less than 5. The minimum expected count is 39.96

E.2.3. Vehicle ownership

Table E.5: Crosstab of vehicle ownership and openness

		Openness to use shared bicycles					
Availability vehicle		**I do not know**	**Not interested, at all**	**Not interested**	**Neutral**	**(Very) Interested**	% of total
One or more bicycles	Count	48	391	301	226	133	1101
	% within use	4.4%	35.5%	27.4%	20.5%	12.1%	70.5%
No bicycle in household	Count	32	242	98	62	26	460
	% within use	7.0%	52.6%	21.3%	13.5%	5.7%	29.5%
One or more cars	Count	56	505	345	226	110	1242
	% within use	4.5%	40.7%	27.8%	18.2%	8.9%	79.5%
No cars in household	Count	25	128	55	62	49	320
	% within use	7.8%	40.0%	17.2%	19.4%	15.4%	20.5%

Table E.6: Chisquare test car ownership (Table E.10)

	Value	df	Asymptotic sign.
Pearson chisquare	27.183	4	<.001
Likelihood ratio	26.691	4	<.001
Linear-by-Linear association	1.407	1	.236

0 (0.0%) cell in car ownership have expected count less than 5. The minimum expected count is 16.55

Table E.7: Chisquare test bike ownership (Table E.10)

	Value	df	Asymptotic sign.
Pearson chisquare	54.280	4	<.001
Likelihood ratio	55.245	4	<.001
Linear-by-Linear association	48.542	1	<.001

0 cells (0.0%) have expected count less than 5 for bicycle ownership. The minimum expected count is 23.59.

E.2.4. Frequency of travel

In Table E.8 the travel frequency and the openness to using is compared in a cross table.

Table E.8: Crosstable of use bicycle and openness

		Openness to use shared bicycles					
Frequency of travel by bicycle		**I do not know**	**Not interested, at all**	**Not interested**	**Neutral**	**(Very) Interested**	% of total
Rarely or never	Count	31	255	112	57	12	467
	% within use	6.6%	54.6%	24.0%	12.2%	2.6%	29.9%
A few times a year	Count	3	47	24	25	5	104
	% within use	2.9%	45.2%	23.1%	24.0%	4.8%	6.7%
A few times a month	Count	11	72	50	30	17	180
	% within use	6.1%	40.0%	27.8%	16.7%	9.4%	11.5%
A few times a week	Count	18	153	127	96	54	447
	% within use	4.0%	34.2%	28.3%	21.4%	12.1%	28.3%
Daily	Count	18	107	87	80	72	364
	% within use	4.9%	29.4%	23.9%	22.0%	19.8%	23.3%

From the table can be concluded that a big group is not interested at all or not interested. The percentage of people who are open to using a shared bike are highest in the group who use the bicycle daily.

Table E.9: Chisquare test income (Table E.10)

	Value	**df**	**Asymptotic sign.**
Pearson chisquare	126.599	16	<.001
Likelihood ratio	132.109	16	<.001
Linear-by-Linear association	101.383	1	<.001

From the chi-square test can be concluded that the relation is significant. *0 cells (0.0%) have expected count less than 5.* The minimum expected count is 5.40.

E.2.5. Income

The cross tab of income with openness to sharing:

Table E.10: Income and openness to sharing

		Openness to use shared bicycles					
Income		**I do not know**	**Not interested, at all**	**Not interested**	**Neutral**	**(Very) Interested**	% of total
I do not want to say	Count	26	114	77	51	12	280
	% within use	9.3%	40.7%	27.5%	18.2%	4.3%	17.9%
Less than 1000 euros	Count	12	17	13	22	14	78
	% within use	15.4%	21.8%	16.7%	28.2%	17.9%	5.0%
Between 1000 - 2500 euro	Count	24	199	107	97	50	477
	% within use	5.0%	41.7%	22.4%	20.3%	10.5%	30.5%
2500 - 5000 euro	Count	15	254	167	106	64	606
	% within use	2.5%	41.9%	27.6%	17.5%	10.6%	38.8%
5000 euros and more	Count	4	50	36	13	19	122
	% within use	3.3%	41.0%	29.5%	10.7%	15.6%	7.8%

Table E.11: Chisquare test income (Table E.10)

	Value	df	Asymptotic sign.
Pearson chisquare	74.807	16	<.001
Likelihood ratio	73.011	16	<.001
Linear-by-Linear association	6.725	1	.010

1 cell have expected count less than 5. The minimum expected count is 4.04

E.2.6. Knowledge about sharing

Table E.12: Crosstable of knowledge and openness

		Openness to use shared bicycles					
Knowledge about sharing		**I do not know**	**Not interested, at all**	**Not interested**	**Neutral**	**(Very) Interested**	% of total
I do not know the concept	Count	57	236	118	58	24	493
	% within use	11.6%	47.9%	23.9%	11.8%	5.6%	31.6%
Heard of it once, but don't know exactly	Count	9	196	129	68	24	426
	% within use	2.1%	46.0%	30.3%	16.0%	5.6%	27.3%
I do not use it, but I know it	Count	12	196	144	137	67	557
	% within use	2.2%	35.3%	25.9%	24.6%	12.1%	35.6%
I have experience in using it	Count	1	5	9	26	44	85
	% within use	1.2%	5.9%	10.6%	30.6%	51.8%	5.5%

Table E.13: Chisquare test knowledge (Table E.12)

	Value	df	Asymptotic sign.
Pearson chisquare	310.546	12	<.001
Likelihood ratio	254.262	12	<.001
Linear-by-Linear association	178.881	1	<.001

1 cell (5.0%) has expected count less than 5. The minimum expected count is 4.30.

E.2.7. Urbanisation

In this section urbanism is crossed with openness to use shared bicycles. From Table E.14 can be concluded that people who live in Very high urban areas are more likely to be open to using shared bicycles.

Table E.14: Cross table of urbanism and openness

		Openness to use shared bicycles					
Urbanisation		**I do not know**	**Not interested, at all**	**Not interested**	**Neutral**	**(Very) Interested**	% of total
Extremely urbanised	Count	12	120	64	59	53	308
	% within use	3.9%	39.0%	20.8%	19.2%	17.2%	21.6%
Strongly urbanised	Count	17	180	106	74	38	415
	% within use	4.1%	43.4%	25.5%	17.8%	9.2%	29.1%
Moderately urbanised	Count	16	93	86	47	30	272
	% within use	5.9%	34.2%	31.6%	17.3%	11.0%	19.0%
Hardly urbanised	Count	12	109	71	37	15	244
	% within use	4.9%	44.7%	29.1%	15.2%	6.1%	17.1%
Non-urbanised	Count	12	89	49	28	8	186
	% within use	6.5%	47.8%	26.3%	15.1%	4.3%	13.1%

Table E.15: Chisquare test Urbanism (Table E.14)

	Value	**df**	**Asymptotic sign.**
Pearson chisquare	44.495	16	<.001
Likelihood ratio	44.324	16	<.001
Linear-by-Linear association	19.491	1	<.001

0 cells (0.0%) have expected count less than 5. The minimum expected count is 9.01.

E.3. Correlation

Table E.16: Correlation matrix

		Spearman's rho – Correlation							
		Openness to use shared bicycle	Age	Availability car	Availability bike	Use bicycle	Income	Knowledge shared bicycle	Urbanism
Openness to use shared bicycle	Correlaction coefficient	1.000	-.229**	-.026	.167**	.238**	.066**	.316**	-.110**
	Sig. (2-tailed)		*<.001*	*.311*	*<.001*	*<.001*	*.009*	*<.001*	*<.001*
	N	1559	1559	1559	1559	1559	1559	1559	1430
Age	Correlaction coefficient		1.000	.020	-204**	-.182**	-.062*	-.143**	.040
	Sig. (2-tailed)			.430	<.001	<.001	.013	<.001	.131
	N			1574	1574	1574	1574	1559	1443
Availability car	Correlaction coefficient			1.00	.085**	-.049	.192	-.019	.199**
	Sig. (2-tailed)				<.001	.053	<.001	.445	<.001
	N				1574	1574	1574	1559	1443
Availability bike	Correlaction coefficient				1.00	.563**	.078**	.081**	-.030
	Sig. (2-tailed)					<.001	.002	.001	.253
	N					1574	1574	1559	1443
Use bicycle	Correlaction coefficient					1.000	.046	.141**	-.080**
	Sig. (2-tailed)						.070	<.001	.002
	N						1574	1559	1443
Income	Correlaction coefficient						1.000	.108**	.037
	Sig. (2-tailed)							<.001	.158
	N							1559	1443
Knowledge shared bicycle	Correlaction coefficient							1.000	-.094**
	Sig. (2-tailed)								<.001
	N								1430
Urbanism	Correlaction coefficient								1.000
	Sig. (2-tailed)								
	N								

E.4. Non-parametric tests

A non-parametric test is conducted with variables that are not distributed on a normal distribution. Ordinal or nominal variables are often not distributed normal, since they do not have a more qualitative undertone. In this section, the Kruskall test and Mann-Witney U test are executed. These tests are based on the assumption that the sample is an independent sample.

All variables are tested against openness to sharing since this is the main goal of being open. In this section two null hypotheses are tested with the analyses methods:

1. The median of the *openness to using shared bicycles* are the same across categories of *[variable]*.
2. The distribution of *openness to using shared bicycles* is the same across categories of *[variable]*.

The null-hypotheses is rejected when the *p-value* is below the threshold of α 0.05. The test used is or the Independent-sample Mann-Whitney U test or Kruskall-Wallis, which depends on the number of categories in the group. The median-test will be used to compare the medians within groups.

Table E.17: Outcome of non-parametric tests

	Hypotheses summary				
Variable	**Test**	**Mann-Whitney**	**Kruskall-Walis**	**Sign.**	**Decision**
Availability bicycle	Independent-Samples Mann-Whitney U test	300633.000		<.001	Reject the null hypotheses. There is a difference in distribution across categories.
Availability car	Independent-Samples Mann-Whitney U test	172894.500		.520	Retain the null hypotheses. There is a no difference in distribution across categories.
Urbanity	Independent-Samples Kruskal-Wallis test		21.921	<.001	Reject the null hypotheses. There is a difference in distribution across categories.
Age	Independent-Samples Kruskal-Wallis test		95.170	.000	Reject the null hypotheses. There is a difference in distribution across categories.
Use bicycle	Independent-Samples Kruskal-Wallis test		92.080	.000	Reject the null hypotheses. There is a difference in distribution across categories.
Income	Independent-Samples Kruskal-Wallis test		13.978	.007	Reject the null hypotheses. There is a difference in distribution across categories.

E.4.1. Outcome Urbanity

Table E.18: Kruskal-Wallis for Urbanity

Independent Sample Kruskal-Wallis Test				
Sample 1	**Sample 2**	**Test statistic**	**Sign.**	**Adj. Sign.**
Non-urbanised	Extremely urbanised	51.508	.175	1.000
Non-urbanised	Strongly urbanised	97.051	.005	.046
Non-urbanised	Moderately urbanised	117.936	.001	.015
Non-urbanised	Hardly urbanised	153.886	<.001	.000
Extremely urbanised	Strongly urbanised	45.544	.150	1.000
Extremely urbanised	Moderately urbanised	66.428	.056	.559
Extremely urbanised	Hardly urbanised	102.378	.002	.024
Strongly urbanised	Moderately urbanised	-20.885	.496	1.000
Strongly urbanised	Hardly urbanised	56.834	.054	.540
Moderately urbanised	Hardly urbanised	35.950	.273	1.000

From literature it would be expected that the Kruskal-Wallis test would also give a significant difference between hardly urbanised and Moderately urbanised, but this relation is significant. The relation between non-urbanised and hardly urbanised is the only relation non significant for non-urbanised.

E.4.2. Outcome age

Table E.19: Kruskal-Wallis Test Age

Independent Kruskal-Wallis Test				
Sample 1	**Sample 2**	**Test statistic**	**Sign.**	**Adj. Sign.**
Do not want to say	66 years and older	-239.878	0.175	1.000
Do not want to say	51 to 65 years	-272.233	0.122	1.000
Do not want to say	36 to 50 years	-393.241	.026	.390
Do not want to say	26 to 35 years	-457.017	.010	.146
Do not want to say	16 to 25 years	-549.241	.002	.031
66 years and older	51 to 65 years	32.355	.312	1.000
66 years and older	36 to 50 years	153.363	<.001	.000
66 years and older	26 to 35 years	217.139	<.001	.000
66 years and older	16 to 25 years	309.362	<.001	.000
51 to 65 years	36 to 50 years	121.008	<.001	.001
51 to 65 years	26 to 35 years	184.784	<.001	.000
51 to 65 years	16 to 25 years	277.007	<.001	.000
36 to 50 years	26 to 35 years	63.776	.059	.884
36 to 50 years	16 to 25 years	155.999	<.001	.002
26 to 35 years	16 to 25 years	92.224	.027	.412

The Kruskal-Wallis test for age shows that the relation of the group *16 to 25 year* is only not significant with the group of *26 to 35 years old.* The median of the groups of *16 to 25 years* also have a higher median than the other groups (of neutral).

E.4.3. Income

Table E.20: Kruskal-Wallis Test income

Independent Kruskal-Wallis Test				
Sample 1	**Sample 2**	**Test statistic**	**Sign.**	**Adj. Sign.**
Do not want to say	Between 1000 - 2500	-84.392	.010	.100
Do not want to say	Between 5000 and more	-103.850	.025	.247
Do not want to say	Between 2500 - 5000	-106.767	<.001	.007
Do not want to say	Less than 1000	-152.350	.009	.089
Between 1000 - 2500	Between 5000 and more	-19.458	.649	1.000
Between 1000 - 2500	Between 2500 - 5000	-22.375	.391	1.000
Between 1000 - 2500	Less than 1000	67.958	.221	1.000
Between 5000 and more	Between 2500 - 5000	2.917	.944	1.000
Between 5000 and more	Less than 1000	48.501	.452	1.000
Between 2500 - 5000	Less than 1000	45.583	.406	1.000

The only adjusted significant group is the relation between *the group of '2500 - 5000 euros'* and *the group of 'Do not want to say'*. The other groups do not have a different distribution in their group after the Bonferroni correction.

E.4.4. Bicycle usage

Table E.21: Kruskal-Wallis Test frequency of bicycle use

Independent Kruskal-Wallis Test				
Sample 1	**Sample 2**	**Test statistic**	**Sign.**	**Adj. Sign.**
Rarely or never	A few times a year	-126.365	.007	.067
Rarely or never	A few times a month	-140.258	<.001	.001
Rarely or never	A few times a week	-210.803	<.001	.001
Rarely or never	Daily	-268.714	.000	.000
A few times a year	A few times a month	-13.893	.790	1.000
A few times a year	A few times a week	-84.438	.070	.701
A few times a year	Daily	-142.349	.003	.029
A few times a month	A few times a week	-70.545	.056	.556
A few times a month	Daily	128.456	<.001	.008
A few times a week	Daily	-57.911	.056	.565

F

Logistic Linear Regression Models

In this chapter, the Generalized Linear Model (GENLIN) is explained and the multinomial logistic regression (NOMREG). In this model, the assumption of parallel lines is not taken into account.

F.1. Generalised Linear Model output

Table F.1: Case processing summary

	N	**Percent**	Unweighted N
Included	1553	91.0%	1430
Exluded	154	9.0%	144
Total	1707	100%	1574

In Table F.1 the summary of the data is given. The deletion of the variables is done, when data from other variables is missing.

Table F.2: Variable information dependent and factors

			N	%	Unweighted N
Dependent Variable	Openness to using a shared bicycle	I do not know	73	4,7%	68
		Not interested at all	664	42,8%	594
		Not interested	412	26,5%	381
		Neutral	255	16,4%	243
		(Very) Interested	149	9,6%	144
		Total	1553	100,0%	1430
Factor	Urbanisation	Extremely urbanised	336	21,6%	306
		Strongly urbanised	453	29,2%	421
		Moderately urban	291	18,7%	269
		Hardly urbanised	269	17,3%	243
		Non-urbanised	204	13,1%	191
		Total	1553	100,0%	1430
	Age	16 - 25 years	129	8,3%	129
		26 - 35 years	272	17,5%	272
		36 -50 years	315	20,3%	315
		51 - 65 years	430	27,7%	430
		66 years and older	407	26,2%	284
		Total	1553	100,0%	1430
	Gender	Women	832	53,6%	709
		Men	72	46,4%	721
		Total	1553	100,0%	1430
	Income	I do not want to say	250	16,1%	216
		Less than 1000 euro	59	3,8%	57
		Between 1000 - 2500 euro	495	31,9%	448
		Between 2500 - 5000 euros	626	40,3%	589
		5000 euros or more	123	7,9%	120
		Total	1553	100,0%	1430
	Knowledge about bike sharing	I do not know	502	32,3%	447
		Heard of it once, but don't know exactly	416	26,8%	384
		I do not use it, but I know it	554	35,7%	519
		I have experience in using it	81	5,2%	80
		Total	1553	100,0%	1430

Table F.3: Variable information covariates

		N	Minimum	Maximum	Mean	Std. Deviation	Unweighted N
Covariate	Availability bicycle	1553	0	7	1,08	1,045	1430
	Availability car	1553	0	7	1,0116	,69506	1430

In table F.2 and F.3 the variable information is given. The continuous variables are coded as covariates, while the nominal variables are coded as factors.

F.1.1. Goodness of fit

Table F.4: Goodness of fit for the MNL model

Goodness of fit			
	Value	**df**	**Value/df**
Deviance	3268,258	4386	,745
Pearson Chi-Square	5036,537	4386	1,148
Scaled Pearson Chi-Square	5036,537	4386	
Log Likelihoodb	-1789,351		
Akaike's Information Criterion (AIC)	3622,701		
Finite Sample Corrected AIC (AICC)	3623,363		
Bayesian Information Criterion (BIC)	3740,356		
Consistent AIC (CAIC)	3762,356		

Table F.4 indicates the Goodness of Fit of the model. The values are harder to interpret and depend on different factors. In general, a value / df close to 1, for the pearson chi-square indicate a good fit.

F.1.2. The Omnibus Test

Table F.5: Omnibus Test for Generalised ordinal regression

Omnibus test		
Likelihood ratio Chi-square	**df**	**Sign.**
305.708	18	0.000

Table F.5 shows a significant p-value. This statistic tests the overall fit of the model in comparison to the threshold-only model. A significant value indicates that the fit is significantly improved in comparison to the threshold model.

F.1.3. Test of model effects

In Table F.6 the model effects on the different predictors is shown. From this, it can be concluded that 'income', 'gender' and 'availability of a car' do not have a significant influence on the dependent variable ' openness to use'

Table F.6: Test of model effects

Tests of Model Effects			
	Wald Chi-Square	df	Sig.
Urbanisation	16,779	4	,002
Age	40,542	4	<,001
Gender	,291	1	,590
Income	1,420	4	,841
Knowledge shared bicycle	155,486	3	,000
Availability bicycle	18,483	1	<,001
Availability car	2,978	1	,084

F.1.4. Generalised ordinal regression

In Table F.7 the parameter estimates can be found. The tests are conducted in SPSS. From these outcomes the significance of different categories can be found.

Table F.7: Generalised Linear model outcome

Parameter		B	Std. Error	95% Wald Confidence Interval		Hypothesis Test	Hypothesis Test		Exp(B)	95% Wald Confidence Interval for Exp(B)	
				Lower	Upper	Wald Chi-Square	df	Sig.		Lower	Upper
Threshold	I do not know	-4,569	,3726	-5,300	-3,839	150,389	1	,000	,010	,005	,022
	Not interested at all	-1,468	,3587	-2,171	-,765	16,737	1	<,001	,230	,114	,466
	Not interested	-,148	,3589	-,851	,556	,169	1	,681	,863	,427	1,743
	Neutral	1,266	,3563	,567	1,964	12,617	1	<,001	3,545	1,763	7,126
Extremely Urbanised		,571	,1707	,236	,905	11,184	1	<,001	1,770	1,267	2,473
Strongly urbanised		,468	,1600	,154	,781	8,542	1	,003	1,596	1,167	2,184
Moderately urbanised		,643	,1724	,305	,981	13,908	1	<,001	1,902	1,357	2,666
Hardly urbanised		,332	,1756	-,012	,676	3,574	1	,059	1,394	,988	1,966
Non-urbanised		0a	.	.	.	.	.	.	1	.	.
16 - 25 years		1,027	,2007	,633	1,420	26,153	1	<,001	2,791	1,883	4,137
26 - 35 years		,685	,1530	,385	,985	20,039	1	<,001	1,984	1,470	2,677
36 - 50 years		,394	,1464	,107	,681	7,230	1	,007	1,483	1,113	1,975
51 - 65 years		,113	,1329	-,147	,374	,729	1	,393	1,120	,863	1,454
66 years and older		0a	.	.	.	.	.	.	1	.	.
Women		,053	,0977	-,139	,244	,291	1	,590	1,054	,870	1,277
Men		0a	.	.	.	.	.	.	1	.	.
Do not want to say		,063	,2133	-,355	,481	,087	1	,768	1,065	,701	1,618
Less than 1000		-,004	,3153	-,622	,614	,000	1	,989	,996	,537	1,847
Between 1000 - 2500 euro		,155	,1961	-,229	,539	,624	1	,430	1,168	,795	1,715
between 2500 - 5000 euro		,164	,1864	-,201	,530	,777	1	,378	1,179	,818	1,698
5000 euros and more		0a	.	.	.	.	.	.	1	.	.
I do not know the concept		-2,889	,2502	-3,380	-2,399	133,343	1	,000	,056	,034	,091
Heard of it once, but don't know exactly		-2,460	,2479	-2,946	-1,974	98,478	1	,000	,085	,053	,139
I do not use it, but I know it		-1,970	,2412	-2,442	-1,497	66,697	1	<,001	,139	,087	,224
I have experience in using it		0a	.	.	.	.	.	.	1	.	.
Availability bike		,207	,0481	,113	,301	18,483	1	<,001	1,230	1,119	1,351
Availability car		-,127	,0737	-,272	,017	2,978	1	,084	,881	,762	1,017
(Scale)		1b									

F.2. Multinomial logistic regression with 5 levels

In the multinomial logistic regression, the ordering of the dependent variable is not taken into account anymore. Every category is evaluated in comparison to the reference category.

F.2.1. Case processing summary

Table F.8: Summary MNL

		N	Marginal %
Openness to using a shared bicycle	I do not know	49	4,0%
	Not interested at all	503	41,4%
	Not interested	319	26,3%
	Neutral	210	17,3%
	(Very) Interested	133	11%
Knowledge about sharing	I do not know the concept	373	30,7%
	Heard of it once, but don't know exactly	318	26,2%
	I do not use it, but I know it	445	36,7%
	I have experience in using it	78	6,4%
Gender	Women	582	47,9%
	Men	632	52,1%
Valid		1214	100,0%
Missing		90	
Total		**1304**	

In Table F.8 the unweighted variables are shown.

F.2.2. Model fitting information

The model fitting information shows that the model has a significant value of p<.001. This means there is an improvement in the model in comparison to the model with no predictors.

Table F.9: Model fitting information

Model	Model Fitting Criteria	Likelihood Ratio Tests		
	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	3063,048			
Final	2720,031	343,017	36	<,001

Table F.10: Model fitting information

Goodness-of-Fit			
	Chi-Square	**df**	**Sig.**
Pearson	3567,674	3648	,826
Deviance	2457,563	3648	1,000

Both Table F.10 and Table F.9 show a good model fit. The chi-square test and deviation show an insignificant p-value, which shows a good model fit.

F.2.3. Pseudo R-square

The pseudo R-square is an adjustment on the R-square known from linear regression. This value gives an indication of how much variance can be explained by the preditors. Table F.11 shows an McFadden pseudo R-square of .105, which indicates that 10.5% of the variance can extra be explained.

Table F.11: Pseudo R-square of MNL

Pseudo R-Square	
Cox and Snell	,246
Nagelkerke	,262
McFadden	,102

F.2.4. Likelihood ratio test - new 5 levels

Table F.12: Significance of effects

Likelihood Ratio Tests				
Effect	**Model Fitting Criteria**	**Likelihood Ratio Tests**		
	-2 Log Likelihood of Reduced Model	**Chi-Square**	**df**	**Sig.**
Intercept	2720,031[a]	,000	0	.
Availability car	2736,196	16,165	4	,003
Availability bike	2730,250	10,219	4	,037
Urbanisation	2739,129	19,097	4	<,001
Age	2760,672	40,640	4	<,001
Income	2741,975	40,640	4	<,001
Knowledge about shared bicycle	2895,874	175,843	12	<,001
Gender	2722,560	2,528	4	,640

The likelihood ratio test shows the significance of the predictors. Only gender is not significant. Table F.12 shows all outcomes.

F.2.5. Parameter estimates

Table F.13: MNL including do not know group

Parameter Estimates									
Openness to use		**B**	**Std. Error**	**Wald**	**df**	**Sig.**	**Exp(B)**	**95% Confidence Interval for Exp(B)**	
								Lower Bound	**Upper Bound**
I do not know	Intercept	-4,060	1,329	9,330	1	,002			
	Income	-,715	,267	7,183	1	,007	,489	,290	,825
	Age	,240	,149	2,604	1	,107	1,271	,950	1,701
	Urbanisation	,462	,138	11,121	1	<,001	1,587	1,210	2,082
	Availability car	,554	,252	4,839	1	,028	1,740	1,062	2,850
	Availability bicycle	-,368	,200	3,386	1	,066	,692	,468	1,024
	I do not know the concept	4,235	1,079	15,396	1	<,001	69,034	8,326	572,398
	Heard of it once, but don't know exactly	2,242	1,152	3,789	1	,052	9,416	,985	90,049
	I do not use it, but I know it	1,119	1,161	,930	1	,335	3,062	,315	29,777
	I have experience using it	0b	.	.	0	.	.	.	.
	Women	,329	,376	,767	1	,381	1,390	,665	2,902
	Men	0b	.	.	0	.	.	.	.
Not interested at all	Intercept	-4,262	,739	33,248	1	<,001			
	Income	,008	,160	,003	1	,959	1,008	,736	1,380
	Age	,479	,093	26,709	1	<,001	1,615	1,346	1,937
	Urbanisation	,321	,090	12,649	1	<,001	1,378	1,155	1,645
	Availability car	,462	,181	6,496	1	,011	1,587	1,113	2,263
	Availability bicycle	-,258	,102	6,416	1	,011	,773	,633	,943
	I do not know the concept	3,962	,546	52,664	1	<,001	52,585	18,034	153,329
	Heard of it once, but don't know exactly	3,839	,543	50,056	1	<,001	46,475	16,046	134,612
	I do not use it, but I know it	2,891	,510	32,150	1	<,001	18,013	6,631	48,934
	I have experience using it	0b	.	.	0	.	.	.	.
	Women	,011	,224	,003	1	,960	1,011	,652	1,570
	Men	0b	.	.	0	.	.	.	.
Not interested	Intercept	-3,527	,686	26,449	1	<,001			
	Income	,054	,163	,112	1	,738	1,056	,768	1,453
	Age	,233	,095	6,027	1	,014	1,262	1,048	1,521
	Urbanisation	,315	,092	11,708	1	<,001	1,371	1,144	1,642
	Availability car	,558	,174	10,273	1	,001	1,746	1,242	2,456
	Availability bicycle	-,133	,102	1,727	1	,189	,875	,717	1,068
	I do not know the concept	3,018	,464	42,366	1	<,001	20,456	8,243	50,761
	Heard of it once, but don't know exactly	3,004	,458	43,024	1	<,001	20,169	8,219	49,493
	I do not use it, but I know it	2,240	,417	28,864	1	<,001	9,390	4,148	21,257
	I have experience using it	0b	.	.	0	.	.	.	.
	Women	,203	,230	,778	1	,378	1,225	,780	1,923
	Men	0b	.	.	0	.	.	.	.
Neutral	Intercept	-1,090	,632	2,980	1	,084			
	Income	-,374	,166	5,053	1	,025	,688	,496	,953
	Age	,148	,098	2,255	1	,133	1,159	,956	1,406
	Urbanisation	,180	,095	3,553	1	,059	1,197	,993	1,443
	Availability car	,594	,174	11,707	1	<,001	1,812	1,289	2,546
	Availability bicycle	-,067	,104	,416	1	,519	,935	,762	1,147
	I do not know the concept	1,371	,409	11,253	1	<,001	3,941	1,769	8,782
	Heard of it once, but don't know exactly	1,573	,395	15,877	1	<,001	4,823	2,224	10,458
	I do not use it, but I know it	1,349	,334	16,311	1	<,001	3,854	2,002	7,416
	I have experience using it	0b	.	.	0	.	.	.	.
	Women	,065	,239	,073	1	,787	1,067	,668	1,703
	Men	0b	.	.	0	.	.	.	.

a. The reference category is: (Very) Interested.

F.2.6. Classification of the model

Table F.14: Classification of the MNL model

Classification						
Observed	**Predicted**					
	I do not know	Not interested at all	Not interested	Neutral	(Very) Interested	**Percent correct**
I do not know	1	42	4	1	1	2,0%
Not interested at all	2	441	38	15	7	87,7%
Not interested	0	251	38	18	12	11,9%
Neutral	4	131	29	27	19	12,9%
(Very) Interested	0	54	17	21	41	30,8%
Overall Percentage	**0,6%**	**75,7%**	**10,4%**	**6,8%**	**6,6%**	**45,1%**

Table F.14 shows the classification table of the Model. It shows a total correct predictive power of 45.1%.

F.3. Multinomial with 4 levels

The multinomial regression is conducted again, with some variables specified as continuous variables. The assumption is made with this, that the distance between every step is equal.

F.3.1. Case processing summary

Table F.15: Summary MNL 4 levels

		N	**Marginal %**
	Not interested at all	503	41,4%
	Not interested	319	26,3%
	Neutral	210	17,3%
	(Very) Interested	133	11%
Knowledge about sharing	I do not know the concept	334	28.7%
	Heard of it once, but don't know exactly	313	26,9%
	I do not use it, but I know it	441	37,9%
	I have experience in using it	77	6,6%
Gender	Women	551	47,3%
	Men	614	52,7%
Valid		1165	100,0%
Missing		71	
Total		**1236**	

F.3.2. Model fitting information

Table F.16: Model fitting information

Model	Model Fitting Criteria	Likelihood Ratio Tests		
	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	2699,963			
Final	2424,543	275,420	27	<,001

The model shows a significant value in Table F.16. This indicates a good-fitting model in comparison with added predictors.

Table F.17: Model fitting information

Goodness-of-Fit			
	Chi-Square	df	Sig.
Pearson	2699,963	2570	,295
Deviance	2200,008	2670	1,000

The Goodness-of-fit table (F.17) shows a non-significant relation, which indicates a good model fit.

Pseudo R-square
The Pseudo R-square shows an explanation of 9.3% when looking at the explained variance. Table F.18 also shows different other metrics, but most of the times the McFadden metric is used to explain variance.

Table F.18: Pseudo R-square of MNL

Pseudo R-Square	
Cox and Snell	,221
Nagelkerke	,228
McFadden	,093

F.3.3. Likelihood ratio test
The likelihood ratio test shows the significance of the factors.

Table F.19: Significance of effects

Likelihood Ratio Tests				
Effect	**Model Fitting Criteria**	**Likelihood Ratio Tests**		
	-2 Log Likelihood of Reduced Model	**Chi-Square**	**df**	**Sig.**
Intercept	2424,543[a]	,000	0	.
Availability car	2441,005	16,462	3	<,001
Availability bike	2433,365	8,822	3	,032
Urbanisation	2440,792	16,249	3	.001
Age	2465,625	41,083	3	<,001
Income	2437,832	13,289	3	,004
Knowledge about shared bicycle	2555,306	130,763	9	<,001
Gender	2426,578	2,036	3	,565

The chi-square statistic is the difference in -2 log-likelihoods between the final model and a reduced model.

The reduced model is formed by omitting an effect from the final model. The null hypothesis is that all parameters of that effect are 0.

a. This reduced model is equivalent to the final model because omitting the effect does not increase the degrees of freedom.

Table F.19 shows a non-significant factor for only gender. The rest of the predictors are significant, which means, they influence 'openness to use'.

F.3.4. Parameter estimates

Table F.20: Parameter estimates of 5 level

Parameter Estimates									
Openness to use		**B**	**Std. Error**	**Wald**	**df**	**Sig.**	**Exp(B)**	**95% Confidence Interval for Exp(B)**	
								Lower Bound	**Upper Bound**
Not interested at all	Intercept	-4,337	,745	33,919	1	<,001			
	Income	,024	,161	,022	1	,881	1,024	,747	1,406
	Age	,485	,093	27,408	1	<,001	1,625	1,355	1,948
	Urbanisation	,318	,090	12,445	1	<,001	1,374	1,152	1,640
	Availability car	,477	,182	6,843	1	,009	1,611	1,127	2,303
	Availability bicycle	-,255	,103	6,203	1	,013	,775	,634	,947
	I do not know the concept	3,979	,546	53,060	1	<,001	53,473	18,330	156,000
	Heard of it once, but don't know exactly	3,851	,543	50,323	1	<,001	47,054	16,236	136,369
	I do not use it, but I know it	2,905	,510	32,423	1	<,001	18,258	6,718	49,621
	I have experience using it	0b	.	.	0	.	.	.	.
	Women	-,006	,224	,001	1	,980	,994	,640	1,544
	Men	0b	.	.	0	.	.	.	.
Not interested	Intercept	-3,617	,692	27,291	1	<,001			
	Income	,073	,164	,198	1	,656	1,076	,780	1,483
	Age	,237	,095	6,260	1	,012	1,268	1,053	1,527
	Urbanisation	,315	,092	11,705	1	<,001	1,370	1,144	1,641
	Availability car	,570	,175	10,632	1	,001	1,768	1,255	2,491
	Availability bicycle	-,128	,102	1,571	1	,210	,880	,720	1,075
	I do not know the concept	3,036	,464	42,781	1	<,001	20,820	8,383	51,709
	Heard of it once, but don't know exactly	3,018	,458	43,329	1	<,001	20,451	8,326	50,232
	I do not use it, but I know it	2,253	,417	29,129	1	<,001	9,512	4,198	21,553
	I have experience using it	0b	.	.	0	.	.	.	.
	Women	,198	,230	,737	1	,391	1,219	,776	1,913
	Men	0b	.	.	0	.	.	.	.
Neutral	Intercept	-1,137	,639	3,170	1	,075			
	Income	-,365	,168	4,750	1	,029	,694	,500	,964
	Age	,151	,098	2,347	1	,126	1,162	,959	1,409
	Urbanisation	,177	,095	3,483	1	,062	1,194	,991	1,439
	Availability car	,604	,175	11,960	1	<,001	1,830	1,299	2,578
	Availability bicycle	-,063	,105	,366	1	,545	,939	,764	1,153
	I do not know the concept	1,381	,409	11,404	1	<,001	3,980	1,785	8,871
	Heard of it once, but don't know exactly	1,578	,395	15,945	1	<,001	4,843	2,233	10,506
	I do not use it, but I know it	1,357	,334	16,463	1	<,001	3,883	2,016	7,478
	I have experience using it	0b	.	.	0	.	.	.	.
	Women	,063	,238	,069	1	,793	1,065	,667	1,699
	Men	0b	.	.	0	.	.	.	.
a. The reference category is: (Very) Interested.									
b. This parameter is set to zero because it is redundant.									

F.3.5. Likelihood ratio test

Table F.21: Significance of effects

Likelihood Ratio Tests				
Effect	**Model Fitting Criteria**	**Likelihood Ratio Tests**		
	-2 Log Likelihood of Reduced Model	**Chi-Square**	**df**	**Sig.**
Intercept	3208,262	,000	0	.
Availability car	3223,388	15,126	4	,004
Availability bike	3224,412	16,149	4	,003
Urbanisation	3242,348	34,085	16	,005
Age	3276,653	68,391	16	<,001
Income	3248,345	40,083	16	<,001
Knowledge about shared bicycle	3391,469	183,207	12	<,001
Gender	3210,323	2,061	4	,725

F.3.6. Classification of the model

Table F.22: Classification of the MNL model

Classification					
Observed	**Predicted**				
	Not interested at all	Not interested	Neutral	(Very) Interested	**Percent Correct**
Not interested at all	446	37	13	7	88,7%
Not interested	251	40	15	13	12,5%
Neutral	134	30	27	19	12,9%
(Very) Interested	56	16	19	42	31,6%
Overall Percentage	**76,1%**	**10,6%**	**6,4%**	**7,0%**	**47,6%**

Table F.22 shows that 47.6% of the model was expected to be observed.

G

Open answers panel data

In this chapter, the open answers for the selections from chapter 6 and open multiple choice answers are given:

G.1. Reasons to switch

In Table G.1 the reasons are shown under which the respondents of the panel data would switch to a shared mobility mode. The three most given answers are highlighted blue. As can be concluded, these are 'certainty availability vehicle', 'vehicle within 400 meters' and 'never'.

Table G.1: Reasons to switch to Shared Mobility

	Responses		**Cases**
Reasons to switch	N	%	% of cases
Certainty availability vehicle	580	15.6%	37.2%
If reservation is possible	344	9.2%	22.1%
Physical point of contact	172	4.6%	11.0%
Sustainable vehicle	186	5.0%	11.9%
Vehicle within 400 meter	452	12.1%	29.0%
No smartphone needed	151	4.1%	9.7%
One application	156	4.2%	10.0%
Ease of switching modality	147	3.9%	9.4%
Close to other facilities	49	1.3%	3.1%
No parking limits	314	8.4%	20.1%
Available further than municipality borders	260	7.0%	16.7%
Available everywhere	188	5.0%	12.1%
Faster combination public transport and Shared Mobility	135	3.6%	8.7%
Never	591	15.9%	37.9%

G.2. Selection 1: influence of income on reasons to switch

Table G.2: Open answers selection 1

	Income				
codes	Less than 1000	1000 - 2500	2500 - 5000	5000 or more	Do not want to say
1 application / payment system	0	2	0	0	0
Availability	1	3	5	2	1
Certainty	0	1	0	0	0
Clean	0	0	1	0	0
Comfortable	0	3	0	0	0
Conditions	0	1	0	0	0
Connection other vehicle	0	0	1	0	0
Convenience	1	3	2	0	0
Costs	0	0	0	8	2
Costs / price	1	20	26	0	4
Costs gasoline	0	0	1	0	0
Costs own car / vehicle	1	1	9	0	0
Ease of use with disability	0	1	1	0	0
Discount	0	1	0	0	0
Ease of use	0	1	14	5	5
Efficiency	0	0	1	0	0
Flexibility	0	1	0	0	0
Free	0	0	1	0	0
Fun	0	1	1	0	0
Future	0	0	1	0	0
Infrastructure (availability + limits parking)	0	0	3	0	1
Innovation	0	0	1	0	0
Investment	0	0	0	1	0
Lack information / experience	1	0	3	0	0
Lack of availibility own vehicle	2	6	5	0	3
Location	0	1	0	0	0
More benefits (costs, environment, etc)	0	0	0	0	1
No application	0	2	0	0	0
No idea	0	7	9	0	6
None	3	10	11	1	5
Proven that it works	0	0	2	1	0
Quality service	0	1	0	0	0
reservation	0	0	0	0	1
Safety	0	1	0	0	0
speed / time saving	0	2	3	0	1
subsidy	0	0	1	0	0
Sustainability / environment	2	5	6	0	4
To decrease traffic	0	1	4	0	1
Trade-off	2	4	2	0	0
Unusable	3	13	20	6	1
Remote working possibilities	0	0	0	1	0

G.3. Selection 2

Table G.3: Open answers to selection 2: all respondents open to using shared bicycles

Code	Count	Code	Count
Unusable	43	Less effort	1
None	48	lack information / experience	1
No idea	29	1 application / payment system	1
availability / reservation / 1 app	1	Chain journey / costs	11
Price / sustainability	8	Ad hoc	1
Availability	13	living conditions	1
remarks	12	More benefits (costs, environement, speed, availability)	1
Ease of use	33	Reservation / ease of use	1
1 app	2	Sustainability / environment	18
Costs / price	78	money saving	4
Availability / price	3	Decreased frequency use	1
Costs own car / vehicle	8	To decrease traffic / ownership	8
Price / speed / sustainability	2	Availability / ease of use	1
Ease of use / speed	1	Availability / costs	1
Lack of availibility /possibility own vehicle / ov	24	Convenience	8
Other vehicle (scoot mobile)	1	speed / flexibility	1
Service quality	1	Sustainability / ease-of-use	2
ease of use / price	10	speed / ease of use	1
Speed	2	1 app / price	1
Proven that it works	8	Innovation	1
Lack of other options	2	Subsidy / employment payment / discount / something in return	3
No mobile phone	3	Possibility to work	1
Situation specific	1	Fun / adventure	2
Speed / price	1	Costs / parking	2
Accessibility	5	speed / time saving	6
reservation	1	Certainty	1
Circumstances	3	Costs	1
Price & flexibility &/ availability	2	Practical / price	1
Price / speed	10	Practical	1
safety / price	1	Decrease ownership	1
Specifications vehicle	2	Future	1
Vehicle specifications	2	price / efficiency	1

H

Interviews

The goal of the interviews was to get more insight from different angles on the shared bicycle system. Four people were interviewed:

- A behavioural specialist at a mobility company specified in behaviour. The goal of this was to find the main aspects which influence behavioural change, and how it takes place as validation of the framework. This interview was conducted on the 7th of June.
- A shared mobility provider. The goal of this interview was to get insight into the current patterns they see in users, who are the users, and how they stimulate use right now. This provider was chosen, since this is the biggest provider of non-station-based bicycles in the Netherlands. This interview was conducted on the 13th of June.
- A bicycle specialist at the Fietserbond. "ANWB, BOVAG, RAI Vereniging, the Fietsersbond and the coalitions "Anders Reizen" will use their own communication channels to promote sustainable mobility..." (Rijksoverheid, 2019, p.74). They are appointed by the Government to work together to stimulate people to use the bicycle. The goal of this interview was to get insight in how people are stimulated to use bicycles right now and what preconditions are necessary. This interview was conducted on the 8^th of June.
- Municipality interview. This interview was conducted with a policy officer of the municipality. This municipality was chosen since they renewed the contract with their shared bicycle suppliers, after the pilot. This interview was conducted on the 23th of March.

The interviews were recorded, summarised, and checked with the interviewee. The summaries can be found in the following sections. The semi-structured interview method was chosen, the interview guide can be found in the last section.

H.1. Interview questions

First, the interview is started by introducing both interviewee and interviewer. The goal of the research and the subject are introduced (sub questions, main research question, developed framework). The framework is introduced and it is explained that the questions are deduced from this framework, literature, and the panel data of Mobycon. The questions asked(translated from Dutch):

General questions

1. How should behavioural change be stimulated?
2. How does your company stimulate behavioural change?
3. How much influence do you believe social contacts has?

Framework specific questions

1. How much influence do the social circumstances have on people their choices?
2. With what purpose could people use a shared bicycle system?
3. How do you think bad publicitiy or familiarity play a role in people their openness to use a shared bicycle system?
4. What is your experience with shared bicycle systems and behavioural change?
5. Which factors influence people their openness to use a shared bicycle system according to you / your company?
6. Which factors now limit people their behaviour towards using a shared bicycle system?
7. What could change people their behaviour to the better?
8. What kind of projects do you facilitate now?

Additional questions to Donkey Republic:

1. What makes you special in the market?
2. How does your system work? (free-floating, hubs, etc).
3. What is the history of the company?
4. Which users do you see now? What are their characteristics?
5. What is the role of the municipality in the system?

H.2. Interview behavioural specialist

The interview was conducted on Teams. First the interviewer and interviewee introduced themselves and their projects. The interviewee is a behavioural psychologist. The interviewee first worked with younger groups in traffic education, and now works at this company in behavioural change project. One of the focuses of the company is sustainable mobility.

The interviewer wrote down some subjects to discuss with the interviewee. After introducing the subject of a shared bicycle system, an important aspects was given, why people seem to think shared systems are a problem now: “The concept is still very unknown, therefore it seems difficult”.

Question related to behavioural change:
Behavioural change is about resources and what you see underneath. The first step in behavioural change is to find what makes people change their travel choice or not (age, motivation, neighbourhood). Travel behaviour is often “habitual behaviour”. To change travel behaviour, these habits need to be broken. A way to do this is to target larger groups. An example of one of these large groups is employees. More often through employer actions, travel behaviour is pushed to change. An example of this employer action is changing the mobility policy of the company towards other mobility options (e.g. bicycle millage allowance/reimbursement).

For pushing people to change their choice of behaviour, different options are available for campaigns. The goal of the campaigns is to let people make other choices than normal. Even though often done online, personal is often better. For bicycle systems, to campaign a change of choice and behaviour it is important to respond to current resistance: it looks like a difficult system, difficulty finding a bike, need for a subscription, and parking problems, etc. A solution to this could be making the plan concrete, and behaviour manageable. Show how to use a system, and create a simple 1-2-3 step-by-step plan. Make the behaviour manageable.

Questions related to the framework
Social influence and its influence on behaviour have a lot to do with each other. If you ask people, they are often not able to acknowledge the influence other people their behaviour has on their own. For example: solar panels. In neighbourhoods with more solar panels, often people are more inclined to get their own when they see the phenomenon more around them. For the shared bicycles, this same snowball effect could happen, just as with the shared scooters. The more people also see it, the more people are inclined to use it or have an opinion about it. Social media can also play a role in people their opinion, less than their direct social surroundings but is still present. E.g. the news about nitrous oxide, young people saw that people in their surroundings used it, so they would think it was a ‘new normal’. This is an example of a negative impact.

Examples from the company projects
One project was based on shared mobility and cooperation between SmartwayZ. This happened in Limburg and Noord-Brabant. The goal was to improve sustainable mobility, and to see how people used shared mobility hubs. In this project, the company had an advisory role. How do people change their behaviour and what is the impact of measurements. The company is still tracking change and the influence of measurements, which is also an important part of the process.

Another example of a project, more focused on stimulating bicycle use, was a project for a company, where a bicycle application was introduced to stimulate people to take the bicycle more to work. The impact of the app and the stimulation of the bicycle was tracked again, 6 months later. People still seemed to take the bicycle more than before the application. The concept was that someone who already took a bicycle often would invite team members, who did not use the bicycle often, and were often dependent on the car. The buddy and the team members would get a reward (first money) when they took the bicycle. After a month, the rewards would disappear but people would still take the bicycle. Their intrinsic motivation was higher. This could be explained by the fact that they liked it, saw that it was easy and it was an activity with colleagues. The goal of the application and incentive was to get employees out of the car. A project which is being executed now is a project with and for MBO students and cycle behaviour. The project investigates why people do not cycle more, even though the school also facilitates bikes, which are never used. An important aspect of this seems to be the student travel product.

Travel behaviour – specific known projects
In travel behaviour, the target group is also important to map and take into account, and needs a different approach. Some examples of approaches in the Netherlands: - Non-dutch people: bicycle provision, cycling

practice. Integration lessons and bicycle assistance. - Employees are stimulated via employer - Seniors: programs such as 'Doorstrappen'.

Travel behaviour
Behaviour is often influenced by circumstances. For example, during the strikes last year, when the buses did not drive anymore, the ov-bike was used more often then. Especially with shared bikes, the chain trip can be done. Seeing it more around you also helps, often in rural areas, people also do not have the possibility to see the shared bicycle since it is not available there.

Steps to change behaviour
The company often uses the six steps CASI model of the government. First it is important to inform what people already know. The target groups need to be analysed, what makes people not use the bicycle yet. Find out which behavioural determinants are there already. Social environments also play a part in this. Then a strategy is deployed; the intervention strategy. Often people are eager to participate in positive development. The output of the process is often an effect measurement.

Tips in the end
For shared bicycle stimulation, often unfamiliarity plays a part. If people already want it, it is easier to change their behaviour to use the mode. But car ownership is not discouraged in the Netherlands. Car use is not discouraged by the government, since they still invest in highways. "It is not made difficult for people to use their car".

Awareness should be increased to increase the easiness of the mode. Familiarity is not great in some places, which also discourages people to use a shared mode.

When telling the interviewee that costs are often given as an open answer, the response was that often affordability and costs are easily answered. It is an easy answer for a lot of people. It is more of a threshold. Often the behaviour is not changed or little by making something more expensive to inhibit behaviour. A positive approach, by facilitating other options, influences behaviour more. Make it as easy and affordable as possible.

H.3. Interview Fietsersbond

The interview took place on Teams. Initially, both the interviewer and the interviewee introduced themselves. The interviewee, who is a Consumer and Vehicle Specialist, has been working at the Fietsersbond for 25 years. After introducing the subject of the thesis, the interviewer asked the interviewee about the most important aspect of a general bicycle system. The interviewee responded that the preconditions of a bicycle system are crucial, especially the infrastructure. Additionally, factors such as pleasantness and cycling happiness also contribute to bicycle usage.

Bicycle stimulation
The Fietsersbond is dedicated to promoting bicycle usage through concrete measures, including: - Improving cycling paths - Implementing regulations for cyclists, such as tax-free travel allowance - Enhancing parking facilities at public transport stations to encourage more people to use bicycles for commuting in combination with taking the train. The interviewee stated that, in general, when conducting a cost-benefit analysis, investing in bicycle promotion always yields positive economic effects. "In general, what we know is that if you create better conditions for cyclists, people will use bicycles more frequently as well."

Shared mobility
The Fietsersbond actively participated in the establishment of the ov-bike, a successful shared bicycle concept. However, the organization is not involved with other shared bicycle providers, as they perceive less potential in free-floating shared bicycles. The Fietsersbond still remains involved with the ov-bike, which is now managed by the NS (Dutch Railways), overseeing aspects such as pricing and the need for additional facilities.

A current concern regarding the ov-bike is its pricing. Public transportation receives more subsidies compared to the ov-bike. One potential solution could be to increase the subsidies for ov-bikes, which would lower the price. If more people took (ov-)bicycles instead of buses or other modes of transport, it would significantly benefit society (for health befits etc). The interviewee emphasized that "the price would be an important factor in stimulating bicycle usage, along with the availability of ov-bikes and parking facilities at the stations." Additionally, facilitating extra bicycles at transportation hubs, where multiple buses converge, could help promote bicycle usage. Careful selection of these hubs is necessary since buses often stop near destinations (schools, hospitals, etc).

The potential of free-floating bicycles
The Fietsersbond is not actively involved in free-floating bicycles, as they perceive this concept as having limited potential. Free-floating systems are less effective in optimizing the chain journey since the starting and ending points are typically the stations. The target group for free-floating bicycles is less defined compared to ov-bikes. Free-floating bicycles, similar to shared scooters, are often used on an ad-hoc basis. A significant drawback of free-floating bicycles is their lack of a specific target group or clear role in the transportation system. Managing them in public spaces is also problematic, as they do not belong to any specific owner. Also, the quality of a free-floating bicycle may be compromised due to the need to withstand vandalism. Furthermore, free-floating bicycles, when not used, are always parked in public spaces, and not in specific parking spaces such as the ov-bike. When renting a public transport bicycle, the responsibility lies with the user, whereas with a free-floating bicycle, the responsibility is relinquished after parking it. Implementing Bicycle hubs could potentially only be effective when strategically placed at logical rental locations. In conclusion, the Fietsersbond does not consider free-floating bicycles as an efficient solution.

Potential in own city
In one's own city, when an individual already owns a bicycle, the question arises as to why they would opt for a free-floating or hub-based system with higher costs. Swapfiets, on the other hand, could be more appealing for individuals without access to a bicycle.

The current pilots
The current (free-floating) shared bicycle pilot programs have not yet proven to be convincing according to the interviewee. These pilots could mostly benefit employees. Companies could facilitate "service bikes" for their employees, which might be more advantageous than implementing a free-floating system. Once again, it is emphasized that the potential user base for these systems is not clear. At stations or bus stops, the potential users are more easily identified.

Examples of bicycle stimulation

One ongoing project that the Fietsersbond is working on is the "15-minute city." This project focuses on spatial design, developing neighbourhoods without parked cars in the direct surroundings. The cars are situated on the outskirts, with convenient access points to the beltway or highway. This indirectly encourages bicycle usage by stimulating spatial development. The STOMP principle is employed in this project, prioritizing non-motorized traffic in the initial design phase.

Final points
As suggested by the interviewee, one potential free-floating sharing market which could have potential is the cargo bike. These bikes are needed on an occasional basis and could be compared to the occasional use and rental of a boedelbak" at a gas station.

The final thought expressed by the interviewee was that in some cases, the underlying rationale behind municipalities implementing free-floating bicycles is still unclear. The description of the target consumer and how a shared bicycle system provides added value compared to other alternatives is sometimes lacking. The interviewee concluded that often if it is a bicycle system and it has the potential to add value, it is implemented and tested, and the argument why it is being implemented, is not substantiated enough. The implementation of the system sometimes fails to address why people should choose free-floating bicycles if they have a preference for cycling.

H.4. Interview shared bicycle supplier

The interview was conducted on Teams. First the interviewer and interviewee introduced themselves. The interviewee is working in the team of Business Development and does market research for Belgium and the Netherlands for Donkey Republic. Donkey Republic was founded in 2015 in Copenhagen, and was introduced in Amsterdam in 2017, but left (with other providers) quite soon after, due to the nuisance of the bicycles. Since 2019 they are back, and running in the big cities (Amsterdam and Rotterdam).

Questions related to the concept
Donkey Republic has around 2500 bicycles in the Netherlands. It varies per city how the bicycles are located and the rules around the hubs. When asked about the ov-bike, it was answered that the ov is another calibre since it already exists long and is already a big established brand. There are two ways Donkey Republic distinguishes itself from the other providers mentioned by the interviewee: - The distinction with the rest of the competition, by not providing free-floating bicycles, but hub locations. The bicycle can be parked in any hub, and does not have to be brought back to the same hub (distinction with ov-bike). No extra fee is charged, for parking at another hub. - Only offering bicycles, instead of e-bicycles. Donkey Republic is one of the few providers, together with the ov-bike, who do this. This also leads to a more attractive price. This distinction is both with the ov-bicycle and the free-floating bicycle. Sometimes the distinction does not matter, and a collaboration can arise: the interviewee read about a new collaboration between the NS and Tier just today.

The user
The users of the system are quite diverse. It is one of the most asked questions by municipalities. This depends on the characteristics of the city, for example, Amsterdam has a lot of students, tourists, people who come there for a day, and a big group of expats. The people who cannot have or own their own bicycle on location. In Rotterdam, more local users can also be found, this can be explained by the 'design of the operation'. In Amsterdam, the rules by the municipality are stricter than in Rotterdam. This has an influence on the optimisation process of the network, by closing and starting hubs. This leads to more freedom in going from hub to hub in Rotterdam, while in Amsterdam, people still need to search for a hub, and cannot get close to the center of the city.

The use is also dependent on the season. It is a seasonal product. Shared bicycle use is exploding in the summer by tourists. In Copenhagen, this same phenomenon can be found. Local use is higher after the tourist's time.

Selection vehicle mode
The interviewer asked if no e-bikes were facilitated in the Netherlands by Donkey Republic. The interviewee answer that the e-bike is offered, but it depends on the location. The first trial in Copenhagen just started. Geneve and Antwerp already had e-bikes. In Amsterdam, a few e-bikes are introduced, more as a trial. The e-bike is another story in comparison with the normal bike, due to the costs and battery changing, but also the different user experience. The e-bikes are heavy, which makes redistribution harder. Also, the Netherlands is a flat country, which made the need for e-bikes smaller than in Geneva.

Replacement of the car
The e-bikes are also used as a replacement for the car, which is the goal in Antwerp. In the Netherlands, the need is smaller and is less appropriate for the operation. The interviewer asked: "Do you see that bicycles also replace the car", the interviewee responded to this: "to some extent, yes, but to a lesser extent". Walking and public transport are replaced more. In an internal study, the conclusion was that people if they would not have used a Donkey Republic bike, they would have stayed home. The interviewee repeated his conclusion: car trips are replaced but in a lesser extent than in Antwerp. An explanation for this could be the fact that Donkey Republic can supply e-bikes for the whole region, not only the center of Antwerp.

Motivation to use
The use is stimulated by offline and online marketing of the marketing department. A factor that has an influence on the use is the location of the bicycle. The orange colour is the most recognizable of the brand, and brings the most new users according to internal research. The right location is deducted from the data, for a longer time, than the network can be optimised.

The integration of Tier and NS also helps with getting more people to use the shared mode, since people see the concept more often then. Familiarity plays a role. When asked to compare the hubs and the ov-bike, the interviewee explained that an advantage of a hub is that it is clear to regions and municipalities where the

vehicles are located and that this can be controlled. In Copenhagen the density of the hubs is high. Internal research showed that users want to walk for a maximum of 100 or 150 meters. Municipalities like to know this, so they can influence and control the public space, and bicycles are not parked anywhere. The philosophy of this is that in the shared bicycle system, there are more stakeholders involved (e.g. pedestrians), which should also be considered.

Questions for the framework
In the next part of the interview, the interviewer explained that the questions would focus on aspects from her framework:

The social influence of a system
The social influence of the bicycle system plays a role to some extent. Word of mouth, and people who had a good experience, are good marketing. Also, the functionality of the application, where you can book multiple bicycles with 1 account and 1 app, makes use with friends easier. “Again, lowering the threshold is important”. When asked about, if referral codes were already used, the response was that referral codes are more marketing related, so this question could not be answered fully. To the interviewees knowledge, referral codes were not used yet.

Purpose travel
With what purpose people travel is hard to collect, this is data less available. The phone number can give insight into if it is for local use, tourist use, or expats. Donkey Republic does offer memberships, but the ‘commuting market’ feels “almost like a saturated market, with multiple existing structures (e.g. lease structure)”. According to the interviewee this could be an interesting market to crack. The Donkey Republic bicycles are often used around campus, indicating high usage by students, and younger people, seen as the early adopters.

Ease of use
When asked about how people rated their experiences, the interviewee said that most people responded that using a Donkey bicycles was an easy and positive experience. Most questions are about payment methods and payment questions. The interviewee gave another positive side about Donkey Republic in comparison to other providers of shared mobility, which is that no credit card is needed for payment. The registration is also fast, since an account with a working phone number, can be created in minutes. All these measurements are taken, to increase ease of use.

Factors that play a role in the bicycle usage
The interviewee gave as one of the positive points, that the bicycles are of good quality. Another important factor mentioned, was the density of the network: this should be high. This also ensures that if there is no vehicle available in the closest hub, another hub is not further than 100 – 150 meters away. When looking at the maintenance of the bicycles, most reparations could be done at the location, only big replacements should be done in the workshop.

Optimal use
The best scenario (which does not exist yet) would be if there does not have to be any redistribution, and the distribution of the bicycles is done by the user self. Most of the time, people travel toward the city, which cannot be easily countered with optimization. Data analyses play a role in this again. Since working in a virtual infrastructure, a hub can be opened when popular and closed in minutes if not. The permission of the municipality is in this part the most time-consuming. For opening new hubs in locations that are stimulated by the municipality, which do not efficiently work in the network, subsidies are needed. Antwerp does supply subsidies, which makes the operation interesting since villages, which have a higher risk of less use, are covered by the subsidy.

Free-floating and station based
Since the dip in 2019, a rise in shared bicycle use can be seen again. The dip was not full, but the network in Amsterdam and Rotterdam had just started in 2019 again, and then the world closed. After COVID-19, the network could also be optimised better with opening and closing hubs.

When asked if ownership plays a part in the Netherlands, the interviewee answered that this could play a part since cycling in the city is already high. But in Copenhagen, also a place with high bicycle ownership, this influence is not seen. This can be explained by the length of time it is already available in Copenhagen. This

question is often asked the interviewee responded and could be an explanation for why municipalities do not want to invest subsidies in promoting shared bicycle systems (due to the high ownership degree).

The potential of the shared bicycle
When asked what woud stimulate use, the interviewee answered that a shared bicycle could be interesting especially when there is another mode involved in the journey. When people take a bike to work, it is more convenient to invest and use your own bicycle, otherwise, shared bicycles could be an interesting addition to the travel journey.

If asked, if Donkey Republic replaces in a way the ov-bike, the interviewee answered that there is enough stretch in the market to work next to each other. Also, the ov-bike is not available at GVB or RET points, which creates a gap in the market. GVB and Donkey already work together.

The potential in non-urban areas
When looking at non-urban areas, there is a risk that the use is less. An operation for Donkey Republic also needs to be financially sustainable. Subsidies cover the risks, just like in Antwerp. For local use, it can have positive influence on introduction to be financially sustainable and work with subsidies. Collaborations could also help. For example, when asked about the collaboration between Qbuzz and Donkey, the chance that Donkey would have started in Dordrecht was smaller, also since Dordrecht is a challenging area, with suburban areas and more urban areas. Next to collaboration and subsidies, the province or local government could also play a part in bicycle usage with subsidies or legislations, which could be interesting to stimulate usage and lower the barriers.

When asked about the current collaboration between the municipality and Donkey, the interviewee responded that the collaboration between Donkey Republic and municipalities is tight, but also depends on the size of the operation. When asked about Utrecht, where Donkey need to leave, it was answered that is was an example of a miscommunication with the municipality, the operation did work there as well.

H.5. Interview municipality (Highly urbanised)

The interview was conducted on 23rd of May. The original subject was still focused on the comparison with the disappearance of public transport. Therefore some of the subjects discussed were not relevant anymore. The interview was conducted on Teams and used as exploratory discussion. The interviewer introduced the subject and herself. The interviewee did the same: the person spoken to was specialised in shared bikes, mobility as a service, shared mobility, and area development and previously worked at the GVB. The reason for choosing this municipality was that they just changed their policies, to exclude scooters and only work together with one shared e-bike provider. The shared scooters disappeared but there is still a possibility it can be introduced again, on a regional level. The conclusion from the last pilot was that in the way it was organised now, the concept did not work. In comparison, the shared scooter was used less than in other cities in the Netherlands. The distances traveled could be compared to the e-bike. There are several explanations for this. The main reason was that the business case at this location was less interesting. For the municipality, it is important to invest in active traveling. The e-bike introduced could be seen as an intermediate version [between the scooter and the regular bike. The regular bike was tried, but there was less market demand at the moment of the pilot.

Regulation now

When asked if the implementation of the shared scooter and e-bike is regulated via subsidies, the answer was that shared e-bikes and scooters are regulated through a licensing system. The cargo bikes are provided via different suppliers and via a separate concession. This is mostly caused because the market was still different then and asked for a different approach. Now market participants are allowed in the public space, regulated by an APV ('Algemene Plaatselijke Verordering'). The question was raised, if this should be set up differently. Or if it should become more like a public service, with different user schemes. Now it is the case that if a market provider does not want to do it anymore, or an investor steps down, the service disappears (e.g. GoSharing). This is bad for the reliability of the service. This is different in the world of public transport, so this product is more reliable to stay.

Municipality and the service

Since the sharing service grew, this also gave a bit more room to include some regulations about 'mobility guarantees'. The municipality works together to place e-bicycles close to stop-stations and has the understanding with the provider that there is a vehicle standing at the location and there us plenty of suppliers. The municipality also sees it as quite a new product, which needs some space to grow.

An example given for Tier and promotion codes shows that people with a special card (e.g low income, immigrant background), got an extra discount on the Tier service but did not use it, and the adoption was low. Different reasons for this are researched now by the municipality, such as 'is the price not good? Does this target group need free rides? Is it because there is too little supply'. For both the supplier and the municipality it is important to know, to optimize the service.

When asked about the connection between public transport and shared mobility, the interviewee answered that shared mobility works well close to public transport. Placing a shared mobility mode at a place where bus connections disappeared, cannot be the solution according to the interviewee. There is a reason it disappeared there, the market at these places is often not the one shared (e-)bicycle providers want to join. When asked if the municipality would want to financially contribute to the disappearance of the buses here or stimulate the shared mobility providers to place vehicles here was asked. The interviewee answered that the G4 municipalities are also working on this issue, and talking about the stretched bus routes. The stretching of the buses helps to make ov better and get people out of the car. This is due to the time buses save by not passing all the stops, and becoming more efficient in time. The interviewee answered that in Groningen and Drenthe where most bus lines were stretched or lifted, the use increased. Stretching the bus lines is necessary to be a better alternative for the car, but the downside of this is that some people suffer from this. Financially it is more efficient, but socially, it has a great impact on people.

Potential of the system

The potential of shared e-bikes lies in the chain journey. For example, when it rains, to your location, you take the bus, the way back you take the Tier. The interviewee wonders if they can replace each other. For example, Tier and the municipality just started working at business parks, places where money is less of an issue but reliability is. The buses cannot be connected to these parks, and an e-bike could be a good addition to the system. If reliability can be guaranteed, this takes away the limitation of the unavailability of the vehicle. It

is further emphasized that it should not be a replacement. The municipality could play a part financially to help guarantee the availability.

Tier is sometimes used in the suburbs, but then these bicycles stay at these places for some time. The interviewer asked how the municipality now handles these bicycles. The interviewee answered that it is a collaboration between the municipality and the supplier. The interviewer specified that these cannot be good for the municipality, since there is more nuisance of bicycles wandering around. The interviewee agreed to this. To solve this problem, the next round of concessions will be used in mid-2024.

Inclusitivity
The concepts which play a role for the municipality are reliability and serving all population groups. The interviewee does not believe that is possible at this moment with the shared e-bike system. Also, since people who use a shared scooter and shared e-bike are often younger people, who normally would have taken the bus. The consideration is how this can work together and how resources can be used properly, also since the government subsidizes public transport (buses).

The interviewer asked how the municipality now invests in the combination with public transport and Tier (in this case). The example in this municipality is experimenting with the supply of vehicles and creating an abundance of vehicles [to create more supply than demand] and investigating the influence of this. The interviewee emphasized that at this moment, this is still in the developing phase.

An example given of systems that work is the combination of public transport and shared systems in a Norwegian project, where when using public transport, the person got free driving minutes with their ticket. In the Netherlands it does not work yet, for example, the bicycle facilitated by HTM in Den Hague in combination with the tram. What the interviewee could tell the interviewer was that this was mostly due to not enough mass for the system. The question arose if the bigger municipalities should not work together more in creating one system, since not all providers are the same in every municipality. The interviewee gave a response that in Nijmegen, since Check and Felyx were already known from other places, the use was higher than in other cities.

Final remarks
When asked for the last tips, the interviewee mentioned that the integration of shared mobility, public transport, and other modes should be better. For example, people can take their ov-bike on their business card but need to declare their Tier trip. The next step is to complete the network, and also involve the shared taxi and the flex public transport busses. The different costs for every supplier play a part, but these obstacles are currently under consideration. When asked what influences citizens use according to the interviewee, the interviewee answered that he expects that mostly unfamiliarity with the service plays a role. There is a barrier to using it though, and something needs to happen before using it: e.g. the public transport strikes have led to many new users for Tier. More pushing it at the side of the employee could be interesting. The integration with the public transport which is already done by Check and in the future by Tier, also helps with this.

The municipality also tries with policy to push people to switch their mode. For example, the moment there are detours due to (road) works, it is also tried to encourage changing people their travel behaviour. People need to be motivated and be warmed up to changes, a bus line cannot be removed with the promise that shared bicycles will be placed as a replacement.

The interview ended and the interviewee thanked.

Focus group outcome

In this chapter, the focus group executed on the 15th of June 2023, deducted during lunch will be elaborated on. First, the composition of the group is given and then the course of the focus group was typed out and coded. The coding was done using Atlas.ti. The questions asked during the interview are deducted from the framework and the answers in the panel data.

I.1. The questions

Two question groups are specified. The questions were handed out to all participants to get background information on who participated. The second section gices the question asked via the Mentimeter.

I.1.1. The general participant questions

- What is your gender? [female; male; do not want to say]
- What is your age? [number]
- How often do you take the bicycle? [more than 3 times a week; 1 time a week; a few times a month; a few times a year]
- When more than 1 time a week, where do you use it for? [Open answer]
- I own a car? [no; yes, one; yes,more than one]
- I have used the ov-bike before? [yes; no; do not remember]
- I have used a free-floating or hub bicycle before? [yes; no; do not remember]
- If yes, which one? [Open answer]
- I would recommend shared bicycles to my friends, family, and surroundings? [yes; no; do not know]
- When I go to work, I travel by (e.g. train than by bicycle, train then walking, etc)? [Open answer]

I.1.2. Mentimeter questions

Nine different questions were asked using the Mentimeter, a software used to ask questions to a group via their phone. All participants used their own phone and first answered the warming up question: 'I have already used a shared bicycle before' The answer options: Yes; no; I do not know' could be given. The other questions are listed below:

1. *One-option qiestion*: What is the goal of using a shared bicycle system [Going to family; ad hoc; going to work; none; other]
2. *Scale question*: These factors play a role for me when using a shared bicycle [costs, sustainability, comfort, availability, flexibility, unavailability own vehicle] [1–10]
3. *Scale question*

- If my friends use shared bicycles, I will also use them
- I am influenced by the travel behaviour of my surrounds

4. *Scale question*
   - I think shared bicycles can be best used for tourists and expats
   - Price has influence on my use
   - I see a future in a shared bicycle systems
5. *Ranking question*: I see potential in [station based; free floating; hubs; none]
6. *Open answer question*: What would motivate you to use a shared bicycle system?
7. *Scale question*
   - A shared bicycle could be a replacement for car trips / ownership
   - A shared bicycle could be a replacement of the bike trips / ownership

I.1.3. The group characteristics

The characteristics of the different people:

- Attendee 1: a 23-year-old female. She uses her bicycle more than 3 times a week. She normally uses it to go to friends' houses, city centers or to go to the library. She does own a car and she used the ov-bike before. She did not use a free-floating or hub (e.g. Donkey Republic) shared bicycle before. She would recommend using the shared bicycle with her friends, family, and surroundings. She goes to work on her bicycle or walking.
- Attendee 2: a female, who bikes more than 3 times a week. She does not own a car and used the ov-bike before. She did not use a free-floating or hub-shared bicycle system before. She would recommend a shared bicycle system to her friends, family and surroundings.
- Attendee 3: a 25-year-old female, who uses the bicycle more than 3 times a week. She uses her bicycle to go to the university, the station or to her friends. She does not own a car and used both the ov-bike as a free-floating or hub system. She used the free-floating in Paris, not in the Netherlands. She would recommend using the shared bicycle systems to her friends, family, and surroundings. When she goes to work, she travels by bike.
- Attendee 4: a 37-year-old male, who uses his bicycle 1 to 3 times a week to commute to his work. He does not want to own a car. He has used both the shared ov-bike as the free-floating or hubs shared bicycle system. He used Donkey Republic, Cargoroo, and Nexbike. He would recommend using a shared bicycle system to his friends, family, and surroundings. To his work, he walks, takes the train, and then walks, or cycles the whole way to the office.
- Attendee 5: a 29-year-old male, who cycles more than 3 times a week. He uses his bicycle for running errands, visiting friends and doing groceries. He does not own a car and did use both the ov-bike and the free-floating or hub bicycle system. The used free-floating system is the Cargoroo, which is a cargo bike. He would recommend a shared bicycle to friends, family, and surroundings. He normally takes the train and walks to the office.
- Attendee 6: a 20-year-old female, who cycles more than 3 times a week. She goes to work on the bicycle and in her free time. She does not own a car and did not use an ov-bike before. She did use the Donkey Republic shared bicycle. She would recommend using a shared system to her friends, family and surroundings.
- Attendee 7: a 28-year-old female. She travels more than 3 times a week to do groceries, go to activities, commute and 'everything'. She does not own a car and used an ov-bike before. She did not use another shared bicycle system than the ov-bike. When she goes to work she or cycles, or she walks, takes the train and walks again.
- Attendee 8: a 27-year-old male, who uses his bicycle more than 3 times a week. He uses it to go from home to the train station or for going from home to his friends. He does not own a car, and did use

the ov-bike before. He did not use a free-floating or hubs shared bicycle system. He would recommend using shared bicycles to his friends, family or surroundings. He uses the bicycle and / or train to go to his work.

I.1.4. The focus group

The bold text are the questions or statements asked. The focus group was conducted live in Delft, on the 15th of June 2023, during lunch. Eight people were present during the session, excluding the presenter. The presentation was given via MentiMeter to collect the responses. The interview was 3 times recorded, via laptop, and via two Dictaphones. The spoken language during the focus group was English.

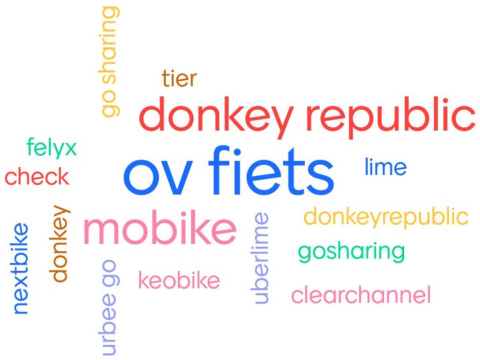


Figure I.1: warm-up question: knowledge about providers

The workshop started with a warm-up question. The question is "Which shared bicycle providers exist?". A lot of the people knew the available vehicles and one person responded with "Felyx, Check", which she responded later was due to misreading the question. The ov-bicycle and the Donkey Republic bike were the most given answers. The presenter introduced the different shared modes, and introduced the concept of "free-floating, station-based, and hubs".

The first question for the focus group entailed **"I have already used a shared bicycle before"**. The attendees were given a few minutes to respond to the statement. The answer option "yes" was given eight times. This means, attendees responded that they use a form of shared bicycles. After asking for elaboration on the response, one person (1) responded that they had a medium experience. "it was okay, I used an ov-fiets, but I did not find it very comfortable like it was quite heavy to bike, and I could adjust it, but with my length, it was not perfect. And, I did find it quite expensive for the limited time I used it..." [code: effort expectancy]. Another attendee (2) responded that they had the same experience, they also thought the price was quite high and responded that if you use it for more than a day, bringing your own bike in public transport would be more convenient [price value, effort expectancy]. Also again, the ease of use was criticized. Another given problem from the ov-bike in particular, but also in general, was the lack of possibilities if you have children [effort expectancy]. The presenter asked if people thought it was the best thing ever, the attendees laughed and one responded "the best thing ever...". An attendee (3) responded that it also depends on where you use it, for example in Amsterdam if you go to more spots, it is convenient to take the ov-bike in comparison to the tram [Performance expectancy]. The same attendee responded that they also just enjoy biking through a place like Amsterdam more than taking the tram [Hedonic motivation]. The attendee also responded to the remarks about the ease of use, she thinks the ov-bike is a very comfortable bike [effort expectancy]. Another remark she made was "that if you only do a short trip, it is too expensive, or there are so many apps out there for free-floating, that I kind of ignore that, because there is too much choice" [Effort expectancy, Hedonic motivation]. The presenter asked if everyone responded to this question, with the ov-bike in my, or if people also used other providers. An attendee (4) responded that he used a free-floating bike, last Monday. He saw the convenience of the free-floating, since he could go from the doctor to the hospital, back to his home, something he could not have done with a station-based bike. And "in the end, it only costs 5 euro, so I was surprised by how cheap that was for the amount of time" [Price value]. Someone else (5) introduced Cargoroo, a cargo bike, which was also a great experience since the people from the company were very helpful when the brakes did not work. Another attendee (6) responded that she used a Donkey bike as well, which was not too expensive [Price value] and it was easy to find another one or change it to another one, when that one was broken [Effort expectancy]. For the ov-bike the same attendee (6) added she could not use the bike, since a Dutch bank account is needed [Effort expectancy]. It was noted that the ov-bike is cheaper than the Donkey bike [Price value], Attendee (4) responded that a positive thing about the Donkey and Nex bike account is, is that they can be used in any country, once you have an account [Performance expectancy]. Attendee 7 mentioned that the availability of ov-bikes is not guaranteed [Influencing factors]. Attendee 4 agreed with this. Attendee 1 responded that a downside of the ov-bike is that it needs to be brought back to the same location [Effort expectancy].

“What is the goal of using shared bicycle system”
Some respondents asked for clarification on the “ad hoc” term. The term was explained like “spontaneous”. Three people responded that they used it ad-hoc, and five people gave ‘other’ reason as goal. Attendee 3 gave as reason that the public transport does not go anymore and other options like the shared bicycle need to be considered then [Performance expectancy].

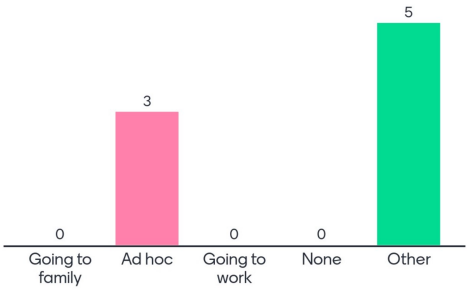


Figure I.2: Question 1 in the Mentimeter

Attendee 8 responded that he used the shared bicycle when he went to “a city where the public transport is unfamiliar, it is nice weather and you want to be free of station. Then you can take a shared bicycle, and you can reach all the destinations you want in a certain area, and in the end of the trip you bring it back to a hub, or put it somewhere” [Performance expectancy]. Attendee 1 agreed with this and added that the fact you are not bound to specific public transport times is also a plus [Performance expectancy]. She mostly used it to go to activities in other cities, with friends or company. Attendee 1 added that it did matter if the surroundings were known. If attendee 1 does know where she needs to go for the activity, she would rather go by public transport (e.g. tram) [Hedonic motivation]. The presenter expanded on this and asked if the attendee would always take public transportation before taking a bicycle. The attendee (1) responded “only if the connection is well”. Attendee 5 agreed to this, he would rather “not take a shared bike... but due to the reason of costs...”[Price value, Hedonic motivation]. Renting an ov-bike for the first 24 hours is less expensive than a round-trip with a tram ride. The presenter asked, that if the costs of PT became lower, the trade-off would not be made. The response (5) was that he “would probably take public transport” [Hedonic motivation]. Attendee 1 added to her own statement, that the reason why she preferred it was, because sometimes you need to take more with you, and an unfamiliar city, Google Maps needs to be used [Hedonic motivation]. With the new legislation, she did not see this as a possibility to combine Google Maps with riding the bicycle, since the ov-bike does not have the right equipment to support this. Attendee 2 added to this, that the ov-bike is missing flexibility, panniers are not an option on ov-bikes [Influencing factors]. Attendee 1 asked the other attendees if the other shared bicycles do have a place for the phone or something like ‘speedbinders’. Attendee 4 added that Donkey Republic does have a space for your phone and that they have a small cargo rack. Attendee 3 added on to the unfamiliarity of the city, she also liked exploring it. She does use Google Maps when she is on the bike. Attendee 3 also pointed out that she takes in the environment more when biking, instead of taking the tram and looking at her phone all the time [Hedonic motivation]. Flexibility mentioned before also is a part in this, attendee 2: “yeah, you cannot miss the bus”. Attendee 5 added that it is “more a price calculation, in his head” [Price value]. In unfamiliar places, he would definitely take public transport. The presenter concluded the discussion and asked if anyone wanted to add something. Attendee 7 wanted to add something about bringing stuff on the bicycle. She normally took everything with her on the bicycle, and rented an ov-bike, and would also do this when public transport was available. Attendee 4 added that he did not use it on a day-to-day bases, but more on a spontaneous trip, and when he needed to go to multiple locations in the city, a shared bicycle is convenient [Performance expectancy]. Attendee 1 added to this, that she also saw the benefit of using a shared bicycle when going to multiple locations, since the public transport is less connected. Some attendees agreed to this by nodding [Performance expectancy].

“These factors play a role for me when using a shared bicycle”
Some attendees asked clarification questions, about availability. The presenter explained that availability should be seen as a “comparison to other means of transport”. The attendees got a few minutes to answer again, so after, the presenter and attendees could elaborate on the scores. The first question was if attendees thought factors were missing from the list.

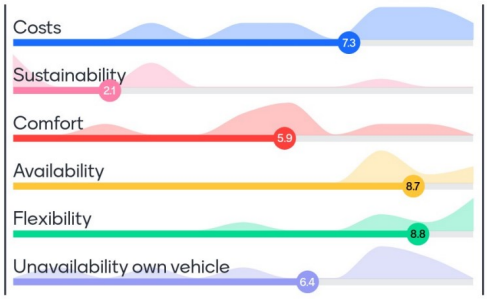


Figure I.3: Question 2 in the Mentimeter

Attendee 3 responded that she missed the factor for the weather, she would always take the bicycle, if it is not raining. Otherwise, she would take public transport [Influencing factors, Hedonic motivation]. Attendee 5 mentioned the multiple options for shared

bicycles and it different app influence his use. With an ov-chipcard, attendee 5 already has this card, so the effort is less [Effort expectancy, Hedonic Motivation]. “ov-bike is an entirely different category for me”. Attendee 1 totally agreed, since she has one bad experience, she is hesitant to use another shared bicycle, and would always prefer an ov-bike[Hedonic motivation]. Attendee 4 would want to add “accessibility for people using it”. Attendee 4 would want to use it, but due to bringing his children, it is not accessible [Effort expectancy]. The presenter asked if attendee 2 would like to add to this. She mentioned that “the costs of the own vehicle is only connected. For example, I do not have a car, so I save a lot of money... so I will pay an ov-bike, I don’t care, so the price is not important”[Price value]. The presenter asked if this is some kind of trade-off. Attendee 2 said that she gets that if you have a car, this could be expensive [Price value]. Attendee 3, since she is still a student, public transport is free, but the ov-bike is not free so that also needs to be taken into account [Price value]. Attendee 4, would rate flexibility higher than costs due to the circumstances you are in [Price value]. When the presenter asked for sustainability, one of the lowest scoring factors, was important or put it high on the scoring, attendee 2 responded that it was important and also the reason she does not have a car. Unavailability of the ow vehicle, how did people interpret this? Attendee 6 responded that she saw this as the unavailability of her own vehicle. Attendee 2 would take the bike in the train, than taking an ov-bike. Attendee 1 added that sometimes bringing the car to other cities, is not beneficial due to the parking costs. She saw unavailability as not having a vehicle available in that context.

The factors could be scored on a 10-point scale. The score was the following from high to low: Flexibility (8.8), availability (8.7), costs (7.3), unavailability of own vehicle (6.4) and sustainability (2.1).

Introducing two scales (social influence): **“If my friends use shared bicycles, I will also use them.”** and **“I am influenced by travel behaviour of my surroundings”**

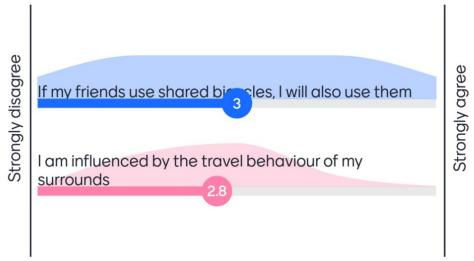


Figure I.4: Question 3 in the Mentimeter

Attendee 3 explained that she strongly agree and that she normally takes the shared bicycle, especially the ov-bike when going to festivals or parties with friends [Social influence]. Attendee 1 wanted to add to that and responded neutral, but had the same reasoning behind it. She would not be influenced if they did it, but if together, she would be influenced [Social influence]. On her own, if someone tell her for example they would have taken the Felyx (scooter), she would say “Good for you, but I would not really do it”. When asked what attendee 8 thought of the matter, he responded that “I am very neutral”. Indirectly attendee 8 feels influenced, he explained: “if people around you, you see them using bikes more in your city, that wouldn’t influence me, but I think if a city has more bike users, the infrastructure becomes better or is good, and that would influence me” [Social influence]. Attendee 2 responded that if you go to other cities, such as Paris, where you see more people using the bicycle, she would see it as a possibility, while if it is not that clear, she would not look it up. Attendee 4 responded, that this question could also be asked the other way around: “if your friends aren’t using, would you then also not use it”. Attendee 5 responded to this and elaborated that this could be an interesting take. In Canada, he would bike there, but some people can be stickered as different’. He also elaborated on the Felyx comment, if someone would introduce him to how to use the system, “I’ll be more likely to use it, because then I do not have to get over that ‘drempel’, that step myself’ [Social influence]. Attendee 6 responded to this, she would rather show that her friends could use a bike instead of the car, to do the opposite, and how them how it could also be done [Social influence].

Scales: **“I think shared bicycles can be used for tourists and expats”** and **“Price has influence on my use”** and **“I see a future in a shared bicycle system”.**

Attendee 7 responded after filling in the scales, that the question was hard to answer since: “it is a great system, if you use it for a last-mile, but I do not think it is a good solution for only your private bicycle” [Performance expectancy]. Also the importance of experienced bicycles is important, that is why it should not be only for tourists or expats. The only strongly agree answer was given because the attendees also saw them self as tourist, when in other cities [Influencing factors]. Attendee 1 would only use it as a tourist since her own bike is much better in her own city [Effort expectancy]. Attendee 7 was asked for their opinion and responded that it is a pity if you cannot use a shared system as a expat or tourist. Attendee 7 is renting a Swapfiets herself. Attendee 5 elaborated on his answer, strongly disagree, this was due to the “shared bicycles can be BEST used for tourist and expacts, because I do not think that is the absolute best use of shared bicycles but one of the, amongst other things”.

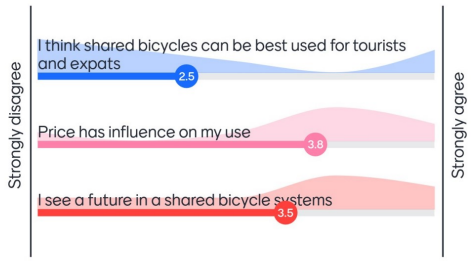


Figure I.5: Question 4 in the Mentimeter

Attendee 5 responded back to the example attendee 4 had given about his latest ride: “I think that is a fantastic use as well”. Agreeing with the statement would mean for attendee 5, that they [the providers] would put the shared bicycles in places such as Scheveningen and central stations, but not places where they could be used to go to the doctors [Interesting comments]. Attendee 8 asked specifications on this statement by attendee 5, if it could also be rephrased to “I think shared bicycles can be best used for spontaneous or ad-hoc moments”. Attendee 5 responded that they could have a good use for bicycles, but it does not mean it is the best use. The price does according to attendee 5, strongly agree, has importance. The future is scaled quite high, but attendee 1 wanted to add to this, that she does agree with attendee 5, that the future is dependent on how the bicycles are spread. If the bicycles are only placed at hotspots, the situation would arise that the bicycles are mostly used by tourists and expats, and it could influence the image of shared bikes, which could influence the use of it [Interesting comments].

Ranking: **“I see potential in” (hubs, station-based, free-floating, none)**
Some clarification questions were asked, about what was meant by the free-floating. The presenter explained that these were bicycles, which could be parked anywhere, and are not restricted to a location. The question was raised what the difference between station-based and a hub was, it was explained that station-based only was close to the train station. It was explained that Cargoroo names their parking location a “station, but it is actually a street corner”.

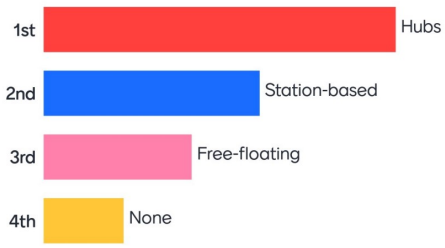


Figure I.6: Question 5 in the Mentimeter

The rating showed that hubs could have the most potential [Category sharing]. The presenter asked if people also responded none, attendee 5 responded to this, that free-floating was placed as last and none as third in the rating [Category sharing]. Attendee 7 agreed with this. Free-floating is seen as more chaos, and attendee 5 explains why he made this rating. For example, the Felyx is free-floating, and is parked anywhere, for people other than himself such as his father could be an obstacle, if you cannot easily avoid this. Attendee 8 and attendee 1 both agreed with this. Attendee 8 elaborated on the agreement, by saying he disliked free-floating in general [Category sharing]. He portrayed a perfect solution: “In my perfect image, there would be, because there is social, there is places where people need to be sometimes, best case scenario, there would be some hubs around it, very close by, it is arranged, there is space for it, they are aligned or something, they are no in the way of other users of the road, or pedestrians, then it is still everywhere but regulated, and free-floating like how Felyx started, and how go is still being used in Rotterdam, it is the worst thing ever, in my opinion” [Performance expectancy]. Attendee 4 responded to this, when the presenter asked if anyone was pro-free-floating, that he was for a combination of free-floating and hubs [Category sharing]. The example was given that for a hub system, 90% is facilitated by hubs, for the odd-trips a possibility is there to park it as

a free-floating system. This information would then used for user-based feedback, back to the operator, to implement a hub there, if a lot of people are in need of it. User-feedback would then be used to optimize the system. Attendee 8 responded to this idea, with the question if a hub-system is then not still your best option then. Attendee 4 refutes this argument, and responded that there is a need for the free element, “in order to develop it. Instead of a static system, and it will never be able to adapt to what users actually need” [Suggestion operator]. Attendee 8 responded to this again, and concluded that you strive to create the data, to place a new hub. He also added to the argument “it sounds to me, as if you are still striving as a free-floating company to where are we going to place the hubs’. Attendee 5 added to this: “The means to that is free-floating”. Attendee 3 wondered if the data could not be attained in other ways, by facilitating discounts if people give feedback to the system. Attendee 3 wondered if giving people the possibility to still operate as if in a free-floating system, even though selling it as a hub, people would not still just go everywhere instead of going to the hubs. Attendee 4 responded to this, that he does not believe this will happen, since as an operator you are still able to steer that. A suggestion would be to still incentivize people leave their bicycles at a hub. If you go outside the hub, you need to report it, or pay a supplement and features could be used to still organise the system. Or geo-fence. Attendee 1 responded to this: “I hear what you say, but I think availability problems would be an issue then, because for the operator it would be more difficult to think in advance if this would happen or not and how they could insure that every hub still has enough vehicles. So, I do hear what you say, but I think it will be difficult in practice"[Risk factors]. Attendee 5 added another thing he did not like about free-floating, is that the system in the Netherlands is for personal bikes already free-floating: “Everybody has their own bike, it is just not shared. And people park it, especially in larger cities (e.g. Den Hague), people park more or less wherever they want, and to me that results in a lot of influence on or hideous of the public space. So to me adding free-floating to the existing system, would only make this problem worse. Yes, there are ways of controlling that, with geofencing, and probably far easier than people their private bike,. . . ,but that is why I was vehemently against free-floating. Even outside bike sharing, people their own bikes I see that as an issue,. . . , the taking over of public space” [Risk factors]. Attendee 3 added to this that she saw it as a “reputational risk for the bike, people who are neutral about bike in general, they think, ah okay, now there is more chaos, now we want no bikes on the street anymore,. . . , the normal bike than also becomes a problem”[Risk factors]. Everyone agreed though that cars take in way more space, but relatively speaking attendee 5 added, that if the cars stay the same, and bicycles increase, there could be no more space to walk. Attendee 3 added to this, that bikes also create more chaos than cars, appearance wise. Attendee 4 also noted that ownership also makes a difference in the chaos. The presenter asked if anyone put station-based as their most important factor. Attendee 7 responded that she thought shared bicycles are best in combination with public transport and there always at the station, and ideally a transport hub [Performance expectancy]. So it should not only be the bicycles, but a bigger transport hub. The presenter tried to clarify if this transportation hub should be closed to the train station then. Attendee 7 responded “or close to a bus station”. The presenter asked a clarification question again, what attendee 7 saw as the difference between a hub and a station-based system. Attendee 7 responded that she would like to combine the first two (station-based and a hub), but “not like there is at every corner of the street a hub”. The presenter asked if anyone wanted to add to this, no one responded, so the next question was introduced.

"What would motivate you to use a shared bicycle system?"
The next question was introduced where the attendees got the possibility to give a maximum of 3 open answers. The attendees were given a few minutes again, to think about it and submit their answers. After submitting all the answers, the presenter walked through the answers and asked if anyone wanted to elaborate on their answers.

Figure I.7: Question 6 in the Mentimeter

The most given answer was flexibility [Influencing factors]. The presenter noted that a few of these things were mentioned before, and scanned the list. The presenter asked if the person who wrote it could explain ‘chipcard working no app’. Attendee 1 responded that she meant: “I really like the system of the ov-fiets, that you can tab your card and use it, because I find the apps, well not necessarily difficult, but I had problems with identifying, or even finding one. So that would be very flexible and no time consuming, if it could work, something like

that, not necessarily with your chipcard but for example with your ING bankpas" [Hedonic motivation, interesting remark]. Attendee 7 added that it could be an interesting research topic, to see if people liked the ov-bike better because it works with manned stations, but she also stated that more often now also ov-bicycle stations are unmanned. Attendee 5 elaborated on his answer 'knowing where they are', which was not only cantered around the location, but also the different providers and their conditions "where do I need to park, do I need to bring it to the same place,..., do I need a creditcard,...,its all these factors to me, even one is complicated to know, to know four,..., to have something that tell me all of that, like you can use this one at this place, to go where you need to go, period, would be really easy, but that doesn't exist...to my knowledge" [Effort expectancy]. Attendee 1 added to this, that even the websites of the providers are very vague. The conditions are unclear, and everything is different for every provider. An overview would be perfect. The presenter asked to attendee 6 what she added to the list, and she responded that it was flexibility and she was too late to add the rest since she already submitted it. She added to the story of the unavailability of clear information, that she had the same with the Donkey bike, she wanted to know how much she needed to pay, to compare options, but on the website, you cannot find it, you need to download the app, create an account, find where you are, so it could be good to have an overview of this [Effort expectancy]. Attendee 2 responded, "an one app fits all". The presenter asked again if there was anything anyone would like to add before going to the last slide and question of the presentation.

"A shared bicycle could be a replacement for car trips / ownership" and **"a shared bicycle could be a replacement for the bike trips / ownership".**
Another scale was introduced, where the attendees could choose between 'strongly agree' or 'strongly disagree'. An attendee asked if this was in general or personal. The presenter responded that it was in general. The general scores for these were both a two out of five.

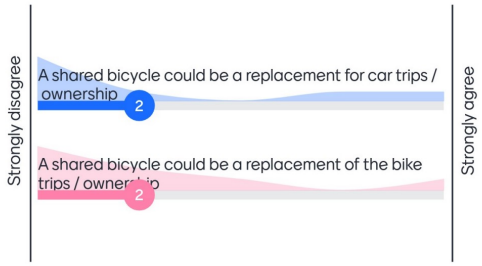


Figure I.8: Question 7 in the Mentimeter

The presenter asked if the person who strongly agreed with the first statement could explain why, attendee 5 responded that in so many cases the car trips are below 5 kilometres [Performance expectancy]. He introduced that especially in his neighbourhood, bike ownership is not seen as 'grown-up'. This is mainly caused by the demography of the neighbourhood. If people have more access to a rental bike, such as Cagaroo and Felix, which were first not located in the neighbourhood, there could be a possibility to replace certain car trips. He emphasized that not all could be replaced, but for short trips it could be [Performance expectancy]. Attendee 4 added to this, that he thought it could be a replacement, but only in combination with other options (e.g. cargo bikes or PT) [Performance expectancy]. Attendee 3 added to this, that some trips are better with a car, but also for this a shared system such as Sixt exists. She emphasized that she does not think it could be a "complete replacement, but it would be in the whole puzzle of shared mobility, be a key in there." [Performance expectancy]. Attendee 3 responded that she thinks that a shared bicycle is quite often a replacement for public transport and that for her, it would not always be for car trips [Performance expectancy]. Attendee 7 responded to this with a murmur "I don't think so" [Performance expectancy]. Attendee 1 also added that the difference between the occasions where you would use a car and where you would use a bike is too big, so for her public transport would replace a car trip before a bicycle would do this. That is why she chose to disagree. She saw it more as an addition to public transport and all together it could replace the car". Attendee 1 also added that it is more likely that an electric bike would replace the car, which she would buy, so she has it all the time since she sees a shared bicycle as something she would take in other cities [Hedonic motivation, performance expectancy]. She added: "A car is mostly for the use, well not everyday life, but more like, you want to know in advance that you have the car and you can plan those things, and there is an uncertainty factor for me in the shared bicycle system". When asked about the motivation of the second statement to choose strongly agree, attendee 8 responded that he thinks about future scenarios and that in 100 or 70 years from now, everyone needs to go there. It is a possibility that all bicycles are shared, and there are 20 or some in front of your house which you can unlock with your keycard. The need for an own bike is not there anymore then, but he empathized "when there are enough shared bicycles". Attendee 2 responded, but that is the problem, there are

not enough. Attendee 8 responded that in his scenario there are, where attendee 1 responded to “the chicken and the egg”. Attendee 1 explained: there have to be enough [supply], but also enough [demand] to use it, and now there are not enough people to use, since there are not enough bikes [Influencing factors]. Attendee 3 finished the focus group by adding “I want to have my own bike, because I don’t want to be in the position where there are no bikes,. . . , other than that I really don’t care if it is my bike or another bike if I share it or not, but that needs to be covered first” [Influencing factors]. Attendee 2 responded to this “it also needs to be quick” and should not be too much effort. Attendee 3 expressed her confidence in a system with a card and added with a laugh that maybe such a system can only exist for a hundred years [Interesting remarks].