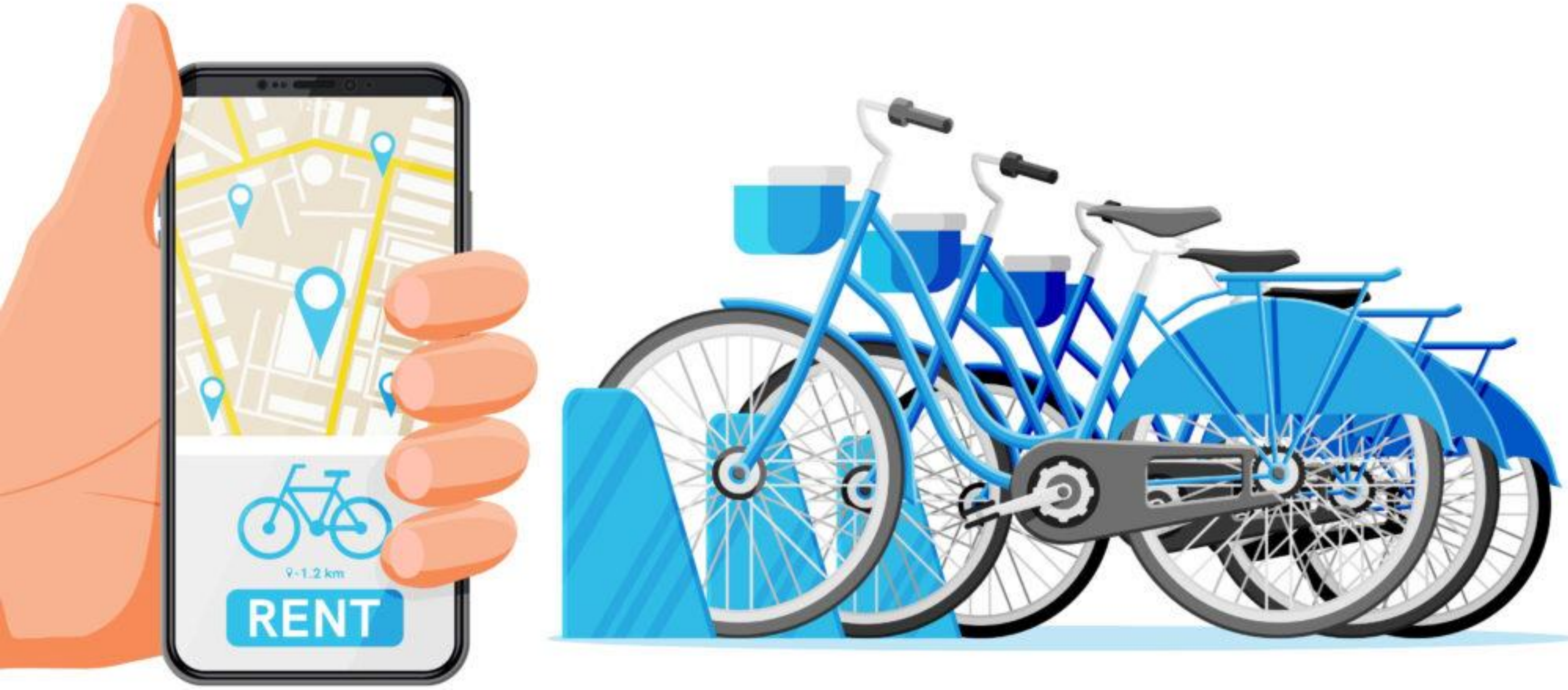

Unleashing Suburban Shared Micromobility

A Comprehensive Framework with Guidelines for Implementing Suburban Shared (E-)Bike and Moped Services, the Netherlands

TU Delft

provincie Zuid-Holland

Master Thesis

R. (Rody) Boting | 13 December 2023

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Master Thesis

by

R. (Rody) Boting

5421446

to obtain the degree of Mater of Science in

Civil Engineering with Track Transport & Planning

at Technical University Delft

in cooperation with Province of South Holland

The Hague

December 2023

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Preface

This thesis covers research into Shared Micromobility in suburban areas, which is the final product of my journey at the Technical University of Delft. Starting with the pre-master during the COVID-19 pandemic and seeing it disappear while continuing my master Transport & Planning. The COVID-19 pandemic was impactful for everyone; although, my pre-master and the subsequent master's program went surprisingly well. Looking back, the decision to pursue a university master's degree after completing an HBO degree (University of Applied Science) in Civil Engineering was a good and highly educational choice. Despite not everyone having confidence in it, I smoothly navigated through the process. It went so well that during my master’s degree, I did not have to retake any of the 18 exams and managed to complete all the ECTS in 5 quarters – an achievement I can be proud of!

Over the past few years, I have enjoyed what I have done and learned. Since childhood, I have been interested in planning and connecting cities, starting in elementary school with just a pencil and paper. I could create entire cities, complete with legend and, of course, a robust infrastructure.

There is a broad spectrum of possibilities that become available after completing the Transport and Planning master. Whether to start working in the public transport sector, at airports, harbours, on roads, or waterways, everything is possible with the knowledge gained during the master. New topics such as autonomous vehicles or shared mobility are also within reach. The latter has especially gained my interest during my research. I have learned a lot about the opportunities of shared bicycles, shared e-bikes, and shared mopeds.

I also want to take this moment to thank everyone who helped me during the thesis process. First of all, are the students, or better described as friends, that I met during my time studying at TU Delft. Every week, we could discuss each other's issues and motivate one another. I advise everyone to look for this contact during this time. Even if you do your thesis independently, this does not exclude discussing it with fellow students.

Secondly, I want to thank my colleagues at the Province of South Holland, especially Ronald Haverman, my company supervisor. Besides general guidance, he taught me a lot during daily coffee moments and all the activities and conferences I could attend. Especially in the first months, I had the opportunity to go everywhere. Aside from this being interesting, this also provided valuable input for my research.

Furthermore, I want to thank my committee, all the feedback provided was very useful and elevated my research to a higher level. Each supervisor supported me on another part of the research. Many thanks to Niels van Oort who suggested the province of South Holland and provided guidance on the subject. The second supervisor, Winnie Daamen was mainly involved in the method of collecting and processing data, however, I am also grateful for the other conversations. And finally, the chair of the committee Serge Hoogendoorn, who provided helpful feedback on the research with little information and time.

Finally, I want to thank the people who took the time to help me with various questions, filled out the survey, and everyone who was open to an interview. I am positively surprised by everyone's willingness to take the time and help with the research. It is highly appreciated!

R. (Rody) Boting

The Hague, 2023

Abstract

The car has been a significant invention in many respects, providing people with greater freedom of mobility. However, the rapidly growing dependence on cars has also led to adverse consequences. To achieve a sustainable and accessible transportation system, both research and policies emphasize the importance of promoting alternative transportation options over private cars (Lättman et al., 2020). A promising alternative involves combining active forms of mobility with public transport. In countries like the Netherlands, regional public transport is undergoing a transformation, emphasizing fewer stops, increased frequencies, and shorter in-vehicle times. This shift results in an increase in the so-called last mile of the journey, often making it not possible to cover the distance walking. Providing an opportunity for the implementation of shared micromobility.

This research focuses on sharing of bicycles, e-bikes and mopeds, and aims to establish a unified approach for towns and suburban communities. Shared micromobility or in other words shared two-wheelers, are a flexible and eco-friendly transportation option with various benefits, as described in a wide range of international literature. In addition to serving as a valuable complement to public transport and providing an alternative to private motorised vehicles, it also contributes to the more efficient utilization of spatial footprints and enhances awareness for cycling and sustainability.

At the time of writing, shared micromobility services are mainly provided within cities, although it can have substantial effects in suburban areas. Because of this concentration in cities, most research has focused on these areas and are also mainly focused on characteristics of users. The aim of this study is to fill this knowledge gap by investigating and answering the following main question: "What is the most effective approach for implementing shared micromobility services in towns and suburban communities to maximize the benefits for both users and society?". The research methodology to answer this question involves a literature review, expert interviews and a survey.

16 experts are interviewed within 13 separated interviews, divided across 5 expertise groups. Resulting in a total of 348 statements, reduced to 61 codes, grouped into 12 subcategories and 4 overarching categories. The survey included 25 questions, complemented by 8 questions from the choice experiment, which in total consists of 32 different situations. The sample was 566 respondents large, of which 77 were filtered out for various reasons. Only inhabitants of small to large towns of the province of South Holand with an age above 18 year were invited to participate in the survey, with resulted in a representative sample compared to the actual population, with a slightly older average. The data set of the stated preference experiment included 3816 choices. In which, about half of the people were presented a scenario of making a daily trip and the other half were given a commuting scenario. The questions vary regarding distance and time, both of which, based on the results, have a significant impact on people's choices between the four alternatives.

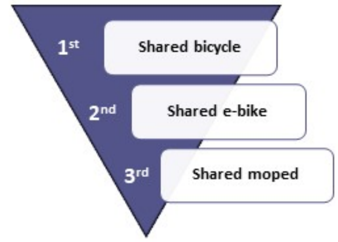
The following page illustrates all key findings and conclusions, followed by a flowchart determining the sharing type in Figure 1. The approach presented on the following page, along with the flowchart, provides guidance for all municipalities and other companies or organisations that want to start or have questions about initiated shared micromobility. With the objective to ensure a service that is more appealing to potential users and causing minimal disruption for local residents.

In practice, these findings along with the complete process of the research already resulted in positive feedback within the municipalities of Katwijk and Leiden. Consequently, the decision has been made to officially introduce shared micromobility in the case area in the upcoming spring of 2024. The research has provided the municipality of Katwijk with sufficient guidelines to establish a service and has successfully persuaded the municipality of Leiden to participate.

Main research question: *"What is the most effective approach for implementing shared micromobility services in towns and suburban communities to maximize the benefits for both users and society?"*

< Based on Literature Review[1], Expert Interviews [2] & Survey [3] >

Sharing type



For the determination of the sharing type, considered from governance perspective, it is recommended to initially follow the order presented in the figure on the right.

However, determining the most suitable modality precisely depends on more detailed specifications. For this purpose, consult to the added flowchart.

Shared bicycle:
- ✓ Travel distances below 4km [3]
- ✓ Suitable application for commuting, crowded areas, P+B and combination with national or regional PT [1] & [2]
- ✓ Mainly preferred by high educated individuals or people with low income [1] & [3]

Shared e-bike:
- ✓ Travel distances between 3km and 8km [3]
- ✓ Suitable application at P+B and combination with national or regional PT [1] & [2]
- ✓ Wide target audience [1] & [3]

Shared moped:
- ✓ Travel distances over 6km [3]
- ✓ Reducing car usage and improving the integration with national PT [1] & [2]
- ✓ Mainly preferred by individuals below 35 years or students [1] & [3]

Service area

Shared bicycle:
- ✓ Sharing system: Back-to-Many, including affordable Back-to-One possibility [2]
- ✓ Maximum of 1 shared micromobility operator (OV-bike excluded) [2]
- ✓ Relatively low investment costs [2]
- ✓ Service area connected to surrounding municipalities [2] & [3]

Shared e-bike & shared moped:
- ✓ Maximum of 2 shared micromobility operator [2]
- ✓ Fundamental condition: Connect service area to minimum one large-sized town (> 100.000 inhabitants) [2]
  - City center: Back-to-Many with few hubs (Preferable physical parking for shared vehicles only or parking for general e-bikes/mopeds)
  - City districts: Depending on situation, Back-to-Many with many hubs or Free-Floating
  - Suburban areas (Medium or small sized towns): Back-to-Many

Hub locations

Key destinations within the area, including but not limited to: [1] & [2]
- ✓ Public transportation stops and stations
- ✓ Business parks & companies
- ✓ Shopping and sport centres
- ✓ Educational campuses
- ✓ Tourist hotspots & event venues

Digital and physical hubs:
The system needs physical hubs at crowded locations, such as railway station and BRT stops. It is recommended to initiate the setup with a limited number of physical hubs, adjusting digital ones based on user data. [2]

When planning the hub locations, the following favourable walking distances to the vehicles should be considered: [1] & [2]
- ✓ Shared bicycle: Below 150 meter
- ✓ Shared e-bike: Below 200 meter
- ✓ Shared moped: Below 225 meter

Operation & Marketing

To ensure a healthy business case – An economically feasible service that minimizes the need for continuous subsidies – it is important to target for daily trips per vehicle: [2]
- ✓ Shared bicycles: Approximately 2 trips per bike per day
- ✓ Shared e-bikes: Over 2.5 trips per e-bike per day
- ✓ Shared mopeds: Approximately 5 trips per moped per day

Starting a new project is ideally undertaken in the spring months, March, April, or May, a time when individuals are more inclined to embrace alternative modes of transportation such as shared bicycles. To ensure a reliable product, it is crucial to offer a year-round service that operates seven days a week, 24 hours a day, preferable for a minimum of four years. [2]

To accumulate initial interest and engagement, strategic measures such as flyer distribution, information at hubs, and incentive programs, such as discounts for leisure use and free usage for commuting, can be implemented during the project's initial phase or pilot period. These initiatives aim to encourage non-users to participate and contribute to the start of the project. [2]

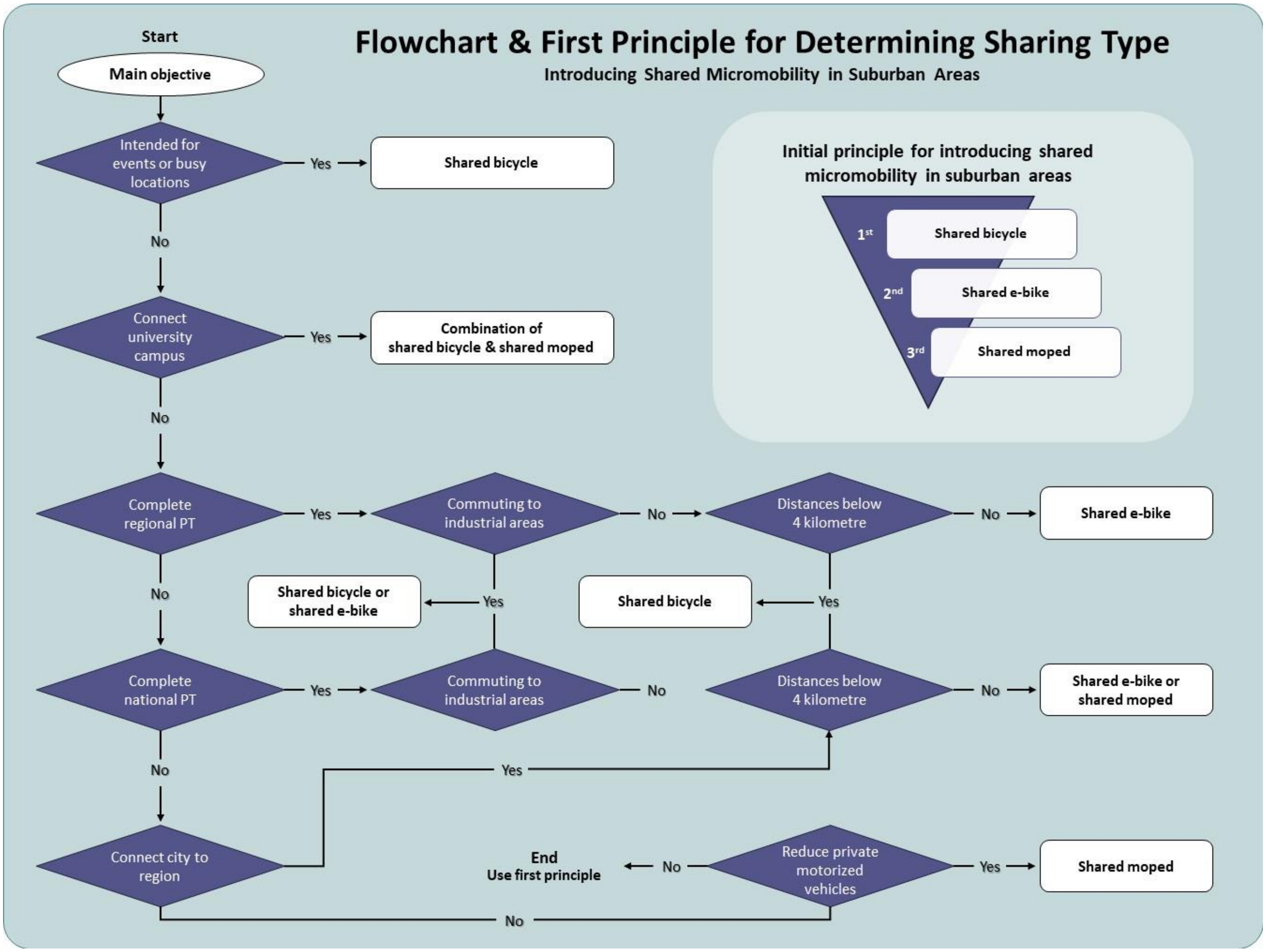


Figure 1: Flowchart for determining sharing type in suburban context

The most effective approach for implementing shared micromobility services in towns and suburban communities, considering the preferences and requirements of key stakeholders, such as users, non-users, shared micromobility providers, public transport operators and municipalities or other government agencies depends on the specific situation. However, a general recommendation can be formulated based on the findings presented above. When municipalities or other government agencies have the intention to initiate and promote a new shared micromobility service, it is crucial to first determine the system's primary objective. Each objective has different service characteristics. Commonly mentioned objectives in literature and during the expert interviews include improvement of the sustainability of the mobility network, increased accessibility, reduction of pressure on bike parking facilities, and lowering the investment costs in transport and mobility.

The starting point to consider is the application of shared bicycles in combination with regional public transport. If key locations are not accessible with this combination due to long distances in the service area, typically exceeding 3 kilometres, then the application of shared e-bikes is more suitable. Additionally, the initiation of shared mopeds could be considered, although it is less likely to use subsidies for this mode of transport.

Continuing with the characteristics of the service area, another important aspect is the inclusion of neighbouring municipalities without direct public transport links and a connection to a larger town or city in the area. The latter is crucial when launching a system based on shared e-bikes or shared mopeds, as insufficient scale and high operation investments make it unappealing for a shared micromobility providers to start. Additionally, the findings of this study conclude the implementation of a back-to-many sharing system rather than a free-floating or back-to-one.

An example of a promising service involves the application of shared bicycles with hubs at all key locations in the service area and various hubs in the neighbourhood (back-to-many). Anticipating on the requests of residents and businesses. The service area is connected to all interested municipalities, with an emphasis on connecting at least one large town or city. If this collaboration is established, shared e-bikes are introduced, primarily focused on distances exceeding 3 kilometres. Finally, the system can be complemented with shared mopeds, limiting their use to a few hubs per municipality. This allows for effective control of usage and minimizes disturbances. Limiting the number of locations makes it possible to create physical parking facilities for mopeds, which contributes to mitigating inconvenience.

In more detail regarding the stated preference survey, the results show a significant effect of costs and distance on the choices. In which the increase in likelihood related to distance is the strongest for shared mopeds, almost six times as strong compared to shared bicycles. This implies that the probability for choosing shared mopeds increases more significantly as the distance increases compared to shared bicycles. Other interesting findings are the strong effect of interest and usage. Both decreases the likelihood for opting out and thereby increases the chose for a shared modality. To end with, it can be determined that age also has a significant influence on decision-making. This study did not found statistically significant relations between decision-making and the level of education or income.

In a follow-up study, the differences between shared bicycles, shared e-bikes, and shared mopeds can be further investigated, potentially supplemented with other modalities. The entire dataset from expert interviews and the survey is available, under some conditions and in good consultation. More detail can be achieved by investigating new relationships and applying a more extended model, such as Nested Logit or Mixed Logit, instead of the utilized Multinominal Logit model. Moreover, two underexplored topics are traffic safety and sustainability. The extent to which bike-sharing is more sustainable compared to shared mopeds can be examined, along with the role of traffic safety. To end with, the study offers valuable insights, but the specific suburban sample and context mean that the results cannot be easily generalized outside the Netherlands, or in urban context.

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PART III: EXPLORING PUBLIC SENTIMENT

Word explanations and abbreviations

Back-to-One	Sharing system, in which users start and end their journey on the same location
Back-to-Many	Sharing system, in which users can start and end their trip at different fixed locations
Docking station	A manually or automated station, sometimes including a kiosk, where bikes or other vehicles can be locked, also called "docking stations" or "docks"
Free-Floating	A Sharing system in which users can end their trip at any location they prefer, within the service area
Shared micromobility	Sharing of pedal bikes, e-bikes, and e-scooters (Shared two-wheelers)
Shared micromobility service	Offering shared micromobility (Also known as programs or schemes)
Town dimensions	Large sized town (City): > 100.000 inhabitants Medium sized town: Between 100.000 and 15.000 inhabitants Small sized town (Village): <15.000 inhabitants
Transport poverty or exclusion	Lack of mobility options that limits a person's ability to participate in society

CBS	Central Bureau for Statistics
SMM	Shared micromobility
SMMS	Shared micromobility services
PT	Public Transport
P+B	Park & Bike
P+R	Park & Ride (Public Transport)
MNL	Multinomial logit (models)
MaaS	Mobility as a Service

Part I:

Why & how

1 Introduction

Having access to public transportation is one of the basic needs, besides e.g., shelter, food, and clothing (Chiappero-Martinetti, 2014). An EU-wide survey from 2014 has examined the accessibility of public transportation. As expected, the level of public transport service is linked to the living area type: in metropolitan areas the percentage of population not served or badly served by public transport is less than 5%, while this share increases in suburban areas, where it amounts to almost 40% (Fiorello et al., 2016).

Accessibility refers to people's ability to reach destinations (Bastiaanssen et al., 2013). To be able to access and participate in activities such as work, facilities, and social contacts, is an important condition for people (Martens K. , 2015). Accessibility is additionally important for the economic functioning of cities and regions, because better connectivity improves business interactions, which contributes to productivity (Banister & Berechman, 2001). Lack of mobility options can lead to inaccessibility and thus result in transportation poverty[1] (Bastiaanssen et al., 2013). On average, a Dutch person lived 1.8 kilometres from an exit of a main road and 5.2 kilometres from a train station (CBS, 2023). Compared to other countries, this is a relatively well-distributed infrastructure, with a large role for bicycles and a public transport network of reasonable quality. However, at the same time, the spatial structure is increasingly based on the car (Bastiaanssen & Breedijk, 2022). With 30% of short business trips, less than 5 kilometres, still carried out using the car (Engbers & Hendriksen, 2010). And this is not only the case for the Netherlands, various cities around the world, for example in America or Asia, are stuck in the cycle of automobile dependence. The effect of this cycle is the ever-expanding car network at the expense of other modes of transport, shown in Figure 1.1 (Will, 2018).

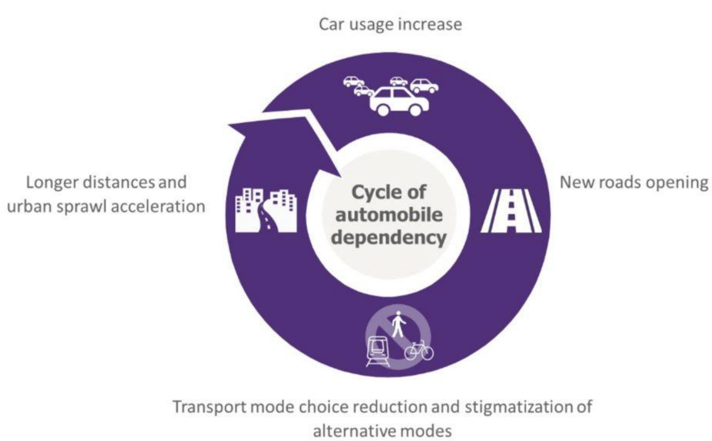


Figure 1.1: Visualization of the cycle of automobile dependency (Will, 2018)

This phenomenon has already created a huge problem regarding the car dependency. On the one hand, cars have improved the access to jobs and services, gave people more freedom and stimulated the development of roads and transportation, however on the other hand, this also has a downside. Currently in the Netherlands, many jobs and facilities are located along highways or urban fringes and many of these locations are difficult or even impossible to reach without a car (Martens, 2000; Bek, 2021). A large-scale study from the UK government, conducted by Social Exclusion Unit in 2003 on accessibility poverty, found that people not owning a car were experiencing frequent problems in visiting family or friends. Even two

[1] Transportation poverty or in other words, accessibility poverty, can be described by low accessibility that severely limits a person's ability to participate in activities considered necessarily or normal (Martens & Bastiaanssen, 2019).

out of five jobseekers had problems getting a job. These findings were mainly concluded for areas outside the city (Preston & Rajé, 2007).

One limitation of public transportation is the challenge to cover the distance of the so called first and lost mile of the entire journey, particularly in suburban areas. This limitation can be addressed through integration of shared micromobility, which is the focus of this research. The study aims to explore how shared micromobility can be effectively implemented in suburban areas and towns to meet the needs of residents and other stakeholders. This integration is crucial for enhancing accessibility and mitigating transport poverty.

1.1 Problem description

Compared to most other countries in the world, the Netherlands is exceptionally well suited to the application of shared micromobility, because the infrastructure of the Netherlands is largely made around the cyclist, which provides an easy application (Bastiaanssen & Breedijk, 2022). In several Dutch cities shared micromobility is currently offered because supply and demand emerge naturally. Many studies in the field of shared mobility are therefore focused on these areas, but as mentioned, shared mobility can also have substantial effect within suburban areas.

During the exploratory phase of this study, including the stakeholder analyses with interviews, it became clear that municipalities and public transport providers are willing to start implementing shared micromobility. However, each municipality or public transport provider have its own approach with another research into the best application of shared mobility. This happens with large investments and finally in various cases to little result. They are all individually looking for a plan or vision for the application and have many questions, especially small and medium sized municipalities. The implementation of shared micromobility can only contribute to better accessibility if the vehicles in the system are actually used by people. While this seems obvious, it can be observed in practice that authorities, operators and transport companies lack knowledge about target audiences, finding the right locations and offering the right facilities, which result in starting projects without a good business plan and consequently low use of the vehicles. The main cities in the Netherlands, such as Amsterdam, Rotterdam or The Hague, followed by cities as Amersfoort and for example Groningen have conducted several pilot studies to find the best application for their city, but grey literature for suburban areas such as towns are not available.

To meet the requirements and expectations of the Province of South Holland and other stakeholders (i.e., municipalities, public transport providers, MaaS platforms and shared mobility operators), it is necessary to formulate a comprehensive approach for shared micromobility services within suburban areas and towns. This should include operational features, recommendations and design guidelines that can serve as framework for any future policies and can be used as a direction or advice when setting up a new service. Section '1.3 Shared micromobility services: Background and scope' elaborates further into the components of this approach.

1.2 Research gap

Apart from pre-interviews, the exploratory phase of the research, included a preliminary literature review as well. Which concluded that besides a practical problem this topic also lacks scholarly literature. The following table provides studies indicating a specific area in the literature, investigating shared micromobility and within the table for each paper is indicated whether it is investigated within **urban** (cities with ≥7000 inhabitants per hectare), **suburban** (towns with 1000 to approximately 7000 inhabitants per hectare), or **rural** (areas with <1000 inhabitants per hectare) **areas**.

Table 1.1: Scientific literature related to shared micromobility

Papers	Location	Urban	Suburban	Rural
Marsbergen et al. (2022); Montes et al. (2023)	The Netherlands	√		
Schwinger et al. (2018)	Germany	√		
Hosseinzadeh et al. (2021); Griffin, G.P. (2016); Fishman et al. (2014); Pelechrinis et al. (2017)	United States	√		
Zanotto (2012)	Canada	√		
Reck et al. (2020); Guidon et al. (2019)	Switzerland	√		
Cerutti et al. (2019); Pritchard et al. (2019)	Brazil	√		
Cherry (2007); Feng & Li (2017)	China	√		
Penati et al. (2021)	Italy	√		
Ma et al. (2020)	Delft (The Netherlands)	√	√	
Adnan et al. (2019)	Belgium	√	√	
He et al. (2019)	Park City (United States)		√	√

Observing the table, the overload of scoping on the cities instead of suburban areas stand out as main literature gap. Scientific studies outside the city are scarce. Furthermore, many scientific studies focus on modal split or the user rather than the implementation of shared micromobility services. There is a lack of research on regulations and policies related to shared micromobility services, specifically the type of sharing mode, in combination with the sharing system. Therefore, this research on the application of shared micromobility for towns and suburban communities is not only of great value for practical use, however, also for scientific contribution.

1.3 Shared micromobility services: Context and scope

Although bicycle, e-bike and scooter sharing has started increasing significantly in recent years, it is not something new. The idea has already been introduced in the Netherlands as early as 1965. However, it took a long time before it really got attention, for example, in 2001 started the introduction of the OV-Bike and shortly thereafter in 2007, the rise of shared bikes allocated to docking stations began (Provincie Zuid-Holland, 2021). From then on, the sharing of bikes, along with other forms, continued to develop. Regarding shared micromobility services, distinctions can be made in terms of various characteristics, for example the kind of transport mode, the type of system, the intended purpose, the area included or excluded in the service and the possible application of Mobility as a Service. Other important parts are the way of marketing, finance and the potential users.

First of all, it is possible to share different kind of vehicles. For this study, a distinction is made between the normal bicycle, electric bicycle and the e-moped (scooter), depicted in Figure 1.2. Within Europe, cars are also shared according to an equivalent system, as well as cargo bikes and standing e-scooters. This research is mainly specified around improving accessibility, for this reason cargo bikes are left out of the scope. To narrow down the subject and find a good alternative to the car, the shared car is not included. As well as the standing e-scooters, these are at the time of writing not yet active on the Dutch market.

Figure 1.2: The three different shared (micro)modalities covered in this study

Secondly, different sharing systems have emerged for the exploitation of shared (e-)bicycles and shared mopeds. The three most common systems are back-to-one station based, back-to-many station based and free-floating, important to mention is that all three are dockless. With a back-to-one station-based system, the bicycle can be picked up at the same location where it must be returned. This is not necessary for the back-to-many station based system, the bicycle can be picked up and returned at several fixed locations and it is not mandatory to return the bicycle to the same location where it was picked up. A system without fixed stations is called free-floating. Here the bicycles can be used freely over a certain area. To end with, it is also possible to combine the 'Back-to-Many' and 'Free-Floating' systems. For example, a business park can be seen as a large zone, where other places are designated as stations (Provincie Zuid-Holland, 2021). All the four different systems will be examined separately in this study, an illustration is given in Figure 1.3.

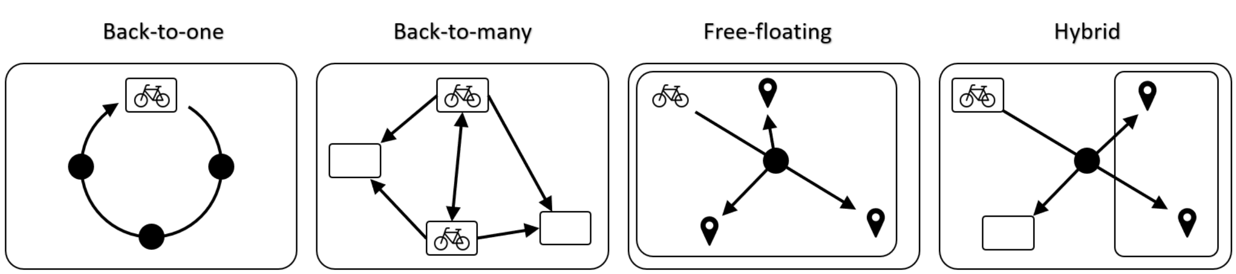


Figure 1.3: Illustration of different sharing systems

In addition, the application of shared mobility has various goals, for a variety of stakeholders. Apart from reducing motorized vehicles and improve accessibility (Fishman et al., 2014; DeMaio, 2009; Barbour et al., 2019), shared micromobility has more to offer, for example expanding transportation options, stimulating public transport, reducing the number of personal bicycles or making mobility more sustainable and healthier (Shaheen et al., 2016; Lu et al., 2018; Pal & Zhang, 2017; Gilbert et al., 2021). This study will further examine the benefits and drawbacks of shared micromobility, thereby identifying the areas where its implementation can bring significant value.

Finally, shared mobility can be offered using Mobility as a Service (MaaS). MaaS is about planning, booking and paying for all possible transportation over one interface. Important is that an entire trip can be easily planned, with transfers between different modes of transportation being clear and easy. Travelling with for example, the shared bike, car, moped, train, streetcar, or your own car or bike. But especially combinations of all these types of transportation. So that door-to-door travel can be improve using the complete mobility system (Hietanen, 2014).

Currently, operating shared bikes and scooters does not appear to be easy on the Dutch market, as evidenced by the many news reports. In September 2022, for example, it became clear that shared mopeds would disappear from Utrecht. The municipality saw too little trips in comparison with the investment costs and did receive complaints about the vehicles. In contrast, the municipality did let the number of electric share bikes doubled, from 500 to 1,000 (Hoving, 2022). Another example is HTM's discontinuation of shared bikes in The Hague, these will stop after about 4 years in February 2023. New bicycles are needed, however, the cost would be too high relative to revenues. Only in Zoetermeer the bikes will still be found on the streets. A trial is currently taking place there that will run until September of 2023, in which students and employees of the Dutch Innovation Factory can use the shared bicycles free of charge (TV West, 2023). These decisions are not only made by municipalities and public transport companies, but the operators themselves also independently leave. Such as GO Sharing, which departed from 17 municipalities in the Netherlands at the end of 2022 (CROW, 2022). And even needed to stop completely in the beginning of 2023, after partner company Greenmo declared bankruptcy (NOS, 2023). It is important for municipalities to consider which providers they want to work with and to create a healthy market in the process. They can play a coordinating role in this. Ultimately, this leads to a favourable market for providers, it provides certainty for users, and increases the likelihood of success.

This study focuses on the introduction of suburban shared micromobility services and does not encompass broader issues related to traffic safety, modal split, and the degree of sustainability of shared modes. Traffic safety refers to measures aimed at reducing the number of accidents and fatalities on roads and highways and is a separate area of research. Modal split refers to the proportion of people using different modes of transportation, and the degree of sustainability refers to maintain or enhance natural resources while reducing waste and pollution to minimalize the environmental impact of transportation. While these topics may have some relevance to this study into implantation of shared micromobility, they are beyond the scope and not considered for this specific project.

1.4 Research objective and research questions

Recognizing the described research gaps, this study explores how characteristics of shared micromobility services, including transport modality, quantities, locations and sharing system, influence the adoption and usage of shared micromobility services in suburban areas.

To ensure that shared micromobility – (e-)bike and moped sharing – succeeds and is of additional value for the suburban accessibility; it is important to understand what the success factors are for an integrated public transportation network including shared micromobility, moreover, which design guidelines and recommendations are important, translated into an approach. This approach will allow all municipalities within the same province, or even within the entire country, to ensure a unified application with a solid business plan and a greater chance of success.

A main question has been formulated as a guideline for the entire research, which is supported by various sub-questions. The main question is as follows:

"What is the most effective approach for implementing shared micromobility services in towns and suburban communities to maximize the benefits for both users and society?"

The main question is then divided into the following sub-questions, listed below:

1. *How and due to what causes, has the implementation of shared micromobility services evolved and changed overtime?*
    - ✓ Literature review.
2. *What are the crucial factors that influence the operation of shared micromobility services?*
    - ✓ Literature review (international context) completed by expert interviews (national context).
3. *What are the current challenges, and the potential economic, social, and environmental benefits associated with the implementation of shared micromobility services?*
    - ✓ Literature review (international context) completed by expert interviews (national context).
4. *Which guidelines and policy recommendations are important from the literature and expert interviews to optimize the implementation of shared mobility services in towns and suburban communities?*
    - ✓ Literature review (international context) completed by expert interviews (national context)
5. *Which socio-demographics are associated with (e-)bike and moped sharing?*
    - ✓ Literature review completed by stated preference survey.
6. *To what extent does price and distance influence the use of (e-)bike and moped sharing?*
    - ✓ Literature review (international context) completed by stated preference survey (national context).
7. *To what extent are suburban residents and visitors (daily work & non-daily non-work) interested in and willing to accept the introduction of shared micromobility?*
    - ✓ Stated preference survey.
    a. *To what extent do they have knowledge, experience and understanding of the potential benefits for the introduction of such services?*
    b. *What are the user preferences, motivations, and concerns related to shared mobility services, so that this information can be utilized to enhance the implementation and design?*

1.5 Scientific and societal relevance

In terms of societal relevance, the contribution of this research is the output of the approach of implementation of shared micromobility services. Focussing on the suburbs and towns will meet the requirements and expectations of various government agencies, such as the Province of South Holland and municipalities. To provide evidence-based recommendations for policymakers to inform their decisions, and helping with development, implementation, and evaluation of policies that benefit society.

Moreover, the results of this study are interesting for consultancies, operators of sharing services, MaaS-parties, and public transport providers. The results of this research will provide suggestions how to implement sharing services in these specific areas, which can be used by the mentioned stakeholders. With the overall aim to achieve uniformity in the application and further development of the integrated public transport network and thereby improving accessibility in the region. In addition, decision makers get insight in the needs and interest of residents and employees, and regulations and policies can be adjusted based on these new insights.

This study makes a valuable contribution to scientific research by presenting empirical findings on the utilization of sharing services in suburban areas. Gaining knowledge on the interests of suburban residents and employees in the potential introduction of such services. By examining relevant literature from an international perspective, the study provides insightful analyses that highlight differences and similarities between existing studies and the current research. Building on this foundation, the study specifically focuses on national factors that shape the potential and viability of sharing services in the Netherlands. The use of expert judgment further informs the study's conclusions on how such services operate in this context, and how they might function elsewhere. By taking this approach, the study provides valuable insights that have relevance beyond the specific case in the Netherlands and can inform international evaluations of sharing services in suburban context.

1.6 Thesis outline

The thesis is divided into four main parts. The first part 'Why & How' continues after this chapter with Chapter 2 Research Methodology, describing the research methods in detail and outline the case study in Katwijk & Leiden. Part 2 'Existing Knowledge & Expert Judgement' starts with the results of the first method in Chapter 3 Literature review and continues with finings form the expert interviews in Chapter 4. The literature review describes the historical development of shared micromobility and reviews studies into influencing factors and effects of shared micromobility. During the expert interviews, these subjects are discussed with experts in the field along with other topics regarding shared micromobility services.

The next part 'Exploring Public Sentiment' surveys the opinion of the society. Starting with Chapter 5 Survey Design, followed by the findings of the survey in Chapter 6 Survey Results. These chapters provide a detailed explanation of the different parts of the survey, including the choice experiment. The elaboration of the choice experiment outcomes using a MNL model are given in Chapter 7 Results Discrete Choice Model (DCM). Implementation of the estimated model are examined in Chapter 8 Implementation of the Model. The fourth and final part of the thesis 'Résumé' includes the conclusion, discission and recommendations for practice, in respectively Chapter 9, 10 and 11. Answering the main question, discussing the findings and methodology and providing recommendations for future research. The thesis ends with the Appendixes.

2 Research Methodology

Numerous studies on shared mobility concentrate on examining and analysing available data, however, this research adopts a different approach. Primarily due to the limited data in suburban regions, but also because the objective of this research is to develop an approach that can be used to implement an accessible and viable service. In addition to flows or movements of current users, emphasizes the interest and requirements of potential users and non-users is of even importance. This makes it possible to increase the success and accessibility of the service for all stakeholders. The study results, with guidelines, will be summarized in a framework. A visual and conceptual structure helps readers understand the guidelines. This approach enhances clarity and coherence, making it more useful and applicable for stakeholders in the field.

By introducing a new (innovating) concept or in this case a shared micromobility services it is important to keep in mind the three lenses of human-centered design (HCD), which is part of the Design Thinking methodology (Fenn & Hobbs, 2017). The three lenses are named desirability, viability, and feasibility, schematical given in Figure 2.1 (Konrad, 2023).

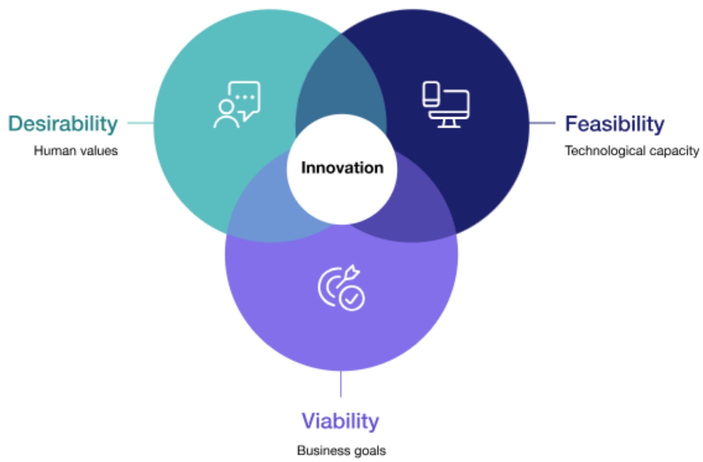


Figure 2.1: The three lenses of Human-Centered Design (Konrad, 2023)

All the three lenses presented in the model will be addressed in this research. The service need to be financially and environmentally sustainable (Viability) and the technology need to be appropriate for realization (Feasibility). Both addressed within the literature review and expert interviews. To generate solutions that are desirable to people, so that the service meet their needs the methodology includes a survey.

The process of the research with all elements is illustrated in Figure 2.2 on the following page. The research focused on shared micromobility within suburban areas in the Netherlands starts with examining the current literature and is supplemented by expert knowledge. After finishing the bases of the research, the interest in shared micromobility will be examined using a survey. The different research methods are examined in more detail starting from section 2.1.

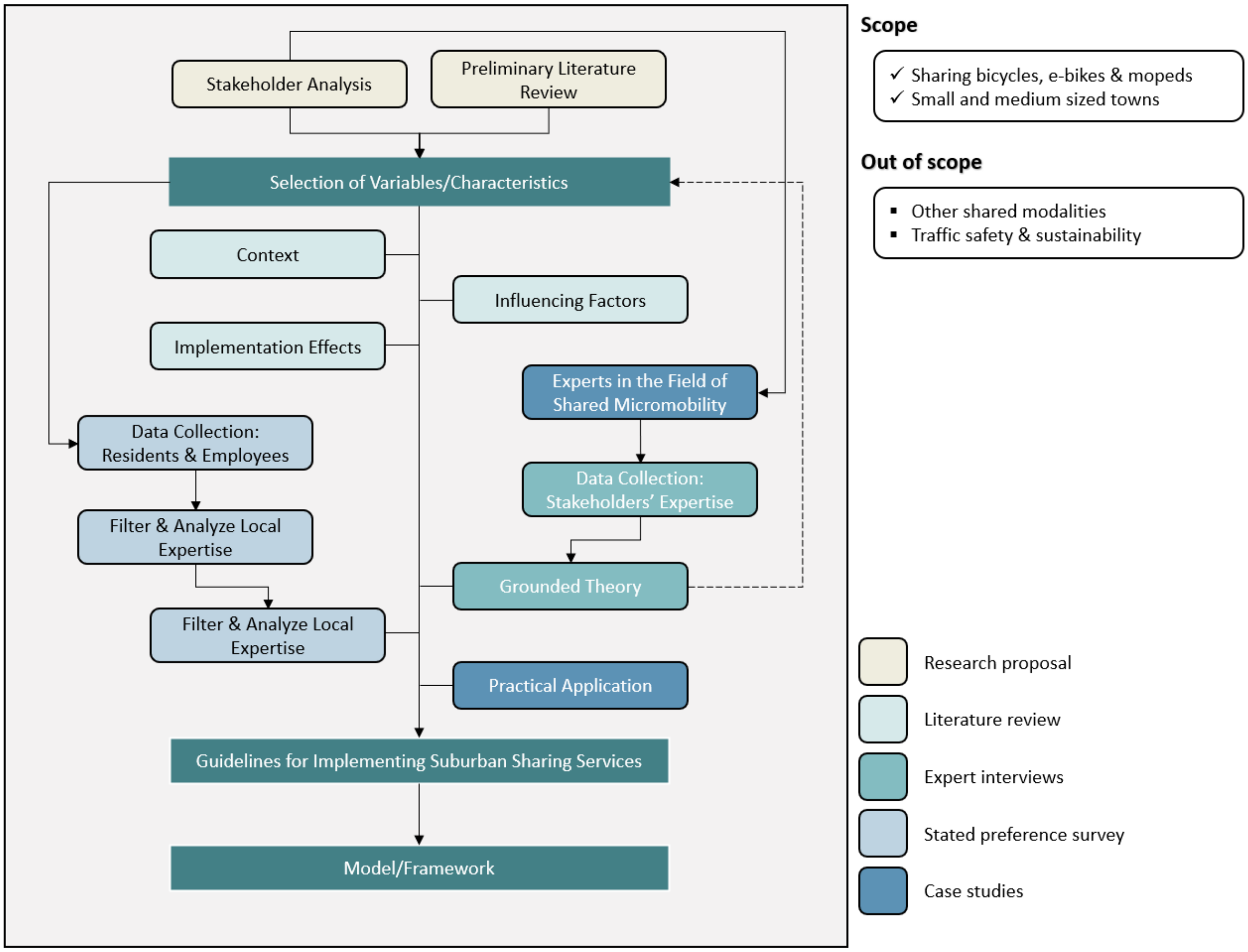


Figure 2.2: Overview research methodology

2.1 Research techniques

Different research methods have been chosen to create the possibility of combining quantitative and qualitative data collection techniques. Quantitative research involves the gathering and examination of numerical data and utilizing statistical techniques to detect patterns and correlations. Qualitative research, on the other hand, focusses on non-numerical data such as observations, judgments, or images. With the purpose to investigate and comprehend individuals' experiences, perspectives, and behaviour. So, qualitative research typically involves a more flexible and open approach to data collection and analysis, while quantitative research tends to follow a more structured and systematic process focused on numerical data and hypothesis testing.

Both qualitative and quantitative research methods have their own strengths and weaknesses. Combining them increases the possibilities and can provide the study with more in-depth findings. In addition, the limitations of one method can be balanced by the strengths of the others. The research techniques are chosen based on the research questions and objective. The research starts broad and works towards more detail as the project progresses. The techniques will be discussed in Figure 2.3, on the next page.

Figure 2.3: Overview research methods

The literature review aims to understand shared micromobility concepts in a broader sense and to investigate what results have been found in this area, including any conclusions. In addition to this, national projects will be examined from different points of view, through the expert interviews. These will be addressed to government agencies, shared mobility providers and MaaS-operators.

Subsequently, interest is polled within suburban areas and towns. The survey is aimed at residents, companies and organizations of among other towns Katwijk and Gorinchem. And provides information about people their opinion about sharing bicycles and mopeds. The questions will answer what residents and employees find important when shared mobility is applied in their neighbourhood. Understanding of shared mobility can be gauged by asking questions without explanation and this can then be compared to answers after giving a clear explanation. The topics that will be covered includes Knowledge, Attitude and Behaviour.

2.2 Literature review

The literature review will be a follow-up to the preliminary literature survey that was carried out as part of the research proposal in the orientation phase. While the aim of the preliminary phase was to identify gaps in the existing knowledge and ensure that the research is original and builds on the previous work rather than duplicating it, this follow-up review is intended to better understand the current scientific literature and identify the key concepts, theories, and methodologies that are relevant.

Besides examining scientific literature, grey literature is also used for this study. To find proper reports and other documents, Scopus, Google search and Google Scholar are used as search engines. The number of studies related to shared micromobility has increased considerably in recent years and because it has become a broad concept, it was necessary to search with specific terms, namely keywords.

Using the defined keywords, including synonyms, a set of papers is selected based on the title. To assess to which extent the documents are relevant, the abstracts is scanned. The next step is the so-called snowballing strategy, in which the references and citations of the relevant papers are analysed. All relevant documents have been collected and ultimately it has been decided to use information from the most applicable studies, filtering is based on the abstract, publication year, source, and the publisher (Advanced evaluation using PROMPT). The full process is visualised in Figure 2.4, with dashed lines being feedback lopes.

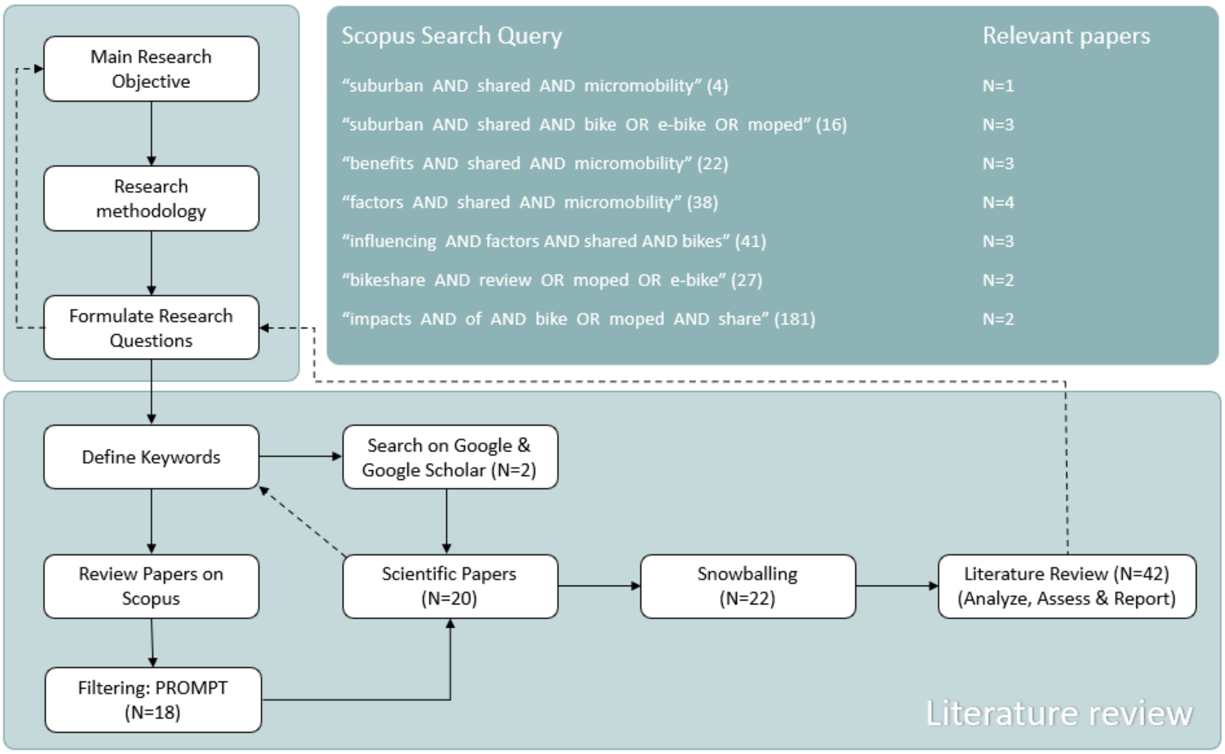


Figure 2.4: Literature review approach

To provide a comprehensive understanding of the used literature, Table 2.1 has been included that outlines the authors of the papers, the year of publication, the type of research, and the journals in which they were published.

Table 2.1: Overview scientific literature

Author	Year	Spatial context	Journals
Akar, G. (2)	2022 (5)	Urban (31)	Sustainable Transportation (2)
Bastiaanssen, J. (3)	2021 (7)	Suburban (6)	Cleaner Production (2)
Bertolini, L. (2)	2020 (6)	Rural (1)	Public Transportation (4)
Buehler, R. (4)	2019 (9)	No context (30)	Sustainable Cities and Society (3)
Chen, Y. (2)	2018 (6)		Transp. Res. Part A: Policy & Practice (5)
Cheshire, J. (2)	2017 (5)		Transp. Res. Part C: Emerging Technologies (2)
Cohen, A.P. (3)	2016 (7)		Transp. Res. Part D: Transp. and Environ. (2)
Eren, E. (2)	2015 (3)		Transport & Health (2)
Fishman, E. (3)	2014 (6)		Transport Geography (5)
Goodman, A. (2)	2013 (5)		Transport Reviews (3)
Guidon, S. (2)	2012 (2)		Transportation Research Board (6)
Martens, K. (4)	2011 (3)		Transportation Research Record (5)
Oort, N. v. (4)	2010 (2)		
Pucher, J. (2)	2009 (2)		
Shaheen, S., A. (5)	2007 (2)		
Zhang, Y. (2)	2000 (2)		

2.3 Expert interviews

In addition to the knowledge obtained through the literature review, expert interviews are also part of the research. To bring the study as close as possible to reality, it is important to obtain in-depth knowledge and expertise. Conducting expert interviews allows to obtain a specific domain of expertise and gain a deeper understanding (Döringer, 2021). Expert interviews are particularly useful when seeking qualitative insights, opinions, and unique perspectives that might not be available through the literature review. By making good choices when inviting the expert, the subject can be discussed from various angles.

The start of this research included a stakeholder analysis. At first, all stakeholders were identified, followed by inviting various people for a meeting. Several stakeholders are involved in the development of shared micromobility. It is essential to highlight these various interests in this research. The stakeholder analyse is also necessary for planning and arranging expert interviews. Furthermore, the meetings provide opportunities to use the connections of these experts, which may gain access to key stakeholders, such as shared micromobility operators or policymakers. Based on the stakeholder analysis, further described in more detail in Chapter 4, experts have been segmented into five specific expert categories and invited for the interviews.

1. Municipalities
2. Transport authorities
3. Consultancies
4. Shared micromobility operators
5. Public transport providers

The expert is chosen based on several criteria and can be asked to various knowledge. Meuser and Nagel (1991) have described an expert as an individual controlling the development or implementation of policies, strategies or solutions. Moreover, this person has privileged access to individuals or information about decision-making processes. The experts can be asked about three different dimensions of knowledge. Detailed knowledge related to the operation, called technical knowledge. Or process knowledge about specific procedure, routine and interaction. And thirdly subjective based knowledge regarding interpretations of rules, ideas and ideologies, named explanatory knowledge (Audenhove, 2011). By interviewing different kind of experts, it becomes possible to get insight into the three mentioned dimensions of knowledge. Besides the distinction in expert knowledge, the interviews can be categorised based on five main methods, including structed interviews[2], unstructured interviews[3], semi-structured interviews[4], focus group[5] (Gill et al., 2008) and the Delphi method[6] (Schmalz et al., 2021).

The interview topics are initially derived from the literature review, but the ability to pose follow-up questions and ask for clarification based on the interviewees' input can steer the researcher towards unexplored aspects, deeper understanding, and underlying factors. Other questions are posed to the various groups of experts. Moreover, Baarda & Hulst (2017) stated that the type of research questions has influence on the format as well. More open research questions ask for an unstructured or semi-structured approach, which is the case for this study. Semi-structured interviews are well suited for the exploration of perceptions and opinions of respondents (Barribal, 1994). Hence, the adoption of a semi-structured interview format is

[2] Predetermined list of questions that are asked in the same order to each participant, without further elaboration on the questions. Quick to follow and organized, easy to compare the different results.

[3] Approach with little or no organization, where the interviewer asks an open-ended question and progress the conversation where it leads. Considering when in general significant depth is required.

[4] Interview method that can result in new insights into the subject, by allowing deviation from the prepared list of questions. Combination of a structed and unstructured interview.

[5] One interview covering the knowledge/opinion of multiple experts at once, allowing the decision of a group of people.

[6] Iterative feedback technique, with multiple rounds of interviews, in which each expert responses to (anonymous) statements made by the others, continues until a collective consensus is achieved.

highly appropriate. The Delphi method is considered impractical in terms of time requirements and raises questions about participants' willingness to commit to multiple interview sessions, therefor not chosen.

Grounded theory can be applied in different coding cycles, the process is visualized in Figure 2.5. Starting with the first cycle, called Open Coding, giving each statement one initial code. The second cycle compares the codes and adjusts similar codes by merging and renaming the initial codes. The next cycle is drawing connections between the codes, named Axial Coding. The connections are coded using subcategories. In the fourth and final cycle (Selective Coding) all codes are further connected by overarching categories (Delve & Limpaecher, 2022). Which makes it possible to analyse the data using codes, subcategories, and the overarching categories. Full list of codes and overarching categories is provided within Appendix C. Respondents with the same answer can be clearly displayed in an overview. This provides good insight into the results and ensures a convincing conclusion.

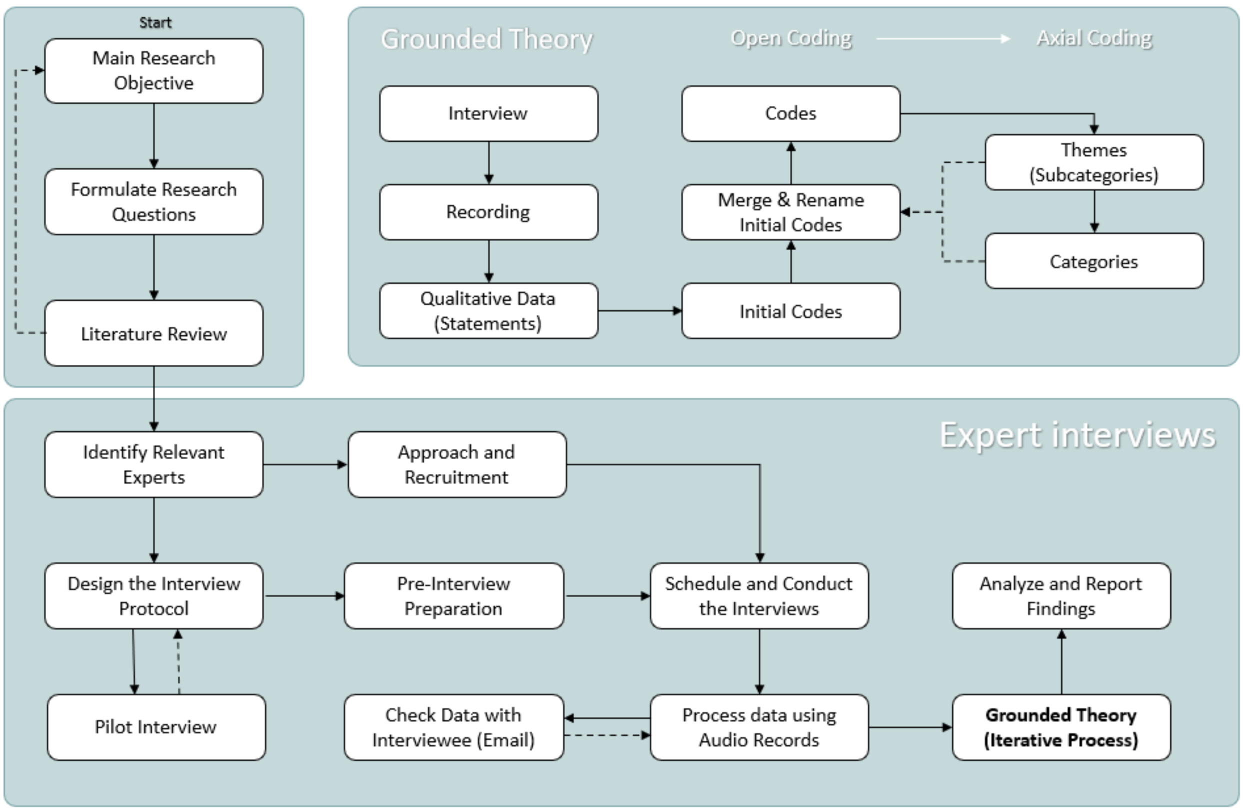


Figure 2.5: Expert interviews approach

2.4 Survey

The third method in this study is conducting and analysing a survey. One of the three lenses of human-centred design is the desirability of the concept, something that is central for the survey. By distributing the survey among people within the project's scope, users, non-users, residents, and employees could share their insights. This complements the expertise within the field. The whole process is shown below.

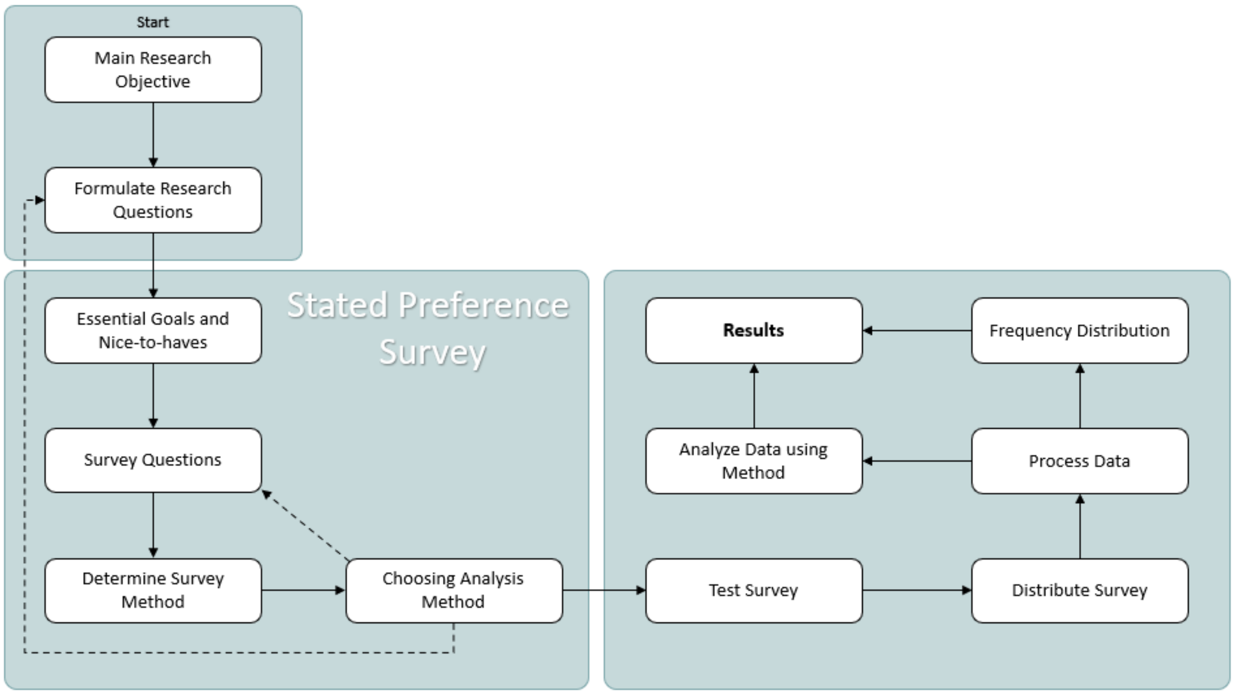


Figure 2.6: Survey approach

Regarding collection of information, it is important that this is carried out in a structured manner. No information is collected that is not necessary for the research, this prevents privacy-related problems. Moreover, it will be clear at all times what information is being collected and what will be done with it. A strategy for monitoring the data will be established through a DMP, signed and discussed with Human Research Ethics Committee of TU Delft (HREC). As for the expert interviews, the informed consent can be found in Appendix A. All other documents related to HREC can be requested for inspection from the researcher.

The survey is divided into two parts: the questionnaire and the stated preference experiment. The questionnaire assesses general impressions of residents and employees, followed by a creating more detail of the usage in the experiment. During the experiment, each respondent is presented with 8 hypothetical travel scenarios in which they must choose from three shared micromobility modalities. These situations vary in terms of price and distance. Respondents are assigned a role for this part, either "daily-work" or "non-daily non-work," meaning that some respondents answer 8 questions as if they are making a daily commuting trip, while others are making a day trip.

The experiment, a descriptive analyse tool, which in this situation cannot be used as predictive model, can be used to analyse relations between price, distance, scenarios and sociodemographic data.

2.5 Case study: Katwijk & Leiden

As already mentioned, the research into shared micromobility within suburban areas runs parallel to the project in Katwijk and Leiden. This project in combination with another shared bicycle project in Gorinchem are used as focus areas for the interviews and survey. Introducing focus areas in this research serves several crucial purposes. Firstly, it helps clarify the objective and research questions of the study by providing direction. Secondly, focus areas facilitate specialization and expertise development. Creating opportunities to delve deeper into the subject, gaining comprehensive understanding of the current knowledge and problems. Furthermore, focus areas create opportunities for collaboration and networking, making it easier to approach experts for the interviews. Moreover, the change of practical application and real impact increases. Insights and recommendations can be addressed for practical issues or inform policy-making in a more relatable and understanding way. Overall, introducing focus areas enhances the potential for generating meaningful outcomes in research.

Regarding the focus area in Katwijk, a collaboration has been started between the municipality of Katwijk and the Province of South Holland to start a project with shared mobility along the R-net lines 430 and 431, see Figure 2.7. R-net can be compared with other international Bus Rapid Transit services and is aimed at shorter routes, higher frequencies, and fewer stops. This new approach results in longer access and egress distances, which could be supported by shared micromobility. The area is also interesting because of the location near to Leiden. Leiden is not a city like The Hague and Rotterdam, but it does have a population over 100,000 inhabitants. Therefore, Leiden has a key position regarding transportation for the whole region. This also applies to shared mobility. Due to the strict regulations regarding shared two-wheelers in Leiden, it is more challenging for the surrounding municipalities to initiate such services. The entire area has no prior experience with shared two-wheelers, making it an interesting area for the survey.

Figure 2.7: Illustration R-net lines 430 & 431
(Source: Website Province of South Holland)

Part II:

Existing knowledge & expert judgement

3 Literature review

The literature review is conducted in order to answer the following research questions:

1. *How and due to what causes, has the implementation of shared micromobility services evolved and changed overtime?*
2. *What are the essential factors that influence the operation of shared micromobility services?*
3. *What are the current challenges, and the potential economic, social, and environmental benefits associated with the implementation of shared micromobility services?*
4. *Which guidelines and policy recommendations can be derived from the literature and expert interviews to optimize the implementation of shared mobility services in towns and suburban communities?*
5. *Which socio-demographics are associated with (e-)bike and moped sharing?*
6. *To what extent does price and distance influence the use of (e-)bike and moped sharing?*

The papers are analysed and compared to find out where the researchers agree and where they disagree. The method and motivation of the stated results are also examined. To answer the research questions the information is categorized into different subjects. Each subject is elaborated separately in a section below.

Before conducting research into shared micromobility services it is valuable to look into the context of the topic, including the history. The chapter continues with the potential effect of shared micromobility services, followed by influencing factors. The chapter ends with a conclusion which reiterates the research questions while summarizing the key findings. The effect of shared mobility on road safety and sustainability are also two important and frequently discussed topics. However, these two topics can be considered in a completely independent study. To narrow down the scope of this study, these topics are both left out of consideration.

3.1 Context

When advising on a concept, a product or in this case a service, it is important to know how it has developed over time. This prevents making the same mistakes again. The context of shared two-wheelers can be summarized into "generations". Researchers have classified the development of shared micromobility services into four distinct generations (Shaheen et al., 2010; Parkes et al., 2013). The generations are linked chronologically, with the first generation being the initial emerged White Bikes program (1965) in Amsterdam (Provincie Zuid-Holland, 2021). The white painted bikes are free of charge and had a limited success, due to the lack of a security system the bikes vandalism rate was too high. The second-generation had a slightly better organized and secured approach. This generation is, among other programs, launched in Copenhagen (1995) and characterized by its coin deposit system, which is similar to trolleys at a supermarket (DeMaio, 2009). The programs within this generation failed again because bikes were taken for a low fee and often were never returned or used for a longer period. Operation of both generations can only be found in Europe and North America (Shaheen et al., 2010).

New technology and user-identification enabled opportunities for better control over the shared services, starting the first large-scale third generation in Rennes, France in 1998, after a first start in Portsmouth, UK (Chen et al., 2020). These services consist of dedicated docking stations including for example credit card payment and websites or smartphone applications for frequent users as new features (Shaheen et al., 2013). The new technology-based bikesharing services also attracted the attention of other continents such as Asia and South America (Shaheen, Guzman, & Zhang, 2010). Increased focus on sharing services led to rapid development and starting of the demand-responsive multimodal fourth generation. Consisting of smart dockless bikes, improved locking mechanism, electric assisted bikes, real-time updates on apps and transit smartcard integration (Shaheen et al., 2010; Parkes et al., 2013). All four mentioned generations are summarized in Figure 3.1 (Chen et al., 2020).

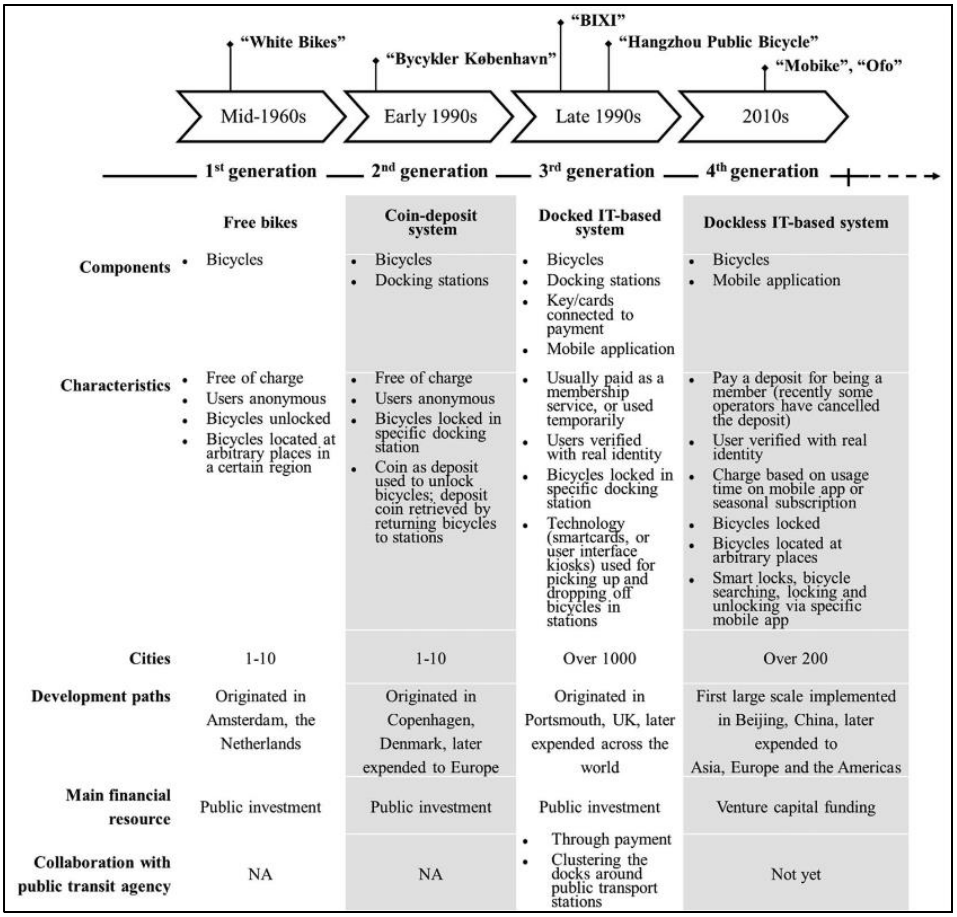


Figure 3.1: Development of bike sharing (Chen et al., 2020)

Whether the current dockless services (e.g., the free-floating sharing system) should be placed under the fourth or fifth generation is not entirely clear. Chen et al. (2018) and Guidon et al. (2019) both argue in their studies that the emerging free-floating services can be classified as fifth generation, formulated as dockless bikesharing programs with big data management possibilities.

3.2 Effect of shared micromobility

Sharing of bicycles, mopeds, or other low-speed transportation modes have gained more attention all over the world and are already widely discussed in scientific research. The introduction of shared micromobility services have a variety of potential benefits on transport and society. The most important objectives are enabling multimodal trips, providing an affordable and sustainable alternative to motorized private vehicles; including the reduction of fuel usage, decrease transport poverty, relieve of negative environmental impacts, decrease parking spaces and mitigate traffic congestion (Fishman et al., 2014; DeMaio, 2009; Barbour et al., 2019). Other studies have found that sharing micromobility is health-inducing through physical exercise, and reported reduction of the transport spatial footprint, decrease of transportation costs, optimize the integrated public transport as well as increase the public transit usage, enhance environmental awareness and serve economic growth (Shaheen et al., 2016; Shaheen et al., 2013; Lu et al., 2018; Pal & Zhang, 2017; Buehler & Hamre, 2014; Gilbert et al., 2021).

Fishman et al. (2013) describes that bike sharing have two different connections to public transport, being substitution and integration, or also known as competing or completing. Which means that introducing shared micromobility services can replace trips that otherwise would be made using public transport or the share of micromobility can stimulate travelling by public transport. Especially shorter trips by public transport, less than 5 kilometres, are likely to be replaced by sharing services (Bachand-Marleau et al., 2012). Ma et al. (2020) discovered that the use of public buses declined following the introduction of Mobike in Delft, whereas there was an increase in train usage. Fishman (2016) stated in another paper that sharing bicycles can relieve crowded public transport, which can be seen as a positive effect for other travellers.

Another advantage of sharing micromobility is the reduce in travel time. While the benefits of reducing travel times are not widely recognized, they can be substantial (Buehler & Hamre, 2014). Particularly in areas on the outskirts of cities and towns, there is significant potential for profit (Jäppinen et al., 2013). Furthermore, sharing services have proven to be suitable to encourage people to cycle and therefore is an effective way in promoting the transition to cycling and reducing the reliance on cars (Bauman et al., 2017).

Besides the mentioned benefits, the shared micromobility services have some downsides as well, such as high starting investments, safety concerns, disruption to traffic and operational complexity (He et al., 2019). And although shared micromobility is a practical solution to negative trends regarding urbanisation, the application might not necessarily reduce environmental impacts during the entire lifecycle (Hollingsworth et al., 2019). This depends very much on the type of vehicle, the assumed lifetime, the method of redistribution and modes of transportation that are displaced.

A completely different problem of shared transport is the pressure on public space and the nuisance for non-users. In Rotterdam, for example, in 2020 there were 519 reports of nuisance related to shared two-wheelers. For the most part, these reports of nuisance were aimed at share mopeds, more than 60% of the reports. The quantities between bicycle sharing and moped sharing were equal in the city. To contrast the reports of nuisance, in that same year there were 20,406 reports of household waste and over 6,000 reports of broken trash cans, street furniture or lighting (Rotterdam, 2021). Equal amounts of reports are observed in The Hague, Utrecht, Amersfoort and Gorinchem. In these places the reports of shared mopeds are significantly higher as well, in comparison to shared (electric) bicycles (Asten, 2021; Gemeente Groningen; 2022; Mateika & Visser, 2023).

Several municipalities in the Netherlands, including Leiden, are interested in reducing car usage through the introduction of shared two-wheelers (Leiden, 2022). It is challenging to precisely demonstrate this decrease, as it depends on various factors, but several studies provide insights into this matter. Before mentioning, the magnitude of the problem of private cars is elaborated upon.

Car-trip substitution

Currently many societal problems are caused by the high use of passenger cars, in terms of lowering the air quality, causing noise pollution, increasing the global warming, and creating physical barriers (Green, 2018). Within Europe, 56% of the most frequent trips is undertaken by car (Fiorello et al., 2016). Jeekel (2011) noted that of all trips made by car in the Netherlands, up to 40% could not be done without a car. A study by K. Geurs and J. Ritsema van Eck (2003) showed, based on traffic model calculations, that in suburban areas car-based trips, within 45 minutes travel time, could reach about 6-7 times more jobs in comparison to trips made with public transport. This difference increases even to 60-70 times as many jobs in rural areas. Studies by De Koning et al. (2017), Martens & Bastiaanssen (2019) and Straatemeijer &

Bertolini (2019), show similar differences in job accessibility in the regions around The Hague and Rotterdam. Average rush hour accessibility by public transport is at least half that by car, despite high standing public transport and bicycle infrastructure. Even considering the current congestion situations on the roads and highways, the car offers by far the highest accessibility.

On top of that, car needs most space per occupant compared to all other modalities (Limburg, 2021). Stam's (2021) research demonstrates that the use of cars around station Almere city results in a footprint of approximately 17.5 square meters per traveller. In contrast, micromobility options such as bikes or scooters result in a much smaller footprint of only 0.3 square meters per traveller. Even more convenient options, such as shared cars and taxis, still have a high footprint compared to micromobility modalities, with respectively 7.5 m2 and 3.9 m2 per traveller. Municipalities in the Netherlands therefore realize that investing in car use alone is not the solution, but not all municipalities are yet convinced of the success of shared micromobility. And are curious about the added value for reducing car trips.

Fishman et al. (2014) confirms that the presence of bikesharing systems led to a notable decrease in motor vehicle usage. Their study was performed in cities in the United States, Great Britain, and Australia, and consistently demonstrated a reduction in car usage. Car substitution ratios for bike-sharing vary across countries and cities, from 20% in Melbourne, Brisbane, and Minnesota to 7% in Washington, D.C. and only 2% in London (Fishman et al., 2014; Guo & Zhang, 2021). A university in Valencia had problems with the large number of parking spaces. Students predominantly commuted to campus by car. Shared bicycles were introduced as a potential solution on and around this campus. With great success, in just 8 months 20% of the students started using them. Additionally, 7% to 11% of the students utilized the shared bicycles as an active form of transportation to school (Gilbert et al., 2021). In Rotterdam (2020), it was investigated how many trips would have been made by car instead of shared micromobility options. It was found that 23% of the trips that were taken on a shared moped would have been made by car, and 10% of the trips would have been made by car if the shared bicycles were not available (Gemeente Rotterdam, 2021). Overall reduction in greenhouse gas emissions, fuel consumption and decrease in traffic congestion is supported by various other studies (Barbour et al., 2019; Lu et al., 2018; Shaheen et al., 2010; Pal & Zhang, 2017; Bauman et al., 2017).

3.3 Influencing factors

Establishing an improvement of effectiveness and usage of sharing services is only possible by analysing the performance of existing services (Fishman et al., 2013). As Fishman et al. highlighted in their study on bike sharing, identifying the parameters and factors that influence the usage of these services is vital for their further development. Research on the influencing factors of shared micromobility services can be categorized into demand or supply related factors, of which demand can be further specified into internal (i.e., user socio-demographics), external (e.g., geography or weather) and trip-related (destinations, distance, time of day) factors (Reck et al., 2020). These four categories, including a section with the relation with public transport, are separately discussed below.

3.3.1 Internal

Identifying the user characteristics of the population using or not using the services, results in better understanding of the user profile and provides insights on how to anticipate on this information (Feng & Li, 2016). Several studies reported strong correlation between trip demand and user characteristics, such as age, gender, income, education, nationality, or vehicle ownership (Barbour et al., 2019; Eren & Uz, 2020).

Firstly, young individuals are more likely to use sharing systems, however, internationally the largest group of users is between 18-37 years old (Wang et al., 2018; Fishman et al., 2015; Eren & Uz, 2020). Fishman et al. (2015) concluded that people between 18 and 34 years old are 3.3 times more likely to use sharing systems compared to all other age groups. The reason why the ages is frequently above 18 is due to the fact that numerous services impose a minimum age limit for users, obstructing the transition to bicycles (Eren et al., 2018; Woodcock et al., 2014).

Secondly, research regarding gender is not unanimous, results differentiate between countries and studies. Firstly considering research conducted in the Netherland, researchers align in observing a slightly higher usage by men (Marsbergen et al., 2022; Kuijk et al., 2022; Ma et al., 2020; Stam et al., 2021). Something that is not obvious, because internationally women are less likely to ride a bicycle relative to men (Akar et al., 2013), while in the Netherlands more women cycle than men (Harms et al., 2014). A study by Feng and Li (2016) about the willingness to use public bicycle services concluded a higher change for females using shared bicycles compared to men. In parts of United States, England and Australia, where bikes are not part of the primary mode of transportation, about 25% to 10% of the trips by shared bikes are done by women (Pucher et al., 2011; Goodman & Cheshire, 2014).

Thirdly, bikesharing membership is usually associated with higher education and income (Shaheen et al., 2014; Fishman, 2016; Fishman et al., 2015; Woodcock et al., 2014). Although, this is not the case for all the studies. A statistical analysis based on a survey by Barbour et al. (2019) found that respondents from households with lower-income had a higher probability of using the shared bikes more often than higher-income users. Same results were found in Washington, DC, the system was mainly used by younger females with a lower level of income (Buck et al., 2013). Research about E-bikes in Zurich concluded higher demand in high-income neighbourhoods, the explanation for this was the relatively high costs in relation to public transport (Guidon et al., 2019). The description of non-users are mainly older people, living in neighbourhoods with relatively lower level of education and income. These non-users can mainly be found in suburban areas, with higher spacing between public transport stops (Böcker et al., 2020). These socio-demographic characteristics are partly due to the lack of supply of sharing services in these areas, because bike sharing services are mainly concentrated in dense urban areas (Garritsen, 2022). According to Ricci (2015) this explains the majority of results describing the user profile as high educated and schooled. The house pricing is more expensive in dense urban areas and business districts consists of higher educated jobs.

Fourthly, Ma et al. (2020) found that 60% of Mobike users around the university campus within Delft were non-Dutch and relatively high percentage of non-Dutch users were found for the OV-bike as well, being 22,5%. This shows that there is interest in shared bicycles by international people.

To end with, car ownership is found to be an attractive condition for the use of sharing services (Shaheen & Guzman, 2011), even in cities as Beijing and Shanghai higher levels of car ownership were found for users compared to non-users (Ricci, 2015). On the other hand, Hyland et al. (2018) concluded that owning a driving license has a negative impact.

3.3.2 External

One of the most important factors is the geographical location or further defined by local culture, climate or urban design (Barbour et al., 2019). The level of success of each sharing service depends for example on the cultural norms which variates per country. For instance, in the Netherlands cycling is widely embraced, compared to India, something that could have big impacts on the effectiveness of sharing bikes, positive or negative. For each country it is essential to determine the operational features that are associated with different levels of popularity or level of interest (Barbour et al., 2019).

Factors that are not bound by boundaries and that positively influence shared micromobility use include weather conditions, public transport availability, population density and workspace density (He et al., 2019;

Dill et al., 2022; Eren & Uz, 2020). On the other hand, inappropriate weather conditions, trip distance smaller than 1 km, low availability, degree of criminality and elevation differences have a negative influence on the choice (Sun et al., 2017; Adnan et al., 2018; Fishman et al., 2014; Fishman et al., 2013). Another noteworthy conclusion by Sun et al. (2017) is the lack of influence of traffic congestion or number of accidents on the demand. Users are not deterred by high levels of congestion or accident rates.

The extent to which the different modes are affected variates. A study from 2016 (Campbell et al., 2016) used a stated preference data from Beijing (China) for determining user's preferences for shared bikes and shared electric bikes. They found that bike share demand is significantly negatively influenced by trip distance, temperature, precipitation and poor air quality. In relation with the electric bike negative influence was smaller for trip distance and temperature. Moreover, elevation does not appear to influence the use of e-bikes (Guidon et al., 2019). Which was stated to negatively influence the use of regular shared bikes (Ricci, 2015; Fishman et al., 2014).

Sharing two-wheelers has proven to be a well working concept in university campuses, so conditions can be seen as good in these locations. This can be attributed to high percentage of mobile phone users, relatively high supply of short trips, high user density, low average age and prevalent focus on environment (Fishman E., 2016; Barbour et al., 2019). All of which are potentially important ingredients for high use of sharing vehicles and therefore important factors for operating the service (Barbour et al., 2019). This is confirmed by many studies into shared micromobility and especially shared bikes (Dill et al., 2022; Hosseinzadeh et al., 2021; Eren & Uz, 2020; Fishman, 2016). Additionally, pedestrians in general show a strong preference for shared bicycles when the purpose of the trip is related to education (Politis, 2020).

The Netherlands has a good infrastructure for bicycles (Bastiaanssen & Breedijk, 2022), something that is already pointed out as an important factor for the successful start of shared micromobility services (Faghih-Imani et al., 2014; Abouelela, 2023). On the other hand, low population density tends to decrease the usage of bike sharing services, which is an important factor for the scope of this study, namely suburban areas and towns (Faghih-Imani et al., 2014; El-Assi et al., 2017). Overall, the number of potential users also decreases as density decreases. However, Kwiatkowski (2021) has drawn some interesting conclusion regarding the area of the shared service. His research within 10 cities and towns in Poland, showed that especially for the small and medium sized towns shared micromobility services has a higher added value, compared to cites in the same region. Due to the implementation of shared bike the transport accessibility was boosted significantly and improved the quality of life of the inhabitants as well. Important factors for this were the option to leave the bicycle outside the public transport stations, new and improved local public transportation options in the region and the year-round operation ensuring flexibility. However, local governments of small and medium-sized towns were unfamiliar and did not have any or enough specialized staff available, limiting the functionality of the service.

3.3.3 Trip-related

The magnitude of the mentioned factors in the previous sections generally varies with time (time of day, day of week, and month of the year) (Reck et al., 2020). For example, while the effect of workplaces is usually found to be positive on weekdays, the same effect is found to be negative during weekends. In conjunction with often observed morning and evening demand peaks, this suggests that an important driver of demand is the commute (McKenzie, 2019). Another example is the variation in trip length over the year, which increases for shared bikes in the summer months and the reverse effect for the shared moped, with longer trip lengths in the colder months (Mateika & Visser, 2023).

Continuing with the trip length of shared mopeds, different results are observed. Highlighting the direct impact of size of the service area on the average trip length. For example, the average length of a shared mopeds in the Netherlands fall within the range of 2 to 3 kilometres (Faber et al., 2020), this is confirmed by studies of large municipalities in the Netherlands, described in grey literature (Mateika & Visser, 2023). Conversely, a study conducted by Howe & Bock (2018) or research by Wortmann et al. (2021) found higher average trip length between 4 to 5 kilometres. This disparity can be attributed to the concentrated service areas in the Netherlands, primarily focused on densely populated cities with smaller service areas (Faber et al., 2020). The average length of conventional bike-sharing trip is lower than for moped-sharing. In the Netherlands, the average is around 2 kilometres (Mateika & Visser, 2023). Remarkable is the already mentioned change in trip length, with higher trip length in the summer and a decrease in the colder months (Mateika & Visser, 2023). According to the study of Zhang and Yu, the average trip distance of shared bikes in Chicago is around 2 kilometre as well (Zhang and Yu, 2016), however Adnan et al. (2018) concludes that the optimal trip distance for shared bikes lie somewhere between 3 and 5 km. Analysis of electric bike share ridership in Park City, Utah, concluded an average trip length of above 5 kilometres, which is comparable to the distance of e-bike usage in Antwerp (He et al., 2019). But differs compared to the results from Reck et al. (2020), who concluded a trip length between 2 and 3 km for trips with shared e-bikes.

3.3.4 Supply related

A key factor in launching a successful shared micromobility service is ensuring that it actually gains attention among users. While this may seem like a simple concept, the reality is that many initiatives fail, as evidenced by the numerous projects that have stopped or the large number of shared mobility providers that start and go or even declare bankruptcy.

Regarding supply a couple of factors are found in literature, for example the fleet size, quality of infrastructure or availability of appropriate bike parking at destination (He et al., 2019). Zanotto (2014) concluded in a research into the adoption of bike sharing with compulsory helmet use that there is no significant effect of this legislation regarding the usage. However, a study conducted by Fishman et al. (2013) in Brisbane discovered that mandatory helmet regulations had a negative impact on the perceived spontaneity of bikesharing usage. Similar findings were observed in research on Melbourne's bike share program, where 36% of individuals mentioned difficulties in finding a helmet and 25% expressed reluctance to wear one as the main obstacles to using the service. Thinking a helmet is required to use the service could effect the likelihood of using the service as well (Dill et al., 2022). Using a sharing service requires specific understanding, including the process of registration, checking in and out, the appropriate method and location for returning it, time limitations, and more. Without this knowledge, or with incorrect information, individuals are less inclined to utilize the shared bike or moped services (Dill et al., 2022).

Dill et al. (2022) created a model including these aspects, Figure 3.2. In this conceptual model is stated that before people start using bike share, they first need to have a general interest in shared services. And this interest consists of several components, such as knowledge about sharing micromobility, attitude to or barriers against the shared use of micromobility and other factors effecting the interest.

In the model, they included attitudes and perceptions of bike sharing in two domains. The first one on personal level; individual thinking that using shared bikes have benefits for their own use, besides liking to ride on a shared bike. And secondly on community or societal level; individual believing in general that shared services are better alternative, environmentally friendly and good for the city. The paper indicates that the extent of influence of having knowledge about the service has not been demonstrated or confirmed in existing literature. However, this subject will be discussed in the survey of this study.

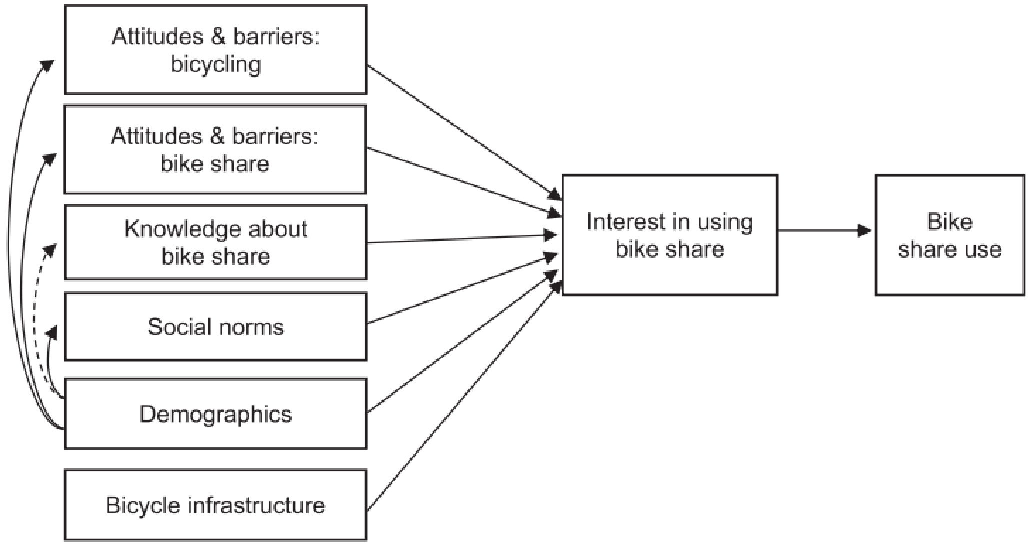


Figure 3.2: Model describing behavior changes related to bike sharing (Dill et al., 2022)

3.3.5 Relation with public transport

The influence of public transport on shared micromobility is widely described in many papers and has a significant influence on the usage of shared two-wheelers, although not all results agree. Sun et al. (2017) studied the impact of public transport on bikesharing use and noticed that shared bicycle services tend to be positively associated with the accessibility of public transport, especially the accessibility of hourly bus connections. While surprisingly metro is negatively associated with the usage. The study concluded that users of bike services are not likely to transfer between metro and shared bikes. Possibly the type of public transport does not influence use, but rather the frequency of public transport. This is confirmed in another study into the choice for shared bicycles in Belgium. Based on stated choice experiments in several small and medium sized cities, this research has shown that a low bus frequency has a positive effect on the choice for a shared bicycle (Adnan et al., 2018).

Another conclusion is drawn by Jäppinen et al. (2013), based on shared bike data. Their research concluded that the busiest hubs were located near to metro stations. 3 out of 5 busiest locations of shared bike use were metro stations and one bus terminal. The positive correlation between bus use and shared bicycles is confirmed by research in The Hague, which showed a clear relationship between high bus use and the use of shared bicycles (Marsbergen et al., 2022). In general there is a positive correlation between public transport and the use of shared micromobility, according to various studies (Shen et al., 2018; Shaheen, 2012). Additionally, shared micromobility extends the catchment area of public transportation, much further than the range of walking and with lower costs than for example taxi or neighbourhood feeder buses (Pucher & Buehler, 2009). Moreover, different researchers argue that shared micromobility should be seen as a form of public transportation rather than a modality on its own (Gleason & Miskimins, 2012; Jäppinen et al., 2013).

According to Politis (2020), when comparing car users to bus users and pedestrains regarding costs, it was found that the willingness to pay (WTP) is higher for car users compared to bus users. As the costs of both car and bus increase for short trips, there is an increased likelihood of choosing shared bikes as an alternative. This suggests that bus users are more likely to switch to shared bikes when faced with increased prices for car and bus travel (Politis, 2020). Commuters who typically use cars are more inclined to transition to bike-sharing, while pedestrians are more likely to choose shared bikes for recreational purposes, especially for short trips.

3.4 Conclusion

First considering the described generations, several aspects are notable. Including the development of services linked to docks, and thus being station based. The first generation was offered dockless and to prevent theft the docking stations were introduced in the second and third generation. However, the vast majority of current services, including many in the Netherlands, are offering shared micromobility without docks and this resembles the first concept of the white bicycles. Only ensures user-identification and direct payments that vehicles can be used with better security to prevent theft. With regard to dockless services, a distinction can still be made between two different systems; station based and free floating. All the influencing factors and effects of shared micromobility are summarized into Figure 3.3 below.

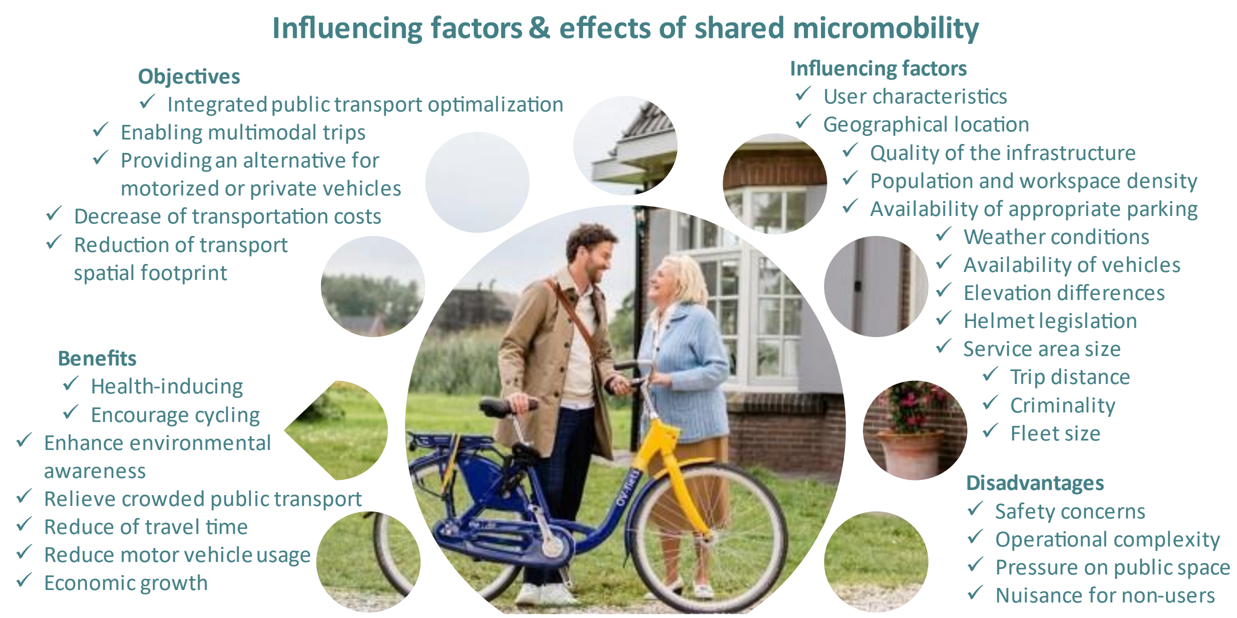


Figure 3.3: Influencing factors and effects of shared micromobility, based on literature review

4 Expert interviews

This chapter presents the findings of the semi-structured expert interviews, divided into five main sections, namely Semi-structed interviews, Reliability and validity, Systematic data analysis, results and conclusion. The expert interviews are conducted in order to answer the following research questions:

2. *What are the essential factors that influence the operation of shared micromobility services?*
3. *What are the current challenges, and the potential economic, social, and environmental benefits associated with the implementation of shared micromobility services?*
4. *Which guidelines and policy recommendations can be derived from the literature and expert interviews to optimize the implementation of shared mobility services in towns and suburban communities?*

The methodology and approach (Figure 2.5) can be found within section 2.3 on page 14.

4.1 Semi-structured interviews

In the exploratory phase of the research beside reviewing first preliminary literature, a stakeholder analysis has been established. Including identifying key stakeholders and interviewing MaaS & shared micromobility operators and municipal officials. After which a power versus interest grid is generated, presented below in Figure 4.1. The vertical axis depicts an actor's power in the action, while the horizontal axis shows the stakeholders' interest. According to this strategy, the stakeholders are divided into four groups: subject, players, crowd and context setters, later renamed to keep satisfied, manage closely, monitor and keep informed (Eden & Ackerman, 1998).

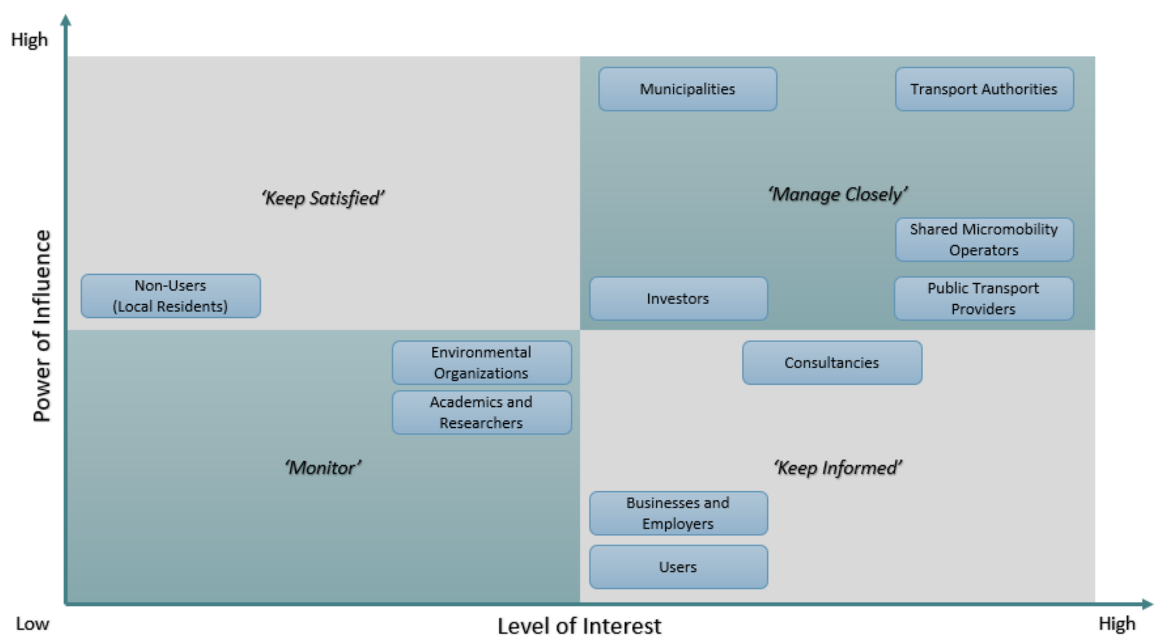


Figure 4.1: Stakeholders visualized in a power versus interest grid

Resulting from the grid five main stakeholders are formulated, with in the end a total of 13 interviews were conducted with 16 experts. The expert groups, including interviews are presented below:

1.	Municipalities	3 interviews	4 experts
2.	Transport authorities	2 interviews	3 experts
3.	Consultancies	2 interviews	2 experts
4.	Shared micromobility operators	4 interviews	5 experts
5.	Public transport providers	2 interviews	2 experts

Prior to each interview, participants are asked about their level of knowledge on the subject, referred to as expert scale, which is rated on a scale of 1 (Familiar with the topic) to 10 (Full professor on the subject). This approach ensures that the interviews are conducted with individuals possessing expertise and allows for meaningful comparisons across different expert groups. The average expert scale across all interviews is 7.7, with the lowest rating being a six. Figure 4.2 presents the average ratings for each group.

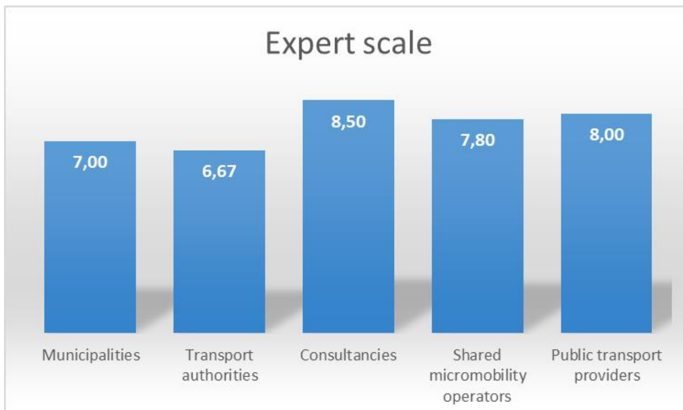


Figure 4.2: Expert scale per expert group

4.2 Reliability and validity

It is important to take both reliability and validity into account by conducting the interviews to ensure quality. The information collected through interviews should be reliable. Reliability refers to the degree to which the answers you receive are independent of chance (Baarda & Hulst, 2017). To ensure the reliability of semi-structured interviews different measures are indicated below (George, 2022; Baarda & Hulst, 2017):

- **Standardized protocol:** The semi-structured interviews are conducted using the interview protocol presented in Appendix B. Prior to the interview, the protocol is adapted to the interviewee in question. The timespan is fixed in advance to a maximum of 60 or 90 minutes and the interviews are in Dutch or English, depending on the guest. The protocol starts with an introduction of the research and an informed consent. After which the interview starts with the indication of the general knowledge about the topic. This can be used to verify that the interviewee is indeed an expert in the field. The protocol consists of different topics, which are not covered in every interview. The order of resulting topics is kept the same for each interview, to ensure uniformity and structure in the answers. This order is based on increasing difficulty. The interview ends by thanking him/her for their time and asking them for additional files or interesting people in their network. And by asking whether he/she has questions and interest in the results.
- **Pilot test:** The protocol of Appendix B was tested in advance with transport-related employees within the province of South Holland. To test the clarity of the questions and obtain time indications per topic.

- **Neutral environment:** A one-on-one interview ensures that the interviewee does not mince words or let someone else change his or her opinion. Furthermore, preference was given to a familiar environment on location, but the option was always offered to do the interview online or at the provincial government building in The Hague.
- **Documentation of the interview:** All interviews will be recorded with acceptance of the interviewee. Audio recordings increase the reliability of the interview, in addition, all attention can be used for asking the questions and notation can be done later. As already mentioned, all interviewees have been informed through an informed consent document, Appendix A. This informed consent is part of a risk assessment and mitigation plan and has been drafted because of involvement of human participants. The data generated during the research is stored according to the data management plan (DMP). The DMP and other documents have all been approved by the Human Research Ethics Commission (HREC) of the Technical University of Delft. All documents related to HREC can be requested for inspection from the researcher.
- **Systematic data analysis:** It is customary to transcribe all interviews, but it was decided not to do so for this study. Transcribing the interviews in full entails that the interviews will have to be recorded. This may not be desirable in all situations, because shared micromobility operators are also part of the target group for the interviews. Furthermore, five different interviewee groups have been chosen. In order to be able to check and compare the information obtained for each group, it is important that at least 2 and preferably 3 experts are available. This results in a high number of interviews. Instead of transcribing all interviews, it was decided to describe all important statements with or without the aid of a recording in an Excel-file. These statements are connected to an interviewee and coded. This process is explained in more detail in the following section.

It is not only important that the results are reliable, but they must also be valid. Validity refers to the extent to which the collected information accurately reflects reality (Baarda & Hulst, 2017). Measures to ensure validity of semi-structured interviews are summed below (George, 2022; Baarda & Van der Hulst, 2017):

- **Diverse sample:** A total of 13 interviews with 16 interviewees were conducted. The interviewees are categorized into different groups, creating a diverse sample. Each group consists of 2 or more interviewees. Information about the saturation can be found in the next section.
- **Expert knowledge:** When conducting an expert interview, it is obviously not the intention to approach every arbitrary person. A certain level of knowledge regarding the subject is expected. To ensure this, only persons who actually perform work related to the subject are invited for an interview. In addition, the level is determined with a question about the level of knowledge (Expert scale) about shared micromobility. Asked for a number between 1 and 10, where 1 is equal to being familiar with the subject but nothing more and a 10 is extensive expert in various fields. A minimum of a 6 or higher is expected when the interview is conducted.
- **Relevant interview topics:** The list of questions and related topics are based on the research questions and performed literature review. The approach is schematically represented in Figure 2.5 on Page 14.
- **Ensure structure in interview and analysis:** All interviews are constructed according to the protocol, Appendix B. In addition to this, which can be found in the informed consent as well, will all employees have the change to check and correct their interview. After each interview the collected data is send by email to the concerning person. This way there is an opportunity to check the information and participants are more at ease during the interview. After all, they know that everything can be assessed one more time before it is used in the research. This email also contains the question for permission to use the data.

4.3 Systematic data analysis

Data management and analysis is a crucial part with semi-structed interviews because answers are less comparable related to structed interviews (George, 2022). Processing the data after conducting the interviews is done using the audio records. All answers of the interviewees related to the subject are written down into an Excel-file. After processing the data, the statements can be coded using Grounded Theory (Sigauke & Swansi, 2020).

Grounded theory is a research methodology that allows for the exploration of a specific phenomenon or process, through the collection and analysis of qualitative data. Unlike traditional hypothesis-deductive approaches, grounded theory employs new theories emerging from the data itself. This method involves an iterative process of data collection (Expert interviews), analysis (Coding), and theory development (Results). This cycle is repeated until theoretical saturation is reached, which occurs when additional data no longer contributes new insights to the emerging theory (Delve & Limpaecher, 2021).

Saunders et al. (2017) has written a paper containing a critical reflection on the concept of saturation and its use in qualitative research. He names the difference between a fixed point at which theoretical saturation has been reached, or a process. So, the question 'Has saturation occurred?' should perhaps be replaced by 'How much saturation is enough?'. Saunders et al. (2017) describes that an important part in determining saturation is the insight of the research itself. It is also important to ask yourself whether an extra interview will provide the desired amount of extra information. It will be important for this research to what extent new interviews will provide new insights. If an interview does not provide new insights, it can be concluded that saturation has been reached. Optional the method can be continuing with one or two additional interviews as 'confirmation' (Forsberg et al., 2000) or 'validation' (Vandecasteele et al., 2015). The process of conducting interviews and coding is done simultaneously to get inside into the degree of saturation. And as already mentioned for each expert group will at least 2 interviews be conducted. Taking into account the above-mentioned information, the following sequence of interviews has been established, as depicted in Figure 4.3.

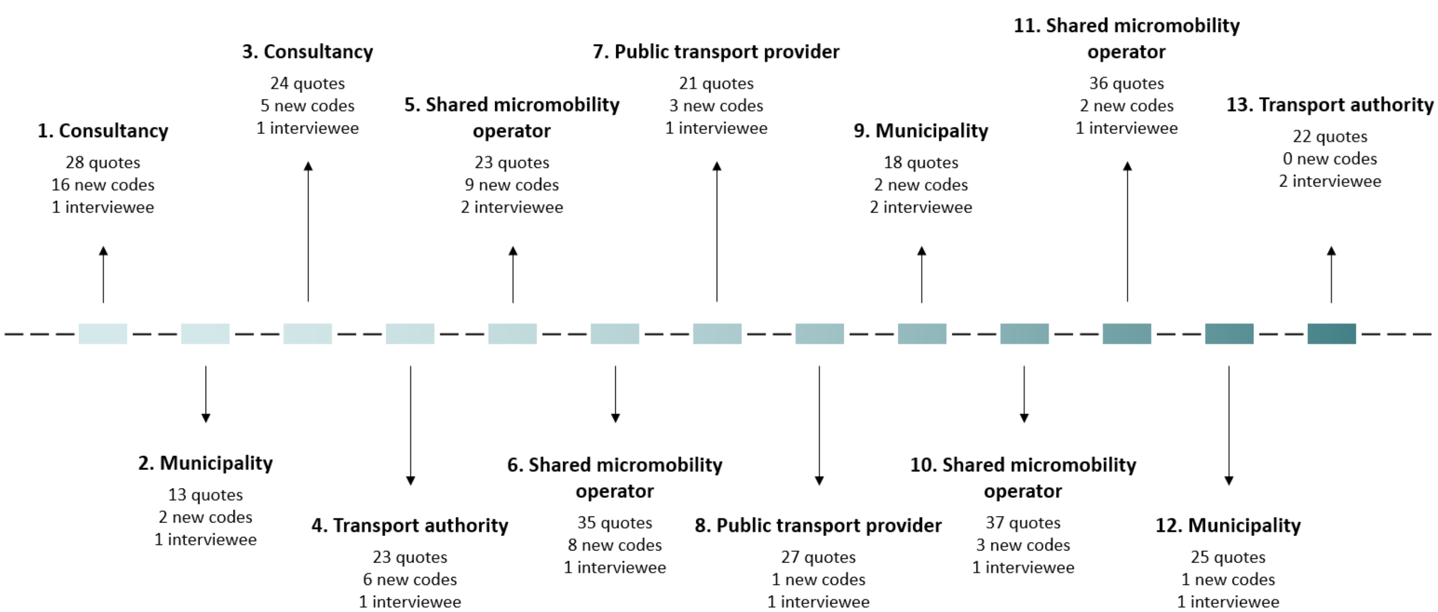


Figure 4.3: Process of conducting the interviews, reaching saturation

The first interview resulted in 28 quotes or statements, which were categorized into 16 different codes. Subsequent interviews generally yielded around 20 to 30 statements, except for the second interview, which was not recorded and covered additional topics not included in the data analysis.

The introduction of new codes varied throughout the interviews, reaching a point of stabilization by the tenth interview. During this initial phase, numerous valuable insights were obtained without the necessity of creating new codes. However, from the eleventh to the thirteenth interview, the number of novel insights declined, leading to a corresponding decrease in the number of new generated codes. Consequently, it was determined that conducting further expert interviews beyond the thirteenth interview would not yield significant additional findings, despite the possibility of exploring additional interviewees. For instance, experts who were consulted during the exploratory phase of the study included the supervisor from the Province of South Holland, recognized for his pivotal role in developing the OV-fiets in the Netherlands.

All interviews, except for one, were recorded to ensure complete focus during the interviews. Afterwards, the relevant statements from each interview were transcribed from the recordings. These statements, referred to as quotes, underwent the process of Open Coding, wherein each quote was assigned a code that accurately represented its content (Preferable 1 or 2 words). Synonymous and related codes were subsequently merged, resulting in a reduced total number of codes. In total, 348 statements were derived from the expert interviews, which were further categorized into 57 distinct codes. Axial Coding was then employed to link these codes to 11 subcategories and 4 overarching categories.

All statements are connected to an ID number, consisting of the number of the interview and the number of the statement itself. So, statement 6:124 related to interview 6 and statement 124. An example of the statements is given in Figure 4.4 below. Complete list can be found in Appendix C.

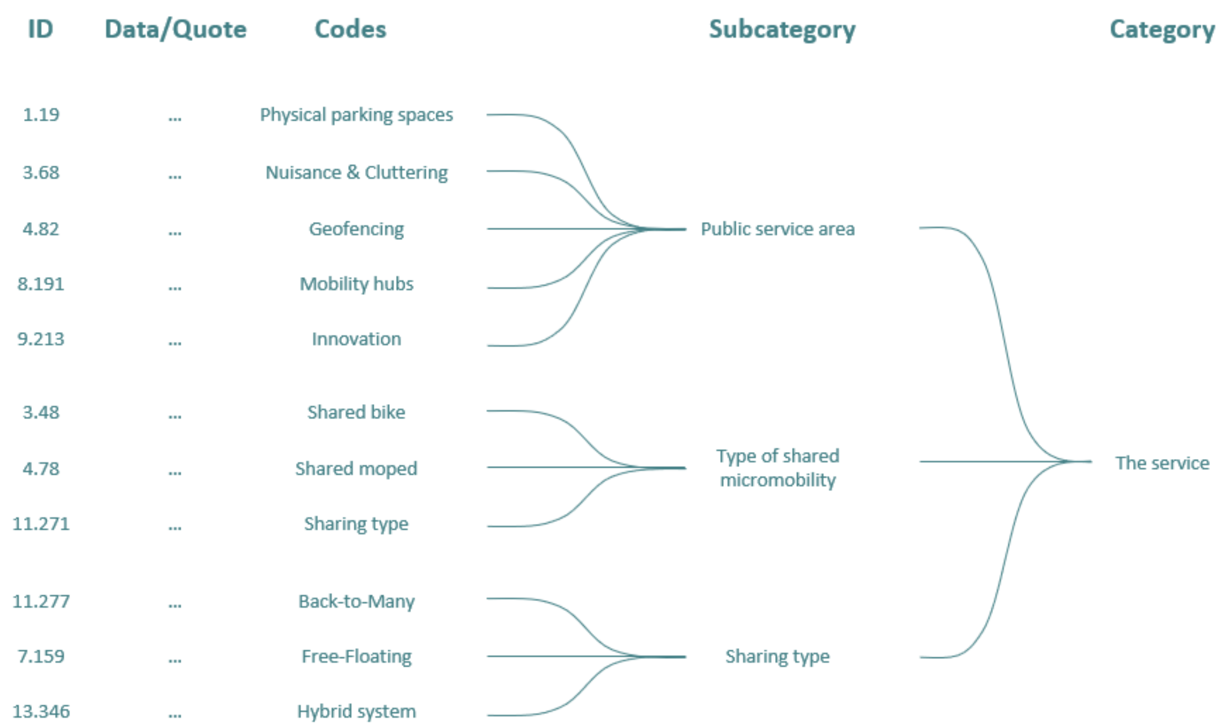


Figure 4.4: Coding structure example

Following each interview, the list of quotes was sent to the corresponding interviewee via email. This process served multiple purposes, including the opportunity for the interviewee to review the quotes, filter out any irrelevant or inaccurate statements, and provide necessary adjustments if needed. Moreover, this email also served as a formal request for approval to utilize the information gathered during the interview. It is noteworthy that all emails were promptly responded to, and approval was granted for the usage of all provided information.

4.4 Results

This section describes the results of the expert interviews divided into 4 sub sections, corresponding to the four categories of the full list of statements.

4.4.1 Effect and influencing factors

All interviewees have expressed their opinions regarding the most significant goals and benefits associated with shared micromobility. One prominent theme that emerged across almost all interviews was the aim to reduce dependence on private cars. Additionally, over half of the interviewees highlighted the importance of increasing mobility options, enhancing flexibility, complementing and supporting public transportation, and ensure an efficient utilization of public space.

Reducing the need for station bikes (additional bikes stationed at locations such as train stations for commuting purposes) and promoting a sustainable society were also frequently mentioned. Furthermore, a few interviewees mentioned additional benefits such as cost savings, improving traffic safety, better regional connectivity to urban areas, and enhanced overall accessibility. Thus, these goals and benefits are not universally recognized as important or obvious by all interviewees.

While shared micromobility may not always directly impact car usage, the combination of public transport and shared mobility can indeed offer a more appealing alternative to relying on public transport alone. Public transport providers aim to facilitate seamless multimodal journeys, encompassing the entire trip from door to door. This presents opportunities for integrating shared transportation options.

However, it is evident that some providers prefer to handle the facilitation themselves, while others acknowledge that their expertise lies in delivering efficient public transport services (buses, trams, or trains) and seek partnerships for additional products. Municipalities, consultancies, and transport authorities also question the role of public transport providers in providing shared mobility services. Although, the importance of establishing a connection with public transport is widely acknowledged. Currently, except for the OV-fiets (shared bicycle service provided by the national railway), this integration has not been fully realized. Which does not yet make it a full part of public transportation, something only recognized by the public transport providers.

Automatically was the focus primarily on highlighting the opportunities and advantages of shared micromobility, with less emphasis on the potential disadvantages. However, a few drawbacks have been identified and examined. These include the risk of no available vehicles at certain moments, resulting from low frequencies. In addition, the absence of shared transportation in areas with limited public transport accessibility (known as "White public transport areas"), low inclusivity and limited service areas. The last mention additionally results in complaints from users, due to high charges when finishing a ride outside the service area. Moreover, there is a perception that shared bicycles and mopeds are currently seen as complementary to existing modes of transportation, rather than leading to a reduction in the overall number of vehicles.

Addressing these challenges requires collaboration between the sector and municipalities. While public transport receives significant funding, providers of shared transport are currently responsible for arranging their own resources. Consequently, it is not realistic to expect these providers to address the shortcomings of the public transport network. Making it evident that they predominantly focus on areas with high demand potential, such as major cities, where supply and demand align more favourably.

As supported by existing literature, shared mobility serves the purpose of both complementing and competing with public transportation. Shared micromobility operators have reported that their vehicles are frequently utilized near or next to public transportation hubs, with major train stations being particularly popular locations. Additionally, these vehicles are commonly used along tram lines, bus stops, and even in conjunction with water buses, as evidenced by the collected data.

"Over 50% of trips are made in combination with public transportation"
Manager SMM operator

"Around 24% of trips start or stop within 125 meters of a public transportation hub"
Manager Public Affairs SMM operator

In addition to public transport hubs, various other locations have been identified as good locations for shared mobility services. These include P+R facilities, shopping centres, educational campuses, and business parks. Tourist hotspots and event venues are also recognized as areas of high demand. However, there is limited usage of shared mobility services around post-secondary schools (MBO or HBO), as well as in suburban areas. To address this last mentioned, it is crucial to effectively align supply and demand, while also dedicating sufficient time and resources to promotional and marketing activities. A strong collaboration between service providers and municipalities is vital in suburban implication, and both parties acknowledge this importance. Establishing connections with the transportation network of nearby major cities is also significant, with collaboration between the main stakeholders: the service provider (sector), regional municipalities, and the nearby city. Notably, expanding the service area by including the surrounding region has resulted in increased usage and longer average trip distances in Amersfoort.

In terms of effective marketing, the experts recommend certain strategies, such as flyer distribution, discounts, and providing comprehensive information. Clearly communicating the costs and benefits of shared mobility is crucial for encouraging behavioural changes. Offering a free service for commuting purposes can facilitate the transition away from private car usage. However, providing an extended period free of charge is only considered viable for commuting scenarios, and could be arranged with the relevant clients. Employers can easily provide reimbursement for public transportation or a car, but in many cases, this is not yet available for shared mobility services. When introducing a shared service, providing a high discount can be more effective in attracting and retaining users, instead of making it free. This approach allows users to experience the service at a reduced cost while still valuing and paying for it, preventing potential issues related to long-term reliance on free offerings. A service should convey quality, and users should be willing to pay for it. This is emphasized by several expert including, Anne van der Veen (Consultant SMM) and a municipality official (Strategic Advisor Smart Mobility).

"Not supportive of providing shared bikes for free, except in exceptional circumstances. Quality is something people should be willing to pay for."
Municipality Strategic Advisor for Smart Mobility

Building upon the discussion of influencing factors, international shared micromobility operators highlight the significance of the availability of appropriate infrastructure. An example is Budapest, where the absence of dedicated bike lanes presents a barrier to the effective implementation of shared bicycles, despite having a considerable tourist population. In contrast, the Netherlands is highly suitable for cycling, and tourists also come to the Netherlands specifically to use bicycles due to the cycling-friendly environment and the local culture.

"From our international experience, it is evident that infrastructure and culture have a significant impact. Furthermore, tourists express a preference to cycle during their visit in the Netherlands."
Business Developer SMM operator

Certain influencing factors depend on the type of shared mobility service. For example, electric mopeds are not suitable for serving remote industrial areas. Acting as a last-mile solution in the morning and a first-mile option for the return trip results in only two trips per day, which is insufficient to establish a viable business case for shared moped operators. On the other hand, regular bicycles are well-suited for such scenarios, as two trips per day can generate enough revenue. Furthermore, events or highly crowded locations like the beach of Scheveningen often lead to long periods of vehicle downtime and one or two uses of the shared product. Once again, this favours the use of shared bicycles but not shared mopeds. Additionally, the redistribution of vehicles is better manageable for shared bicycles compared to shared mopeds.

"The complete multimodal trip is fast and comfortable, providing a good alternative to car; walking the first and last mile makes the trip too long and, as a result, unappealing to consider."
Commercial Transportation Manager at PT provider

Car-trip substitution

As already discussed within the literature review, shared micromobility can influence the use of private cars. This topic has also been touched upon during the interviews, and reference has been made to various studies conducted by municipalities. Results related to this matter are available in municipalities including Groningen, Amsterdam, and Amersfoort. Shared mopeds serve as an alternative to cars in 18% of trips, a trend observed consistently for both the years 2020 and 2021. Furthermore, it has been concluded that shared mopeds are used in combination with public transportation in 22.9% of the trips. Concerning private ownership of non-electric mopeds, 7 out of 39 respondents who own a moped indicated a willingness to sell their moped (30%).

Comparable outcomes have emerged from the mobility research conducted in Amsterdam. A survey targeting users in Amsterdam reveals that 22% of respondents report that their most recent shared moped journey would have otherwise been undertaken using their personal car, motorcycle, or taxi. Moreover, 34% of users indicate a reduction in their personal car mileage. In Amsterdam, 37% of trips involve a combination of shared mopeds and public transport. Lastly, it is noted that approximately 30% of trips on shared scooters accommodate two individuals.

In Amersfoort, the evidence even underscores that 50% of shared moped trips substitute car usage. And 40% of the surveyed population, given the current state of public transportation and the availability of shared mobility options, perceive no reason to purchase a personal car.

Table 4.1: Combined information literature review & expert interviews

Source	**Location**	**Car-use substitute**
Fishman et al. (2014)	Melbourne Brisbane Minnesota London	20% of shared bike 20% of shared bike 2% of shared bike
Guo & Zhang (2021)	Washington, D.C.	7% of shared bike
Gilbert et al. (2021)	Valencia	Reduction of pressure on carparking
Gemeente Rotterdam (2020)	Rotterdam	23% of shared moped 10% of shared bike
Barbour et al. (2019); Lu et al. (2018); Shaheen et al. (2010); Pal & Zhang (2017); Bauman et al. (2017)	-	Overall reduction in gas emissions, fuel consumption, traffic congestion
Gemeente Groningen	Groningen	18% of shared moped
Gemeente Amsterdam	Amsterdam	22% of shared moped
Gemeente Amersfoort	Amersfoort	50% of shared moped

4.4.2 The service

One of the main questions when municipalities have the intention of introducing shared micromobility, is determining the best modality or sharing type. The scope of this research encompasses three types of shared micromobility: shared bicycles, shared e-bikes, and shared mopeds. These three modes were also addressed during the expert interviews. The type of shared two-wheeler is also associated with the sharing system (Back-to-One, Back-to-Many, Free-floating, Hybrid), both of which will be discussed for each modality.

Shared bicycle

When discussing shared bicycles, the OV-fiets cannot be overlooked in the conversation. This concept was originally initiated by Ronald Haverman and has resulted in great success. At the time of writing, there are a total of 22,000 OV-fiets bicycles in the Netherlands, distributed across 284 locations, resulting in over 5 million bike rides annually (Vis, 2022). During the interviews, various reasons are provided for this substantial success. Notably, factors such as accessibility, recognition, and user-friendliness are identified as the primary contributing factors.

However, it's also acknowledged that the OV-fiets has a disruptive impact on the market, partly due to its dominant presence at major train stations. This dominance has the effect of inhibiting the emergence of new developments. Additionally, the OV-fiets rental service is not easily accessible to everyone, as the entry barrier is relatively high due to the requirement of an OV-chipkaart (public transportation smart card). Consequently, tourists might not be inclined to rent an OV-fiets due to this restriction.

"Preference for Back-to-Many but the option to use the system affordable as Back-to-One."
Development Manager at PT provider

Each municipality can determine for itself whether it is interesting to initiate a new location for offering the OV-fiets, because this concept is not only limited to NS stations. Nevertheless, there are also reasons to consider offering a different type of shared bicycles. The OV-fiets operates under a Back-to-One system, to enhance flexibility, an approach based on the Back-to-Many system is recommended by the experts.

Currently, Donkey Republic is the leading provider of regular shared bicycles in the Netherlands using the Back-to-Many approach. These shared bicycles can be both started and locked within the entire service area at digitally designated locations (Preferably equipped with bike racks). Additionally, a trip can span an entire day, multiple days, or just a short duration, with varying pricing structures. The current (2023) shared bicycle providers are shown below in Figure 4.5.

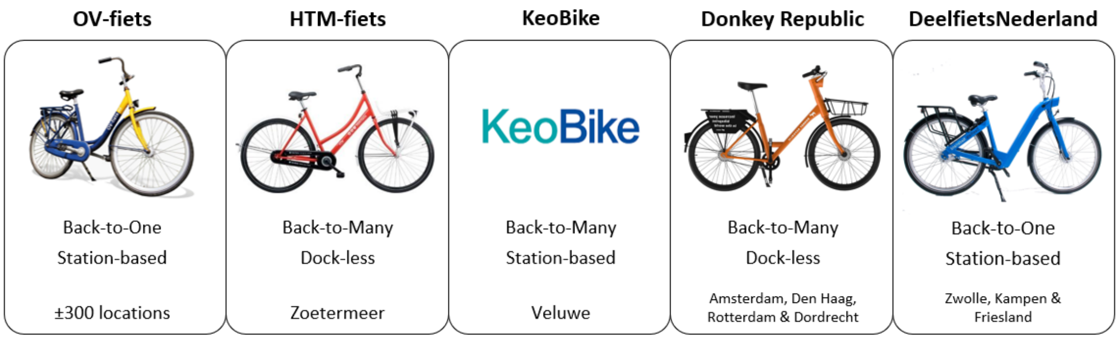


Figure 4.5: Shared bicycles operators in the Netherlands (2023)

In the interviews, it is evident that shared bicycles are highly suitable for integration with public transportation, and they can also serve as a convenient option for Park and Ride (P+R) locations. They serve as a valuable extension for journeys, however, this is valid up to a certain distance. For relatively longer distances, shared bicycles without pedal assistance are less suitable. Shared bicycles align well with municipal policies emphasizing sustainability. Due to their strong cost-effectiveness and the fact that increased usage does not necessarily translate to higher expenses, intentions towards setting a low fee or allowing free usage (e.g., for commuters) is better feasible in comparison to e-bikes or mopeds.

In general the advantages of regular shared bicycles include the highest level of sustainability, cost-effectiveness (relatively low operational costs), the convenience of manual redistribution, and the enhanced reliability. Moreover, risks such as theft and vandalism are reduced. Each user of shared mobility has distinct preferences, hence, regular shared bicycles can be effectively complemented with options like the e-bike or shared mopeds, involving a broader range of users.

Shared e-bike

Naturally, the significant advantage of electric shared bicycles over conventional ones lies in the support they offer during cycling. This benefit does come with a slightly higher price fee, however, traveling greater distances become more easy and often faster. Various experts also acknowledge the potential for connecting towns with nearby cities using electric shared bicycles, thereby serving an entire region through a single shared mobility system.

However, the batteries and the charging aspect of these bicycles render this variant less environmentally sustainable and result in higher operational costs. Providers of shared e-bikes recognizes opportunities for implementing these vehicles beyond urban settings. This idea is substantiated by experiences gained from numerous projects both domestically and internationally. Introducing shared e-bikes in regional context repeatedly shown that expanding the service area beyond the city has a beneficial effect on the usage within the city itself. Residents of nearby towns or villages can conveniently commute to and from the city by utilizing electric bicycles. The current (2023) shared e-bike providers are shown in Figure 4.6.

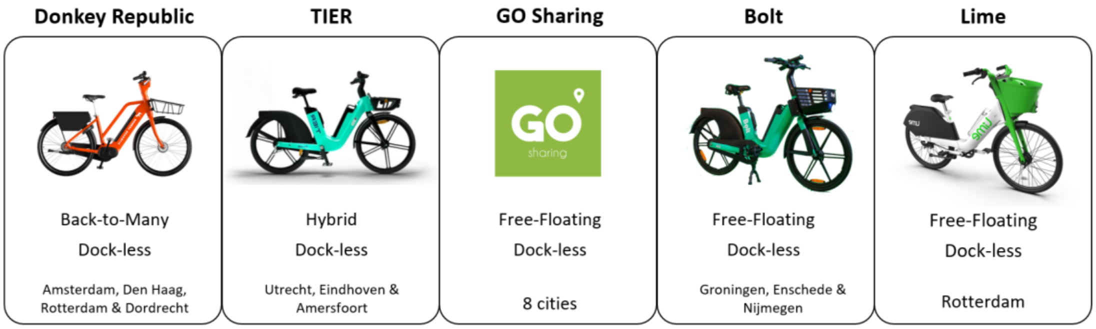


Figure 4.6: Shared e-bike operators in the Netherlands (2023)

A few issues need to be considered while applying electric shared bicycles in suburban regions. To begin with, the presence of a city with electric shared bicycles is essential to avoid high operational costs. Second, the e-bikes should not remain stationary for extended periods, which makes not all locations equally appealing. The process of identifying suitable spots within towns and villages require more time than in larger cities with higher demand. Generally, "scale" and "density" are given as most important by shared mobility companies. In which scale refers to the total number of vehicles within a specific service area, whereas density refers to the number of vehicles per location. In suburban areas, it is more advisable to establish fewer digital or physical hubs with a greater number of vehicles per hub. This approach ensures sustained density with fewer vehicles.

In comparison to shared mopeds, electric shared bicycles are smaller in size, require physical effort when using, and are found to cause less nuisance. These factors played a role in decision of the municipality of Utrecht to discontinue the use of shared mopeds and exclusively continue with electric bicycles (Hovanisyan, 2022). For regional applications and thus longer distances, electric bicycles prove more suitable than regular shared bicycles. However, electric shared bicycles may compete with regional bus routes. Whether this is a negative consequence is a topic of debate. Mainly, transport authorities and public transport providers raise questions about its desirability, while other experts foresee potential positive impacts.

A potential alternative to private vehicles is provided by the combination of public transportation and shared mobility, which could lead to a long-term rise in the modal share of public transportation. Furthermore, shared mobility can bring flexibility in situations of service interruption or peak congestion, and public transit can provide options during bad weather.

Shared moped

Apart from the success in the Netherlands, shared mopeds are only prevalent in large numbers in Spain; in most other countries, standing e-scooters are the norm. This could be a reason for the significant success of shared mopeds in the Netherlands, as electric shared scooters are not yet available. Compared to shared bicycles and shared e-bikes, shared mopeds offer the greatest convenience and comfort. Making a trip is effortless and at the highest speed.

Shared mopeds can be offered in two forms. The "light moped" with blue plate is allowed on bicycle paths and has a maximum speed of 25 kilometres per hour. While the regular moped with a yellow plate, depending on the situation, must be driven on the road or on the moped/bicycle path, with a maximum speed of 45 kilometres per hour. Since January 1, 2023, a helmet must be worn on both types of vehicles. The difference between the two has been discussed with providers during the interviews.

Since the introduction of the helmet requirement for the light mopeds, there has been an increase in the usage of shared mopeds (Yellow plate). Furthermore, the average ride duration for shared mopeds in the major cities of the Netherlands is 17% higher compared to shared light mopeds. A more significant difference is observed in ride length, approximately 43%. Despite this, another provider mentioned that a large group of users prefers the scooter due to the convenience of using bicycle paths, reducing the need to consider where they can and cannot ride. Currently there are three different operators in the Netherlands, presented in Figure 4.7. There was a fourth operator in Utrecht, but TIER has switched over to only providing electric bicycles in conjunction with the municipality.

Figure 4.7: Shared moped operators in the Netherlands (2023)

In terms of sustainability, shared mopeds score slightly lower than the other two modalities, also due to issues such as abandoned helmets in natural environments and water bodies. Additionally, this modality has a higher impact on nuisance. Ultimately, these factors played a significant role in the decision to discontinue the use of shared mopeds in Utrecht. These vehicles are larger than shared bicycles or e-bikes, in combination with commonly applied free-floating model, sidewalks or even bicycle lanes can be completely or partially obstructed.

During the interviews, shared mopeds are primarily associated with longer distances, making them suitable for regional areas. However, it's important for shared mopeds to be used regularly to create an economically viable business case. Without financial support, providers typically aim for an average of 5 rides per day, assuming relatively short trips within the city. The number of daily rides can be lower if longer trips are taken and can be further reduced with subsidies. For comparison, a minimum of one ride per bicycle per day is sufficient for shared bicycles, and the goal is to achieve two rides per vehicle per day for shared e-bikes (Minimum fleet size of 100 vehicles).

"Free-Floating is not preferred in regional context; hubs (Back-to-Many) with physically designated locations and a national design with guidelines are more suitable."

Development Manager at PT provider

Generally speaking, shared mopeds are not ideal for commuting to remote industrial areas, as this typically results in about two rides per day per vehicle. Combining them with regional public transportation is also less common, and they are not well-suited for events. Events often lead to a large influx of vehicles to a single location, resulting in extended periods of inactivity. In many cases, the vehicles need to be retrieved and redistributed, which is neither sustainable nor simple due to the size of the vehicles.

Nevertheless, it is noteworthy that consultancies and shared micromobility operators express a favourable view regarding shared mopeds. In contrast, municipalities tend to hold a more reserved attitude towards shared mopeds. Furthermore, electric shared mopeds have proven to be most effective in substituting car trips and enjoy significant popularity among the youth and students.

Résumé

An important consideration when implementing shared micromobility is scale and density. Scale refers to the number of vehicles in a specific service area, while density is the number of vehicles based on a particular area. To provide users with certainty, it is better to have fewer hubs per area and more vehicles per hub. Regarding the type of modality, it is crucial for each municipality to have a clear understanding of the objective, before the best suitable shared modality can be effectively determined. This is schematically depicted in Figure 4.8.

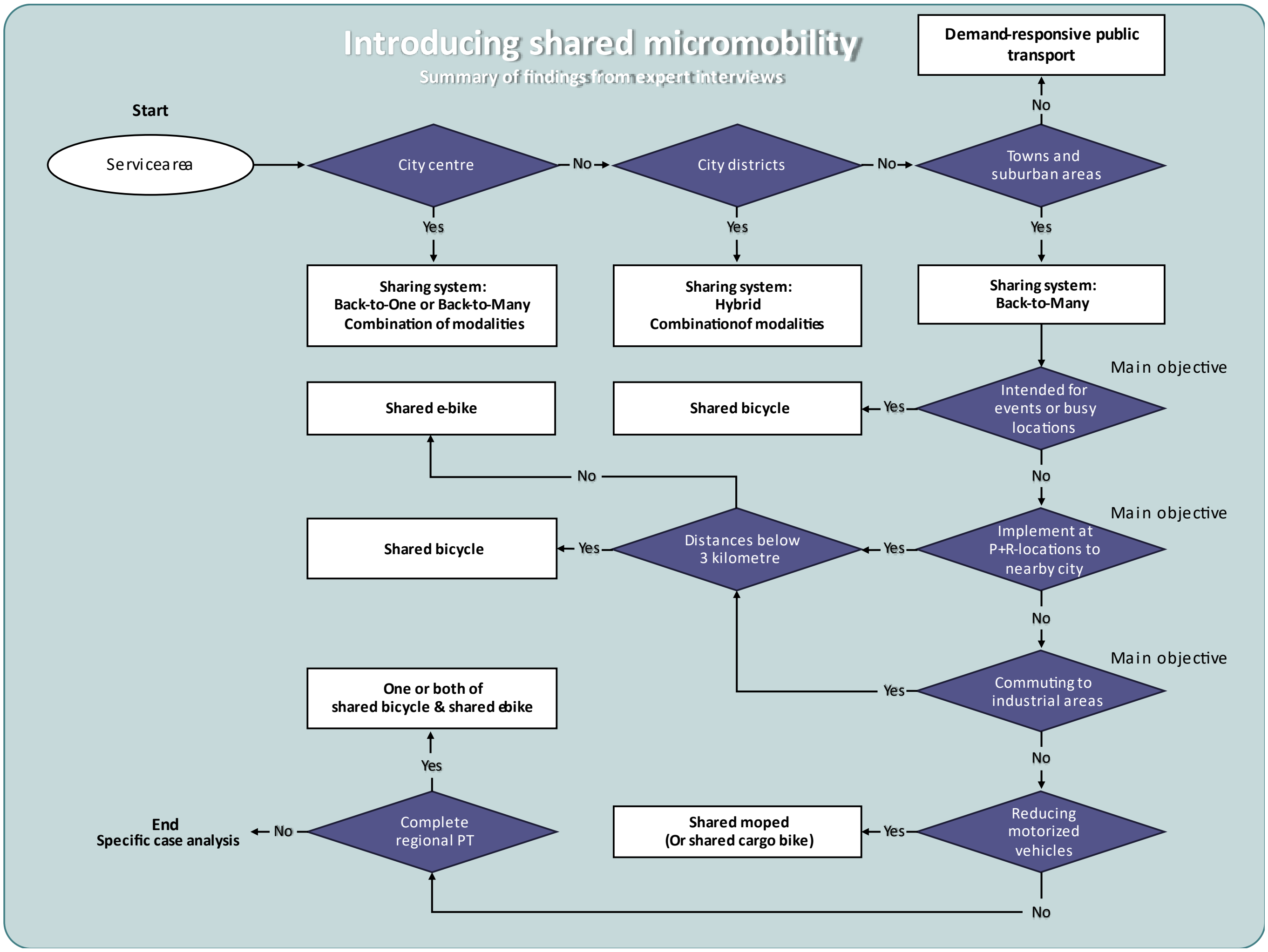


Figure 4.8: Flowchart for choosing sharing modality related to situation

The recommendations of the experts were in full alignment for certain topics, including the application of the sharing-system. The experts recommend a Back-to-Many system for regional and suburban areas. This recommendation was repeatedly supplemented with the concept of a service area consisting of three layers. In this principle, the city centre is equipped with Back-to-Many system (Few central hubs), the districts of the city are entirely free-floating (Or equipped with many hubs), and then everything outside the cities is once again provided with Back-to-Many system. Where regional municipalities can be subdivided with more central hubs in the centre of the municipality and several hubs in the surrounding neighbourhoods, for instance, at regional public transport stops, sports facilities and shopping centra.

"More municipalities make the transition to a Back-to-Many approach instead of Free-Floating. We remain flexible and adapt to the municipality's preferences while considering our users."
Manager Public Affairs SMM operator

Two key factors for determining the sharing modality are distance and the objective, both included in Figure 4.8. In general, longer distances are associated with shared mopeds or shared e-bikes, while shorter distances are related to shared bicycles. When the primary goal is sustainability or supporting public transportation, the conventional bicycle is the most straightforward choice. Shared bicycles consume no electricity and requires the least maintenance. Moreover, bike redistribution involves minimal effort, and even non-users can easily relocate the bikes when they are improperly parked. However, depending on demand, conventional bike-sharing can be combined with shared e-bikes or shared mopeds. Finally, it's worth noting that the application of shared mopeds is not suitable for commuting to remote industrial areas. For a good business case, more than two trips per day are typically required, and extended vehicle downtime is not desirable. Additionally, extended periods of not using a vehicle automatically result in more operational problems and nuisance.

4.4.3 Trips & Users

The interviews conducted with shared mobility providers and public transportation providers yielded valuable insights into trip patterns and users. As mentioned previously, tourists and students emerge as the most important target groups. Furthermore, in the early stages of a project or with implementations in new areas, a lower average age is observed among users, and this average age gradually rises as the service remains available. All providers have a minimum age requirement of 18 years for registration, and moped providers additionally ask a driver's license. Interestingly, there is no notable gender disparity, with similar usage patterns observed between men and women.

"Usage patterns show no gender-based distinctions, and with an extended service duration, the average age increases correspondingly."
Manager Public Affairs SMM operator

A notable observation is the increase in the distance people are willing to walk to access a vehicle. For shared bicycles, it is around 150 meters, for e-bikes just below 200 meters, and for shared scooters around 225 meters. People's willingness to walk increases as the comfort of the vehicle improves. If a vehicle is parked beyond the threshold distance, there is a higher likelihood that the user will not take the ride. These distances need to be carefully considered when setting up a Back-to-Many sharing system. A large client with a hub located more than 250 meters away is not compelling enough to encourage usage.

The usage patterns vary significantly between different vehicles, areas, and circumstances. In the Netherlands, shared mopeds are typically used for distances between 3 and 4 kilometres, with both longer and shorter trips. In areas where the city and the region are connected, higher distances are observed. For example, in Antwerp, there is a high average usage of electric shared bicycles, with 50% of all trips being longer than 5 kilometres. This also applies to regular shared bicycles to a lesser extent, where 25% of trips are longer than 5 kilometres. Another shared bike provider mentions that electric shared bicycles are typically used for slightly more than 2 kilometres on average. In the Netherlands, apart from the OV-fiets, the shared mopeds is considered the most popular mode of shared mobility. This is partly due to the absence of shared electric scooters (deelsteppen), which generate high demand in other European countries.

4.4.4 Other topics

Mobility as a Service (MaaS), as well as issues of nuisance and cluttering, are widely discussed topics in the context of shared micromobility. These subjects were also addressed during the expert interviews. One of the major advantages of MaaS is described as the ease of planning, booking, and paying for a trip using shared mobility services. The strength of MaaS lies in its ability to connect various modes of transportation, enabling a seamless multimodal trip and the flexibility to choose among different providers. Additionally, this opens up opportunities for straightforward and efficient data sharing, which can improve decision-making. In theory, MaaS offers many benefits; however, in practice, it has not fully integrated yet, confirmed during all interviews. Below, the advantages and disadvantages are listed in a table format.

Table 4.2: Benefits and current drawbacks of MaaS

Pros	Cons/Current problems
Data sharing	Too many MaaS-apps
Easily planning, booking, and paying a trip	Slowing down innovation
Enabling multi modal trips	Loss of control over users
Only one application	Reduced functionality of products
New environment, same network.	Additional time and effort, with numerous regulations

Already during the exploratory interviews of the stakeholder analysis and in the first expert interviews a negative picture of the current state of MaaS is situated. Therefore, it was decided not to include this topic in more detail in this research and also not to include it in the survey. The benefits do not outweigh the drawbacks, and there is no main MaaS app available in the Netherlands that can be used across a wide area, encompassing all providers of public transportation, shared mobility, and parking services.

Another topic that came up is the potential nuisance of shared micromobility, which some experts see as a structural issue, while others question whether it is actually a significant problem. Research in Amsterdam, for example, has demonstrated that the number of improperly parked shared vehicles is negligible compared to personal vehicles.

Providers of shared two-wheelers are willing to take measures to reduce or eliminate this problem. A Back-to-Many sharing system inherently has a lower likelihood of clutter compared to free-floating systems. Additionally, features in the app can also lead to less cluttering. Suggested examples by shared mobility providers include requiring users to take a photo after completing their rental period or offering discounts for vehicles with high downtime. Physical parking spaces for shared vehicles are also part of the solution.

Eleven out of the thirteen interviewed experts express a positive view of physical parking facilities. However, it is emphasized that these locations should be established based on usage data because physical locations are not easily moved. It is primarily beneficial to create physical locations at major hubs and busy areas. It is important to ensure there is also enough space for private vehicles to prevent the creation of new problems. An additional advantage of these physical locations is their visibility and ease of finding.

4.5 Conclusion expert interviews

Every environment, and consequently every municipality, is unique, making it impossible to present a one-size-fits-all formula for providing shared mobility. However, a solid foundation can be established to begin with.

Resulting from the expert interviews, several important conclusions have emerged. One key recommendation, although not a strict requirement, is to establish a regional sharing network. Meaning that for a relatively small municipality initiating a shared mobility system, it is important to connect it with a system in an adjacent city with a population of over 100,000 residents. In the province of South Holland, examples of such cities include Rotterdam, The Hague, or Leiden. Collaboration between the regional municipalities and the "main city" is crucial to make the system attractive while also being appealing to shared micromobility providers. A system must have a solid business case to ensure its long-term viability, avoiding significant (government) investments without achieving the expected results.

In addition to the importance of collaboration among various stakeholders, it is also crucial to start with a clear objective. This could be sustainability, reducing car ownership, improving accessibility, or any other specific objective. Each goal is linked to a different sharing service. It is also advisable for municipalities, public transportation providers, or other institutions to not reinvent the wheel. The interviews have shown that using a reliable and well-known sharing provider is much more successful than starting with new shared bikes or mopeds.

Launching a new project should ideally take place in the spring. Investment costs in the first two or three years can be spread along different stakeholders to make a project possible. It is crucial to use this period for identifying the most promising locations, determining the right quantities (scale and density), and reach a broad range of different users. Just like with introducing any new product, marketing plays a vital role. Promoting a new project with free rides does not necessarily need to continue for an extended period, it is essential to emphasize that a quality product can be paid for. Initiatives to engage employees are recommended. Furthermore, marketing should not solely rely on the provider, collaboration in marketing efforts increases the likelihood of success. In this context, door-to-door flyers are cited as an effective method, while, for example, a video on YouTube may be less impactful.

In cities, the maximum providers per modality is two and four providers in total are more than sufficient. For regional and suburban areas, this number can be even lower, with one provider per modality being adequate. Agreements between municipalities and providers will have higher benefits than competition in these situations. Additionally, it is possible to choose for a provider with a portfolio that includes multiple modalities. It is essential for these providers to serve the entire region, ensuring that the services within different municipalities are interconnected. Allowing, for example, a shared moped to be rented in municipality A and the ride to be finished in municipality B.

The above-mentioned elements are all connected to how user-friendly the service is. Customer service and enforcement, which also affects non-users, are further issues that need to be addressed. Every municipality that offers shared micromobility should have a website where problems can be quickly reported, including disturbances, illegally parked vehicles, and general questions about shared micromobility. Municipalities supporting shared micromobility should invest in more resources and capability to make this possible.

To end with, the concept of Mobility as a Service (MaaS) was discussed in all interviews. However, it is unanimously found that MaaS has not been successful in the Netherlands so far. Various reasons are cited, including conflicting interests and an overload of MaaS providers.

Part III:

Exploring Public Sentiment

5 Survey design

In addition to conducting a literature review and expert interviews, the topic is also explored from the perspectives of employees and residents through an online survey. This component consists of several steps, as described in Chapter 2 - Research Methodology. The online survey has been programmed using Qualtrics. Qualtrics is a web-based survey software platform that allows to create, distribute, and analyse surveys and other data collection instruments. The program is highly user-friendly and professional, offering numerous functionalities. For this research, Qualtrics was utilized for creating and analysing the online survey.

The survey is distributed and analysed in order to answer the following research questions:

5. *Which socio-demographics are associated with (e-)bike and moped sharing?*
6. *To what extent does price and distance influence the use of (e-)bike and moped sharing?*
7. *Are suburban residents and visitors (daily work & non-daily non-work) interested in and willing to accept the introduction of shared micromobility?*
    a. *To what extent do they have knowledge, experience and understanding of the potential benefits for the introduction of such services?*
    b. *What are the user preferences, motivations, and concerns related to shared mobility services, so that this information can be utilized to enhance the implementation and design?*

This chapter will describe the structure of the survey in Section 5.1. Continuing with the initial survey design in Section 5.2, which is tested using a pilot study. And the chapter ends with a description of the distribution of the questionnaire.

5.1 Questionnaire structure

The structure of a survey is crucial for collecting accurate and relevant data from respondents. A well-organized survey ensures that the research objectives are met effectively and efficiently, resulting in the following objectives, all scoped to residents or employees of suburban regions and towns:

- Assess the level of knowledge and attitudes towards shared micromobility.
- Determine the degree of usage of shared micromobility.
- Measure behaviour and preference towards different types of shared micromobility.
- Survey reasons for using or not using the service.

During the development of the survey, several key considerations were taken into account. Firstly, anonymity and confidentiality are guaranteed to enhance respondents' willingness to participate. Secondly, only relevant questions are asked to prevent an unnecessarily lengthy survey. In general, efforts were made to limit the completion time to a maximum of 10 minutes, equivalent to approximately 25 to 30 questions (Chudoba, 2022). Additionally, the questions are formulated in a concise and clear manner, avoiding double negatives.

Moreover, branching is employed in the questionnaire, ensuring that respondents are presented with questions logically based on their previous answers. Lastly, the survey follows a logical sequence. In brief, the survey consists of three distinct sections, namely 'Knowledge, Attitude & Behaviour'. The whole survey structure is also summarized in Figure 5.1 below. The full survey can be found in Dutch in appendix D.

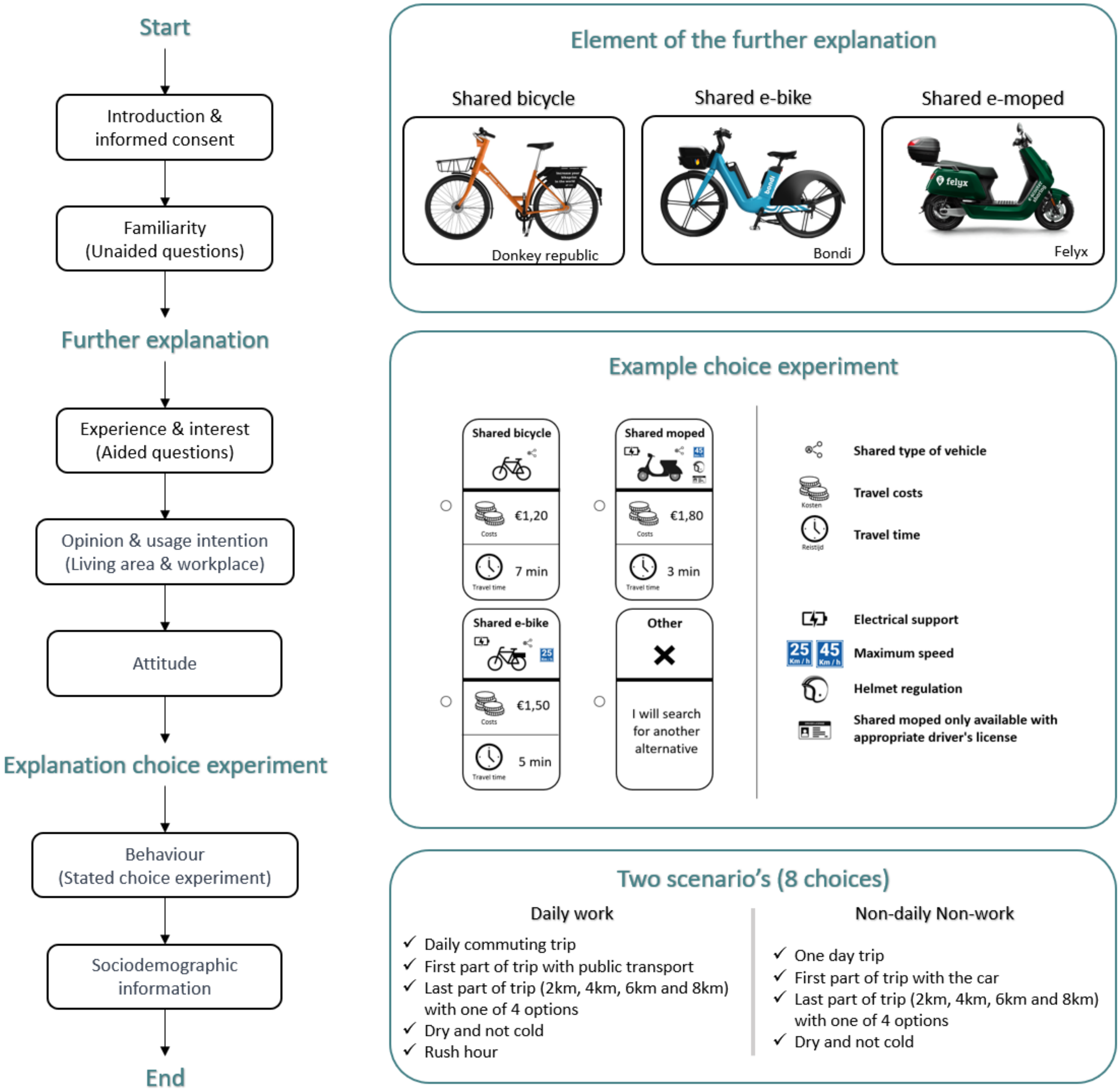


Figure 5.1: Survey structure

The survey starts with a clear and concise introduction including the informed consent. After which the survey continues with two spontaneous (unaided) questions without providing any explanation about the topic. The clarification on the subject follows immediately after the two unaided questions, ensuring that respondents understand the scope of the rest of the questionnaire and avoid misinterpretations. After reading the explanation, respondents proceed to the core of the questionnaire, where Knowledge and Attitude are assessed using various question types (Multiple choice, rating scales, matrix questions, open-ended answers). In some questions, the Likert scale was removed to shorten the overall length of the survey. The process of adding and removing questions in the questionnaire is an iterative one, considering various interests. Since the research also involves literature review and expert interviews, not all information needs to be extracted from the survey. Additionally, an illogical or excessively long survey can lead to unreliable results. Therefore, the questions were critically examined to ensure the reliability of the results.

The next part of the survey consists of choice questions, where respondents are presented with a scenario, either Daily-Work or Non-daily Non-work. In both situations, respondents answer 8 choice questions, selecting between bike-sharing, electric bike-sharing, and shared e-mopeds. There is also a fourth option to not use any shared modality and choose another mode of transportation. People without a scooter license receive only three options and cannot choose the moped-sharing option. After completing these 8 questions, respondents are asked about the factors influencing their choices, and the survey concludes with sociodemographic information.

For two main reasons, gathering sociodemographic data is very important. First of all, it enables the confirmation of the sample's validity as a representation of the actual population, preventing bias in the outcomes. Furthermore, the data can also be utilized to spot significant variations across distinct groups (e.g., age, gender, educational level, etc.). Table 5.1 below provides a summary of the sociodemographic data gathered through the survey. In addition to the listed response options in the table, respondents may also opt not to answer for each sociodemographic question, additional option ‘Prefer not to answer’.

Table 5.1: Sociodemographic information included in the survey

Sociodemographic characteristic	***Categories***
Gender	*Male* *Female* *Other*
Age	*18-24 year* *25-34 year* *35-49 year* *50-64 year* *65 year or older*
Education	*Primary education* *Secondary education* *MBO* *HBO* *WO*
Household income	*< €10.000 per year* *€10.000 - €29.999 per year* *€30.000 - €49.999 per year* *€50.000 - €69.999 per year* *> €70.000 per year*

To limit the collection of unnecessary personal information, the decision was made to request only the before-mentioned characteristics. With this information, it is possible to assess the consistency of the sample, and these four characteristics are the most frequently mentioned in the literature. Two general transportation questions were presented as an alternate method of gathering respondents' opinions on mobility, as shown in the table below. Lastly, participants are questioned about their ownership of a driver's license before the start of the stated choice experiment.

Table 5.2: Transport related questions

Characteristic	***Categories***
Possession of valid driving license for car	*Yes* *No, only moped license* *No, neither* *Prefer not to say*
Main transport modality	*Walking* *(Electric) bicycle* *Moped* *Public transport* *Car* *Other*
Preferred transport modality	*Walking* *(Electric) bicycle* *Moped* *Public transport* *Car* *Other*

5.2 Stated preference experiment

Over the years, stated preference or also called stated choice (SC) experiments, introduced by Louviere and Woodworth (1983) and Louviere and Hensher (1983), have gathered growing interest across diverse fields. Apart from their extensive application in transportation research, these experiments find wide ranged use in marketing, health care, environmental policies, and economics (Hoyos, 2010). Respondents are asked to make choices instead of general judgment. Judgment is known to be much more susceptible to bias than choices and in many cases people hesitate to give true trade-off.

This method was employed in the research to determine which shared mobility option – shared bicycle, shared e-bike or shared moped – is most suitable under various conditions. It allows to analyse the influence of sociodemographic information, but more importantly, the impact of price changes, distance variations, and other situational factors.

5.2.1 Alternatives

This experiment is mainly focused on finding the most appropriate modality between shared bicycle, shared e-bike, and shared moped and therefore, besides some other reasons, is chosen to exclude several other alternatives. Apart from these three alternatives people are also allowed to opt out with a fourth option. The opt-out option creates realism in the sense that participants are not forced to choose between the experimentally designed alternatives.

Before the experiment starts, participants are asked to indicate whether or not they are in possession of a valid driver's license for car or mopeds. Individuals who do not possess a driver's license are presented with a total of three alternatives and do not have the option to choose the shared moped.

5.2.2 Context

As described in the literature review and during the expert interviews, several factors influence mode choice. Such as trip purpose, weather, time of day or for example availability of modes. To whole experiment is divided into two main scenarios, namely daily-work (commuting) or non-daily non-work (day trip). The information that is provided prior to the experiment is repeated below, with explanation.

Daily-Work

The first context scenario involves commuting trips, where public transportation is used to travel to and from work. This is a typical rush-hour travel situation, but the weather is good and not cold. The following text was presented to the respondents:

"In this part of the study, you will be presented with 8 choices related to a daily commuting trip, where the distance, price, and travel time change. Assume the following situation:

- ❖ *You make a daily commute to and from your workplace.*
- ❖ *The car is not available.*
- ❖ *You use public transportation (paid by your employer) and have to continue from the last stop to your workplace. This distance varies from 2 km to 8 km.*
- ❖ *You must choose between 3 modes of transportation: shared bicycle, electric shared bicycle, or shared scooter.*
- ❖ *Additionally, you have the choice not to use any of these 3 options and cover the distance from the last stop to your workplace in another way.*
- ❖ *The weather is dry and not cold.*
- ❖ *You are traveling during rush hour."*

Non-Daily Non-Work

The second context scenario involves a day trip, starting with a car trip. In many locations, it is becoming increasingly challenging to complete the entire journey by car. Facilities are being established at a distance, such as P+R (Park and Ride) locations, as well as at major events. Again the context is designed with good weather conditions. The following text was presented to the respondents:

"In this part of the study, you will be presented with 8 choices to make a trip, where the distance, price, and travel time change. Assume the following situation:

- ❖ *You are going on a day trip. You are either taking your car or being driven.*
- ❖ *Parking at the destination is not possible, so after the car ride, you need to cover some distance. This distance varies from 2 km to 8 km.*
- ❖ *You must choose between 3 modes of transportation: shared bicycle, electric shared bicycle, or shared scooter.*
- ❖ *Additionally, you have the choice not to use any of these 3 options and cover the distance in another way.*
- ❖ *The weather is dry and not cold."*

5.2.3 Attributes

Based on the literature review and expert interviews is chosen to include costs and distance as attributes. Distance is clarified by displaying the travel time alongside the costs for the various alternatives. Travel time is calculated based on the distance and the average speed of the specific alternative. For many people, travel time is more relatable than distance (Fishman E. , 2016).

The costs are attribute specific and differs according to the distance as well. The prices change with or without discount in the context profiles which are given to the respondents. The costs and times are provided in Table 5.3 below.

Table 5.3: Overview of the attributes in the stated preference experiment

Attributes	Attributes levels			
Travel cost shared bike	Normal price [0]		50% discount [1]	
Travel cost shared e-bike	Normal price [0]		50% discount [1]	
Travel cost shared e-moped	Normal price [0]		50% discount [1]	
Normal price	**2km**	**4km**	**6km**	**8km**
Travel cost shared bike	€1,20	€1,60	€2,00	€2,40
Travel cost shared e-bike	€1,50	€2,00	€2,50	€3,00
Travel cost shared e-moped	€1,80	€2,40	€3,00	€3,60
Travel time	**2km**	**4km**	**6km**	**8km**
Travel time shared bike	7 min	14 min	21 min	28 min
Travel time shared e-bike	5 min	10 min	15 min	20 min
Travel time shared e-moped	3 min	6 min	9 min	12 min

All combinations of the price changes (with and without discounts) result in 8 different scenarios. These 8 scenarios, spread over the four distances, create a full factorial design of 32 situations. Including the two context profiles, daily-work and non-daily non-work, there are a total of 64 different situations. With the software program Ngene, this total has been reduced back to 32 situations, distributed across the context profiles. The full factorial design remains complete, and each respondent is presented with eight choices, with each respondent receiving two choices per distance. To avoid confusion, each respondent is assigned to only one role, either making daily-work trips or non-daily non-work trips. The complete list of scenarios is added to Appendix G.1.

5.3 Pilot

Pilot testing the survey with a small group of respondents can help identify any issues with the structure, wording, or flow before launching it to a broader audience. The process provided valuable insights and resulted in various adjustments to the questionnaire.

The survey is distributed to people familiar and people unfamiliar with these kinds of questionnaires. All the respondents are asked to provide feedback, trough WhatsApp, email or face-to-face. Additionally, during the survey completion, several individuals were observed while discussing their reasoning and opinions on various questions. Conducting these discussions gave insights into potential misunderstandings. The pilot survey was conducted in total by 31 respondents. Despite the extensive efforts put into crafting the survey and the various preceding versions, the pilot study prompted numerous changes, making it highly valuable.

Among the alterations made to the final survey design are the following:

- Overall spelling and grammar have been improved.
- The introduction with the informed consent and the additional information followed by the first two questions has been written more concise, making it easier to read and ensuring that all essential information is understand.
- Questions were rephrased when they were not well or completely understood.
- According to comments from responders, some questions were removed and others were added, and the question order has been changed to provide a more logical flow.
- Not all survey questions were display on the correctly way on certain phone brands, resulting in layout adjustments for specific questions. During the pilot phase, the devices on which the survey was completed was tracked and ensured that all commonly known phone brands were extensively tested during the process.
- Several multiple-choice questions are provided with an open-response option, giving respondents the opportunity to provide their own answers.
- Many of the respondents indicated that they did not notice a difference among the various choice questions. To address this, visual aids and a clear summary were introduced. Additionally, textual descriptions were included to clarify that the distance, time, and price variables change with each question.

All the before mentioned adjustments are intended to make the questionnaire as reliable as possible. Respondents should find the survey enjoyable or interesting in some way. Furthermore, the survey should not be overly lengthy, it should be easily comprehensible, and it should be free of any spelling errors.

Regarding the experiment, no dominance of alternatives where found, some participants had a strong preference for an alternative, whereas others did for example not choice the shared moped because of the lake of a driver's licence.

Completion time

The goal was to keep the survey under 10 minutes, as a survey that is too long can have a negative impact on the quality of the results. Additionally, depending on the average completion time, filtering is applied to respondents who may have filled out the survey too quickly. Neil Malhotra (2008) recommended using one-and-a-half standard deviations below the mean in his study. The pilot study was conducted to assess how this distribution is among a group explicitly asked to fill out the survey properly. It should be noted that some respondents may take longer than usual to complete the survey because they were asked to provide feedback.

The average completion time for the pilot sample was 808 seconds (13.5 minutes). This average is influenced by a few extremely high completion times (Above 1200 seconds), partly due to the option to stop and resume later and the request for feedback. The average without these 5 extremely high values is much lower, namely 515 seconds (8.6 minutes), and the median without those values is 510 seconds (8.5 minutes). The median is 575 seconds (9.6 minutes) with the high values included. A box plot of the total is also created, as shown in Figure 5.2 on the following page, which includes the median as well.

The boxplot and the presented values above show that the survey is feasible within 10 minutes. Even with the request of providing feedback during completion. It is noteworthy that completing the survey between 430 seconds and 254 seconds was only achieved by highly educated individuals with a university degree (WO). Furthermore, it can be concluded that for this group, at least 4 minutes are needed to complete the survey, which can be used in filtering the final data.

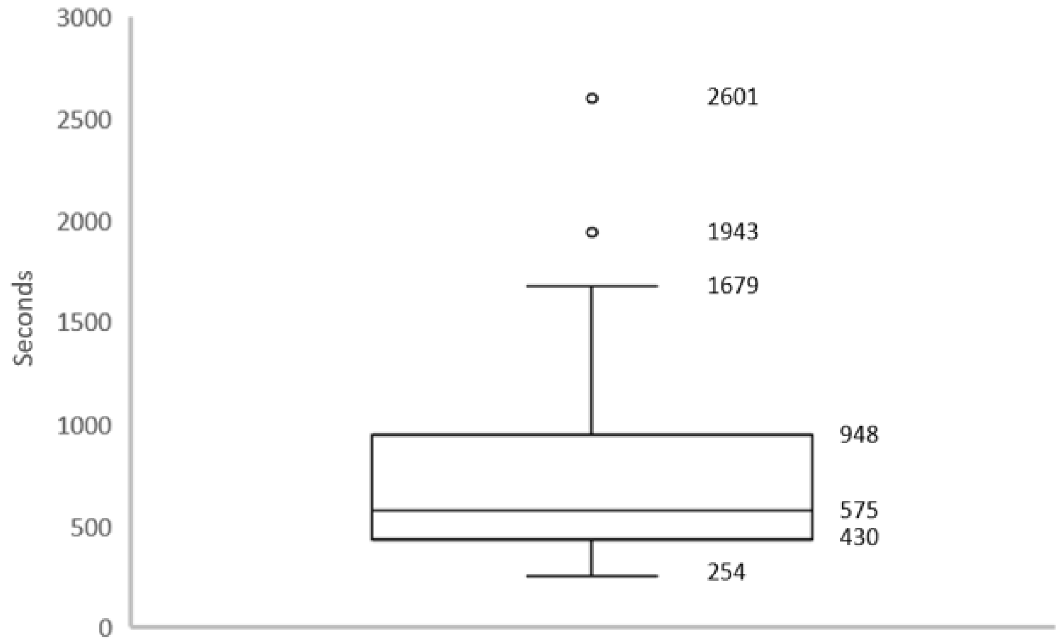


Figure 5.2: Boxplot of the completion time of the pilot sample (N=31)

5.4 Data collection

In the data collection process is thought of different techniques to ensure a representative and generalizable sample. Examples are choosing an adequate sample size, applying mixed recruitment channels, minimizing cognitive biases, manage a strict filtering method, and including a quota at the start of the survey. These and other techniques are described below in more detail.

To start with, the distribution of the final survey design is divided into two parts. People are mainly recruited to participate in the survey using an online panel called PanelClix and on the other hand the list of participants is completed through the researchers own network. This second method is added due to the relative high age of the online panel members. Additionally, this provides the opportunity to involve employees and companies in the research.

PanelClix is a Dutch company that has a large online research panel. They provide a platform where respondents can voluntarily (compensated) participate in various online surveys. This online panel was compared with two other Dutch panels and chosen based on the ability of providing enough completes within the case study area, in combination with the best price for the service. Respondents recruited through PanelClix are rewarded with compensation for completing the survey. However, this poses the risk that some individuals may not be genuinely interested in the survey and may not provide truthful responses. To address this concern, the final results are carefully reviewed based on response times and the combination of given answers.

Completes below two minutes are removed from the dataset because it is unlikely that respondents could thoroughly review and provide thoughtful answers within such a short timeframe. Additionally, all responses completed in under four minutes are checked for contradictory combinations of answers or unusual responses. By implementing these quality control measures, the research aims to ensure that the data collected is accurate, reliable, and reflective of respondents' genuine opinions and perspectives.

To determine the required number of respondents, two factors were considered. On the one hand the minimum number of respondents is generated using the online tool of Ngene (N=320), confirmed with a statistical equation of the sample size $N = (Z^2 * P * (1 - P))/E^2$ with Population proportion (P) of 0.55, margin of error (E) of 0.05 and a confidence level (Z) of 1.96, critical value for a 95% confidence (Cochran, 1977). Resulting in N = 376.776 meaning that the minimal sample size according to this equation is 377 respondents. On the other hand the maximum completes possible using the online panel (N=500). In consultation with Delft University of Technology, it has been agreed to utilize the entire panel for the specified criteria. This enables the possibility of reusing the survey results for future research purposes. The target group or criteria are residents or employees of relatively small municipalities within the province of South Holland, which are at least 18 years old.

To ensure that only the specific target group participated in the survey, PanelClix implemented strict selection criteria. Additionally, a quota has been introduced to the survey. Respondents were asked whether they lived in South Holland and whether they could confirm being 18 years or older. A total of 593 PanelClix members used the provided link. Ultimately, 566 members began filling out the survey, and then 5 members were filtered out using the initial quota. So, 561 individuals have started filling in the questionnaire, of which eventually 527 PanelClix members completed the entire survey.

Respondents obtained through the use of PanelClix were supplemented with individuals from the researcher's personal and professional network. This resulted in a new total number of respondents of 566. These completions are filtered based on the previously mentioned time and answer criteria. Answers are not considered in the results due to the following observations:

- Completed within 200 seconds or less (Data reduced from 566 to 504 respondents).
- Combination of the following points (Data reduced from 504 to 489 respondents):
    - Completed within 4 minutes.
    - Conspicuous answers:
        - Always selecting the top option.
        - Always choosing the obvious answer (No opinion, Prefer not to answer, etc.).
    - Incorrect answers:
        - Indicating the use of shared mopeds and denying it two questions later.
        - Indication place of residence, for example: 'The Big Forest'.
        - Familiarity with the bike-sharing concept Bondi, but not with other concepts.
    - Unusual combination of socio-demographic data:
        - Low age with highest income and no education.

In the end, 489 responses were utilized. Among the 489 respondents, the average time taken to complete the survey was 14,7 minutes and the median 6 minutes. The average is influenced by certain outliers, which arise due to the allowance of resuming the completion at a different time.

6 Survey results

The survey results are divided into four sections. The first section describes the profiles of the respondents using the provided socio-demographic information, section 6.1 "Descriptive Statistics". The general survey questions are covered in second and third sections, namely section 6.2 "Knowledge & Familiarity", and section 6.3 "Attitude". Lastly, in section 6.4 “Behaviour” the choices made in the stated choice experiment are examined. These results are used as input for the discrete choice models in the following chapter. All survey results are also presented in Appendix E.

6.1 Descriptive statistics

Whether the sample is representative for the suburban areas of South Holland is assessed by using the collected sociodemographic data. Table 6.1 provides the data for gender, age, education, and household income. The sample is only filled in by adult inhabitants of suburban municipalities within the province of South Holland, the same municipalities are used as a comparison and the frequencies are added to the table below. The main differences in the sample are the lowest and highest age groups, the group of individuals only possessing a primary education diploma and the differences in household income.

Table 6.1: Descriptive statistics of sample compared to municipalities within South Holland

Characteristic	**Category**	**Sample (#)**	**Sample (%)**	**South Holland 18+ (CBS, 2023)**
Gender	Male	248	50,7%	49,0%
	Female	241	49,3%	51,0%
Age	18-24	35	7.2%	11,4%
	25-34	75	15.3%	17,2%
	35-49	102	20.9%	23,4%
	50-64	135	27.6%	24,8%
	65+	142	29.0%	23,2%
Education	Primary education	7	1.4%	9,8%
	Secondary education	103	21.1%	17,9%
	MBO	174	35.6%	39,6%
	HBO	143	29.2%	18,7%
	WO	61	12.5%	12,2%
	Prefer not to answer	1	0.2%	1,8%
Household income	< €10.000 per year	15	3.1%	14.0%
	€10.000 - €29.999 per year	84	17.2%	37.0%
	€30.000 - €49.999 per year	141	28.8%	23.0%
	€50.000 - €69.999 per year	74	15.1%	15.0%
	> €70.000 per year	73	14.9%	11.0%
	Prefer not to answer	102	20.9%	-

A chi-square test will be conducted to test whether the sample significantly differs from the populations in South-Holland. Because the compared variables are categorical variables, the chi-square test is the most properly to use. As shown in Table 6.2 on the following page, the chi-square tests reveal that, with a 95% confidence interval, the parameters of age, education, and household income are all significantly different. However, gender is the only parameter that does not differ significantly.

Table 6.2: Chi-square tests results on gender, age, education and household income

	Chi-square A	*df*	*Critical point B*	*No significant difference (Accuracy of 95%)*
Gender	0.576	1	3.84	A < B : True
Age	18.792	4	9.49	A < B : False
Education	56.241	4	9.49	A < B : False
Household income	109.280	4	9.49	A < B : False

Apart from the already mentioned socio-demographics, the participants are also asked about their hometown and work location. Moreover, questions were added about the possession of a valid driving license for a car, their main mode of transportation (most often used) and preferred mode of transportation (which they would like to use the most). Table 6.3 includes information about the driving license and work locations, whereas the locations are pictured in Figure 6.1.

Table 6.3: Additional information respondents

Characteristic	**Options**	**Sample (#)**	**Sample (%)**
Possession of valid driving license for car	Yes	428	87.5%
	No, only moped license	12	2.5%
	No, neither	48	9.8%
	Prefer not to say	1	0.2%
Work location	Major city (E.g., Rotterdam)	90	18.4%
	Large-sized town (E.g., Leiden)	110	22.5%
	Village or relatively small town (E.g., Katwijk)	116	23.7%
	Rural area	14	2.9%
	I don't work or study	151	30.9%
	Prefer not to answer	8	1.6%

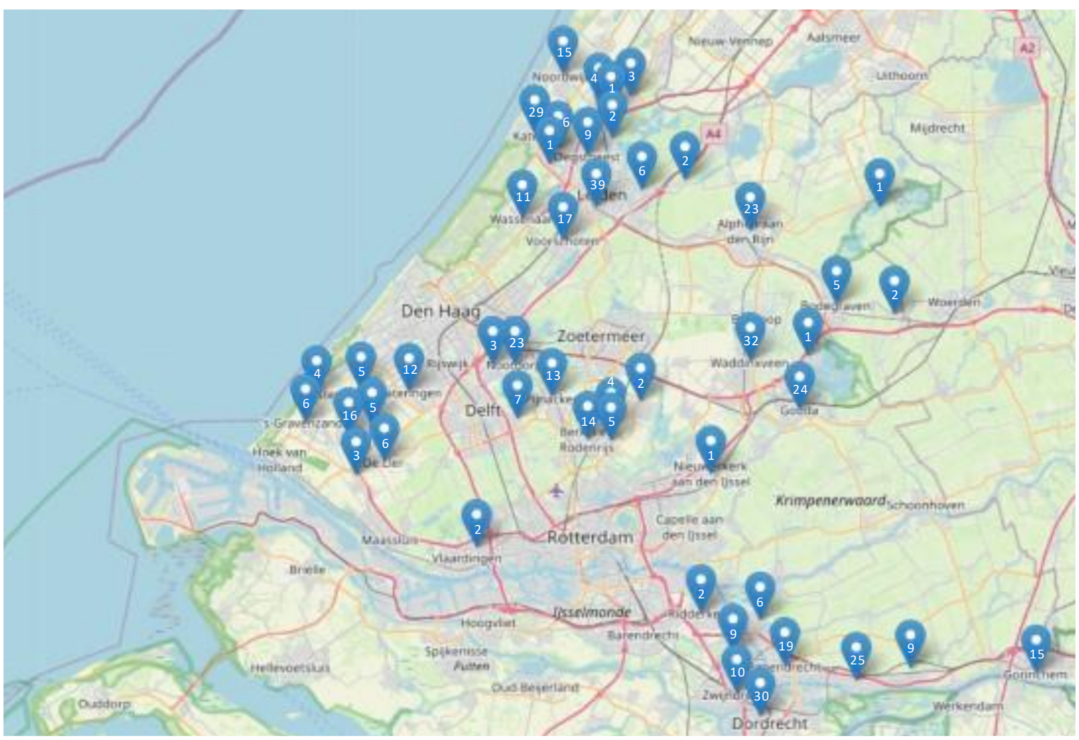


Figure 6.1: Quantities of respondents' locations

The distribution of main and preferred mode of transportation is visualized below in two different treemaps. When asking people's preferred transportation modality, it can be noticed that the modes, walking, (electrical) bicycle and moped increased compared to which modes are used most often – illustrated with a symbol. The main decrease can be observed for car, which reduced to 22.5% from 41.7%. Worth mentioning is the fact that almost 65% of this sample indicates that they prefer to use an active mode option, instead of car, moped or for example public transport. This data could be further analysed by looking into the exact first and second choice of each individual and thereby compare the results with all the related sociodemographic information. However, this is not part of the scope of this specific research and by that reason this is not further looked into.

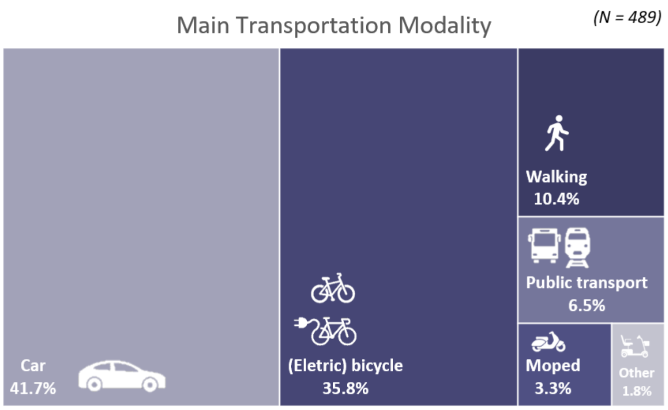


Figure 6.2: How respondents mainly travel

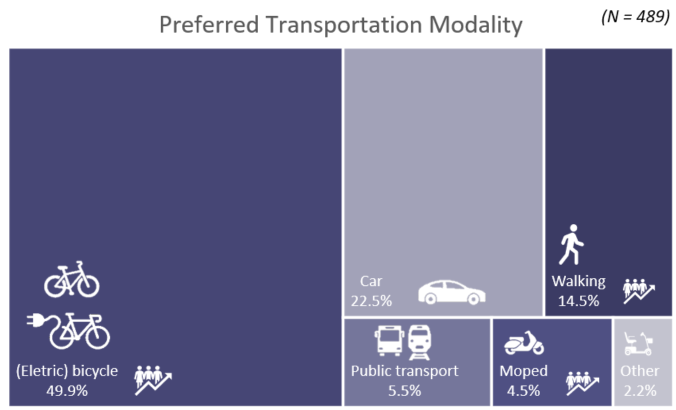


Figure 6.3: How respondents preferably travel

6.2 Knowledge & Familiarity

After the introduction of the survey and the informed consent (IC), the questionnaire starts with two questions without further explanation of the subject. These two unaided questions provide insight into the respondents' knowledge of the topic without their opinions being influenced by information from the questions. The upper question of Figure 6.5 presents the results of the first unaided question, and Figure 6.4 displays the results of the second question. The lower question in Figure 6.5 is shown after the further description of the subject. The further description is provided to ensure that respondents are well-informed about the topic and do not, for instance, associate the questions with car-sharing.

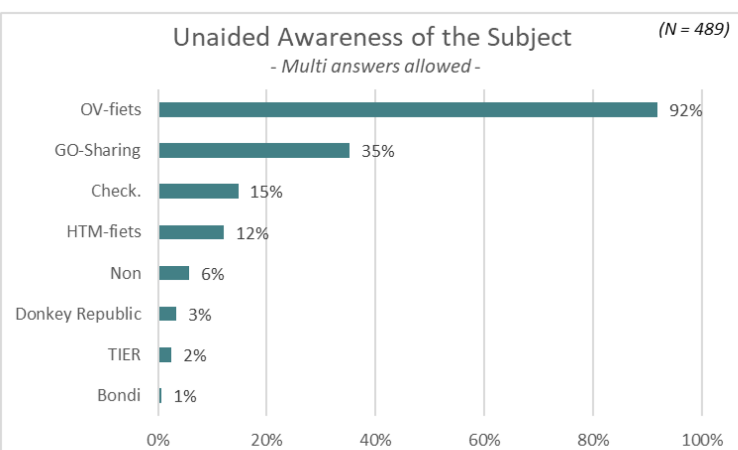


Figure 6.4: Which companies/concepts have you heard of before?

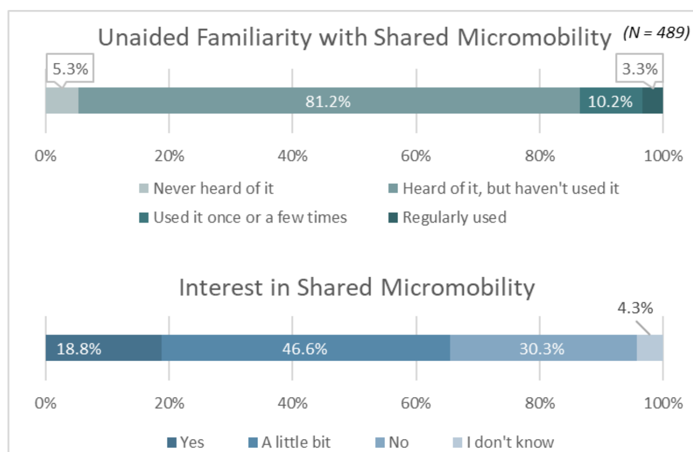


Figure 6.5: Respondents familiarity and interest in the subject

The publicity of the OV-fiets is immediately evident from Figure 6.4, where 92% of the respondents indicate that they are familiar with the concept. While no statements can be made regarding the actual usage of the OV-fiets, it is noticeable that, at least within this sample, the OV-fiets is a known concept. Moreover, GO-Sharing is recognized by more than a quarter of the surveyed individuals, with only 6% being unaware of any of the presented companies or concepts.

Unexpectedly, 75% of the respondents who initially answered 'Never heard of it' in the first question selected at least one company or concept in the second question. Conversely, 90% of the respondents who answered 'No' in the second question opted for 'Heard of it, but haven't used it' in the first question. Ultimately, it can be said that over half of the respondents are at least somewhat interested in the subject, as seen in Figure 6.5. However, 30% of the responders express no interest in the subject.

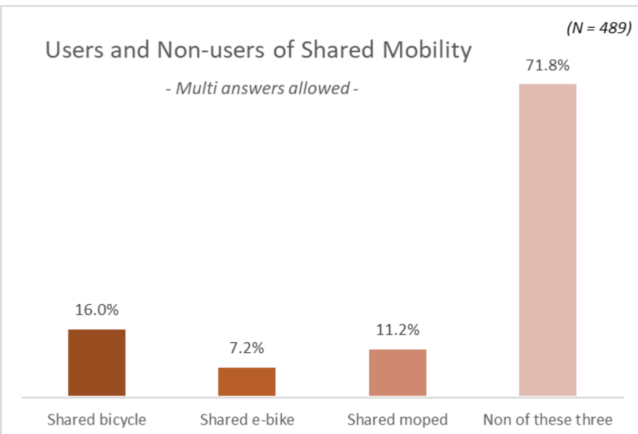


Figure 6.6: Experience of respondents

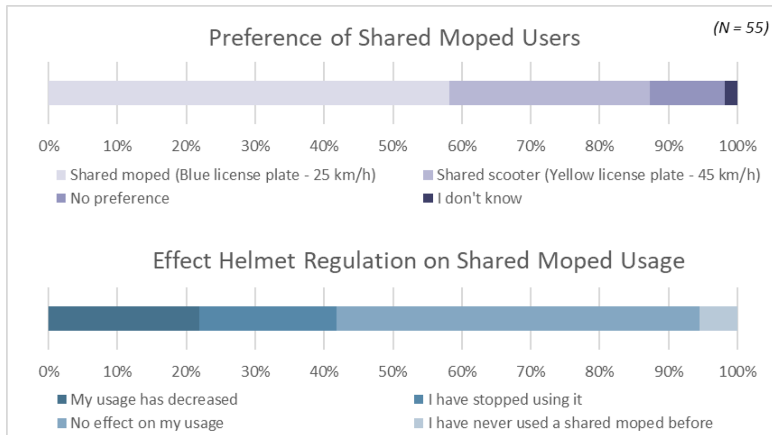


Figure 6.7: Two addition questions for shared moped users

Once again, in Figures 6.6 and 6.7, the results of three questions are presented. Figure 6.6 illustrates the respondents' experiences with shared micromobility and individuals who indicated that they have used shared mopeds are presented with two follow-up questions. Firstly, it stands out that the majority of respondents have no experience with using the three shared modes of transportation themselves. Just 16% have used shared bicycles, 7.2% have utilized shared e-bikes, and 11.2% have personal experiences with shared mopeds. Given that shared mobility services are primarily offered in urban areas, these results are not surprising, as the sample does not include residents of such areas.

From the expert interviews, it was expected that users would prefer shared scooters over shared mopeds, mainly because of their higher maximum speed. However, the data contradicts this expectation, as nearly 60% of the respondents express a preference for shared mopeds (Blue license plate - 25 km/h). It is worth noticing that, as of January 2023, a helmet requirement applies to this type of moped, which also applied to shared mopeds. In the conversation with the shared moped provider, it was mentioned that a decline in the usage of shared mopeds was observed compared to previous years. Whether this decline will continue is impossible to say with certainty. However, this decrease is supported by the data from Figure 6.7, since more than 40% of the users report utilizing this kind of shared moped less frequently. Therefore, on one hand, there is a preference for this type of shared moped, but on the other hand, the introduction of the helmet regulation makes this less decisive.

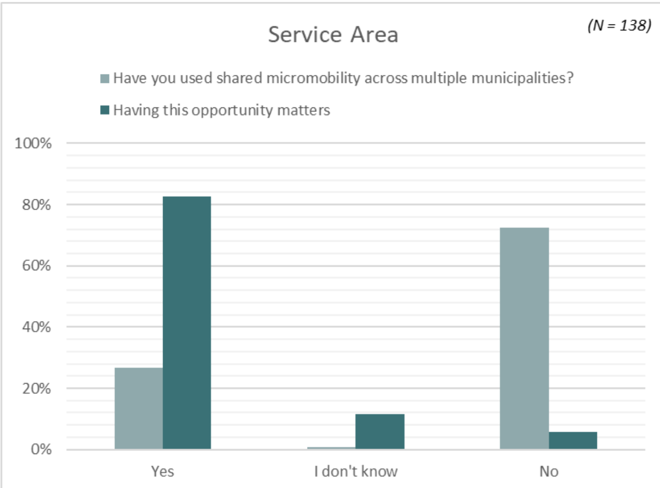


Figure 6.8: Results related to the service area

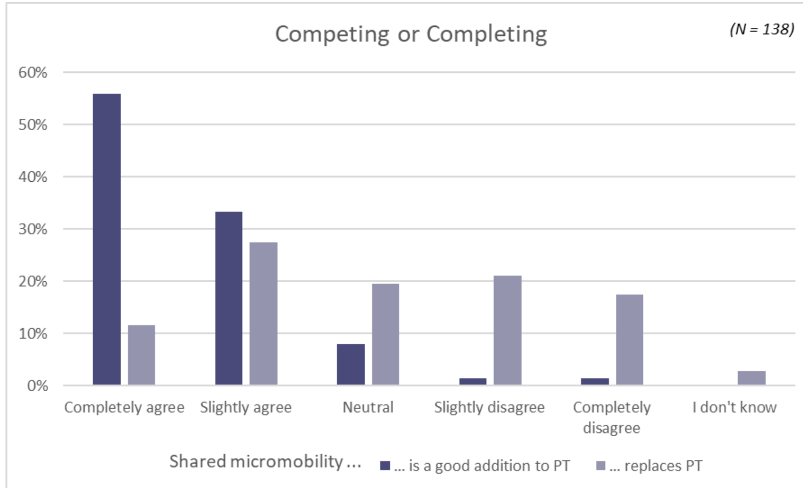


Figure 6.9: Results related to the relation with public transport

Regarding "Knowledge & Familiarity," there are two more questions to analyse, which are the usage across different municipalities and the difference between using the service in combination with public transport or as an alternative to PT. Both questions are only provided to respondents indicating the use of one or more of the shared options (N = 138). As shown in Figure 6.8, there is a clear consensus among users that shared micromobility should be available for travel to and from different municipalities. However, only a quarter of users had tried it at least once. The fact that the majority of respondents had never tried this may be due to the limited availability of such services at the time of the survey.

During the expert interviews, various interviewees discussed whether shared micromobility should be considered a form of public transportation or something entirely different. The results of the survey may not provide a direct answer to this question; however, Figure 6.9 does indicate that the service is more of a valuable addition to PT rather than a replacement for it. When asked whether shared micromobility is a good addition to public transportation, only a small group, combined less than 3% of the respondents, disagreed with this statement. In contrast, this group becomes significantly larger (38.4%) when the suggestion is made that it replaces public transport.

6.3 Attitude

This section analyses the questions from the survey that relate to respondents' opinions about the sharing service. Furthermore, it answers the question of whether they perceive benefits of it or only experience it as a nuisance. To start with, Figure 6.10 on the following page primarily highlights the lack of awareness regarding pricing and the fact that 40.7% of the respondents do not see any advantages in the sharing service. A smaller proportion of respondents indicates that there are too few hubs, the costs of the services are too high and signing up is too much hassle, respectively 21.5%, 18% and 14.7%. Even a smaller group of respondents agrees with having not enough vehicles available at the hubs, 8.2%.

Following up on this, in Figure 6.11 the answers are distributed about potential benefits of shared micromobility. Respondents were not obliged to provide an answer. This question is only presented to individuals who had used shared micromobility one or more times, considering that this group of respondents may have a better feeling of the actual benefits. They were asked to indicate their agreement with statements that began with "The use of shared micromobility is (Or results in)..." and then followed by the various topics presented in Figure 6.11. More than half of the respondents indicated that using shared micromobility saves them time, and 37% agreed that it decreases the need to think about maintenance or theft of a personal vehicle. Additionally, approximately 27% acknowledged the following three benefits: not needing to purchase an additional bicycle, reducing car trips, and increasing physical activity. Lastly, 21% mentioned savings cost as a result of using shared micromobility.

The statement about reducing car trips was presented as follows: "Using shared micromobility makes me drive my car less often". Therefore, 27.5% of the users reported a reduction in car trips as a consequence of their shared micromobility usage. It is important to note that this specific group provided varying responses to the question about which mode of transportation they have already used in the past, so not all of these answers were necessarily from, for example, shared bicycle or shared moped users.

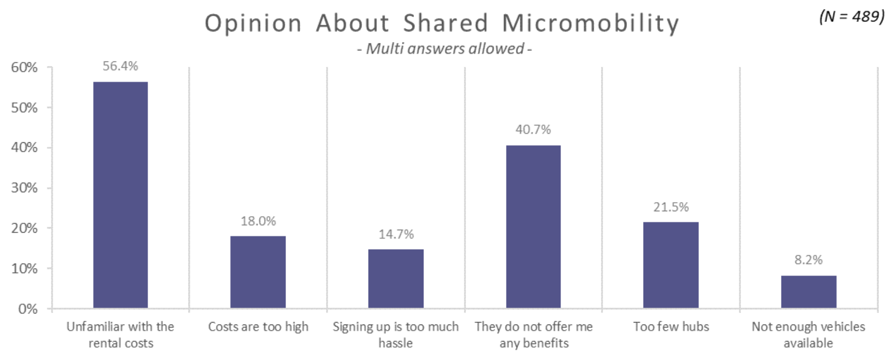


Figure 6.10: Question to all respondents "Which statements do you agree with?"

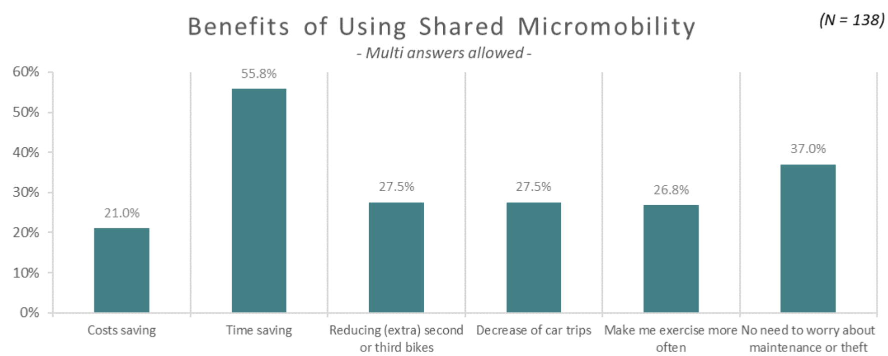


Figure 6.11: Question to users of shared micromobility about their perceived benefits

In addition to the potential benefits that shared micromobility offers, in some cases it can also lead to inconveniences. This problem has been widely addressed in the various expert interviews, both in terms of the source and how it can be avoided or reduced. Out of the 489 respondents, 42.1% indicated that they sometimes or frequently experience nuisance or irritation caused by shared modes, corresponding to 206 respondents. Overall, 4.3% of the respondents chose "Frequently," 12.5% chose "Regularly," and 25.4% chose "Sometimes". Additionally, 30.5% reported never being bothered or inconvenienced by shared micromobility, and 21.9% experienced nuisance only occasionally. All these results are visualized in a pie chart in Figure 6.12 on the next page.

Figure 6.12 also contains information about the before mentioned group of 42.1%, which experiences the most nuisance. They were asked which mode of transportation causes this problem the most, and nearly 80% of them indicated that shared mopeds are the primary source of irritation. Shared bicycles were selected the least in this question (i.e., 8.3%), and shared e-bikes were chosen by 12.1% of the respondents. This difference can be explained by the size of the vehicles or the type of the sharing system. Shared mopeds are often operated using a free-floating system, which may lead to a higher likelihood of causing problems.

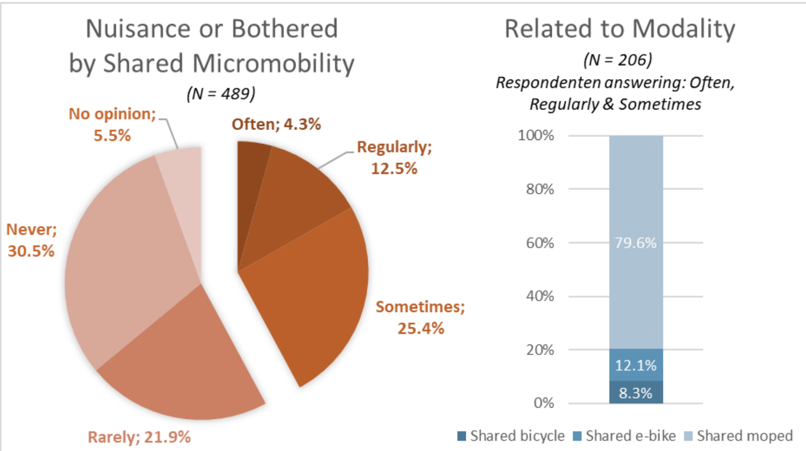
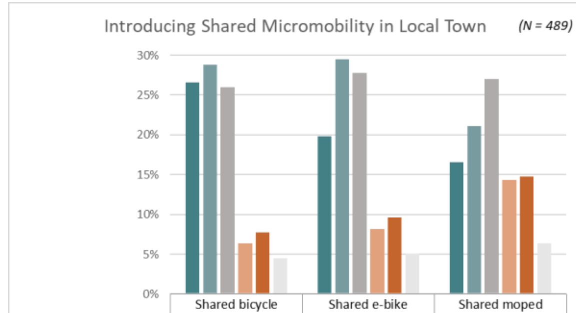


Figure 6.12: Two questions about inconveniences due to shared modes



	Shared bicycle	Shared e-bike	Shared moped
Completely agree	26.6%	19.8%	16.6%
Slightly agree	28.8%	29.4%	21.1%
Neutral	26.0%	27.8%	27.0%
Slightly disagree	6.3%	8.2%	14.3%
Completely disagree	7.8%	9.6%	14.7%
No opinion	4.5%	5.1%	6.3%

Figure 6.13: Introducing shared modes in local towns

The last two questions addressed in this section concern the introduction of shared micromobility in the municipality where the respondents live and its addition to their daily commuting routine. Whether residents of various municipalities in South Holland embrace the introduction of the three types of shared micromobility or would rather not see it appear has been expressed in Figure 6.13 using a bar chart. The green bars correspond to agreement, and the red bars represent disagreement. The chart also includes a table with the exact percentages, which precisely illustrates the differences.

In general, two main conclusions can be drawn from this figure. First, the agreement decreases from left to right, showing that most citizens are more in favour of an introduction of shared bicycle, instead of shared mopeds. A relatively small group, less than 15%, disagreed with the start of shared bicycles. Second, there is generally a large group with no decisive opinion, as "neutral" or "no opinion" is a commonly chosen response. Interestingly, among the respondents who are most bothered by shared mopeds (N=164), 32.9% still agree with the start of shared mopeds in their own municipality. Within this group, only 38.4% disagrees, and 28.7% are neutral or have no opinion on the subject.

Subsequently, looking at Figure 6.14, the answers to the following question are displayed: "To what extent will the addition of shared micromobility near your study- or work-location improve your commute to work or study (e.g., accessibility)?", only answered by people actually going to work or study (N=338). The proportion of people answering “No effect” stands out in the chart, but apart from that, still 32% of all people working or studying in the sample still consider this a valuable addition.

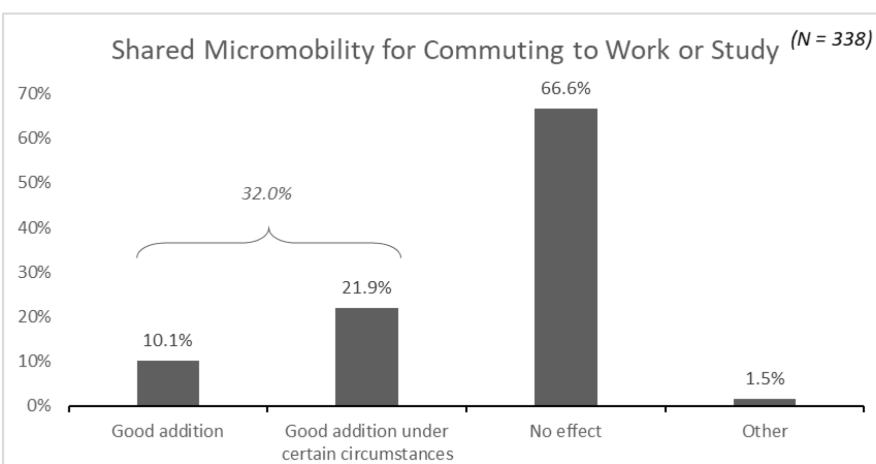


Figure 6.14: Answers whether shared micromobility is of added value to daily commuting

6.4 Behaviour

This section objectively describes the results of the stated choice experiment (choice statistics) before they are analysed using a discrete choice model. These choice statistics provide first impressions of the choices and can also be used as input for the utility functions. After completing all the questions of the experiment respondents were asked to provide reasoning and factors affecting their decisions. The answers to this question are visualized below in Figure 6.15.

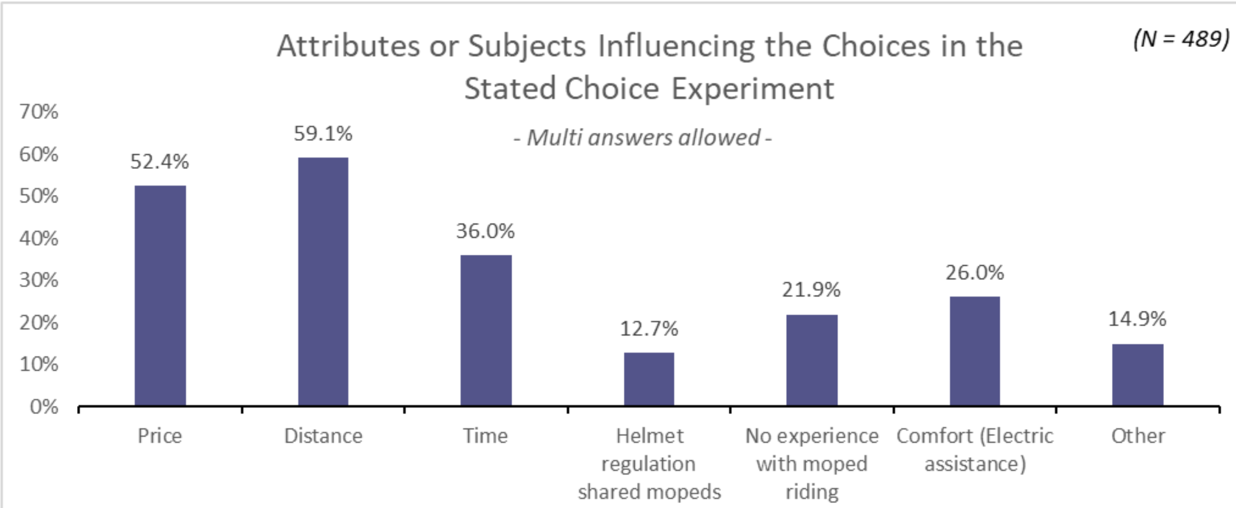


Figure 6.15: Considerations while making the stated choice experiment

Price, distance, and time are the most chosen factors, with comfort – vehicle including or not including electric assistance – and the lack of moped riding experience being frequently mentioned as well. Individuals who responded with 'Other' were allowed to provide their own input. These responses are depicted in Figure 6.16, with the size of the words increasing as they were mentioned more frequently.

Figure 6.16: Input of people answering 'Other' (N=73)

According to Figure 6.15, the general survey results, the findings from the literature review, and the input of the experts, different hypotheses can be formulated. These hypotheses can be examined using the choice statistics and are outlined below:

- First, due to the good diversity of the sample, it is expected that choices will be evenly distributed among the four alternatives. There might be a potential preference for the opt-out option or shared e-bike modality due to the slight overrepresentation of older respondents. This potential preference is likely to come at the expense of choices for a shared moped, which is influenced by helmet regulations and the level of experience.

- Second, increasing distance is expected to have a negative impact on the choice for shared bicycle, while conversely, it is expected to positively influence the choice for a shared moped. As distance increases, so do the prices, which could result in an increased likelihood of opting out in the situations with higher distances.
- Third, based on previous research, it is expected that socio-demographic factors such as age, gender, level of education, and income will also influence the choices. Older individuals are more inclined to choose shared modalities (Fishman et al.; 2015), particularly applying shared mopeds. Furthermore, research findings vary regarding the exact effects of gender, educational level, and income. Furthermore, research findings vary regarding the precise effects of gender, educational level, and income. Additionally, these studies primarily focus on a single modality, unlike this research which examines differences between shared modes.
- Furthermore, it is anticipated that individuals who drive cars daily may respond differently from those who cycle or walk frequently. Differences may exist between what individuals use frequently and what they actually prefer to use.
- Moreover, the expectation is that interest in the topic, having experience with the usage, and the place of residence will affect the decision-making process. If there is no interest, a higher percentage for opting out is expected. On the other hand, having experience with a particular shared modality is expected to have a positive effect on choosing that specific modality in the choice experiment.
- Lastly, it is expected that the level of inconvenience will also influence choices. Someone who is highly annoyed by shared mopeds, for instance, may be less inclined to use them.

6.4.1 Choice statistics

All choices are distributed over the alternatives in Figure 6.17. Showing a general and first preference for shared e-bikes, followed by the shared bicycle. The shared moped is the least chosen option, and just over 1 in 5 choices are in favour of the opt-out. The first hypothesis can be confirmed by this image, a slightly lower preference for shared mopeds and a higher preference for shared e-bikes. All the choices can also be divided over the distances included in the choice experiment, illustrated in Figure 6.18. The choices for the shared moped increases with the distance, while the choices for the shared bicycle decrease. The opt-out option is highly favoured for the 2-kilometer scenario, and the shared e-bike peaks at 6 kilometres. There is an increase from 24.9% for the 2-kilometer scenario to over 40% for the 6-kilometer scenario. Again, this confirms the earlier mentioned hypothesis, although there is no strong evidence that individuals are more inclined to opt-out with higher pricing.

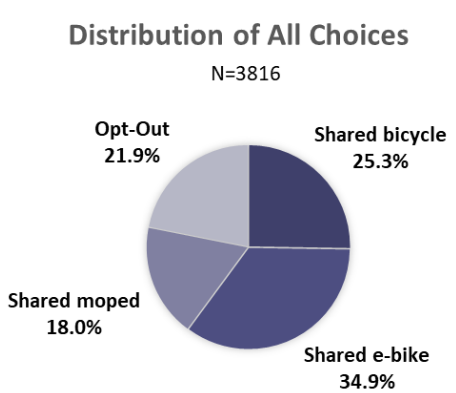


Figure 6.17: Overview of complete choice set

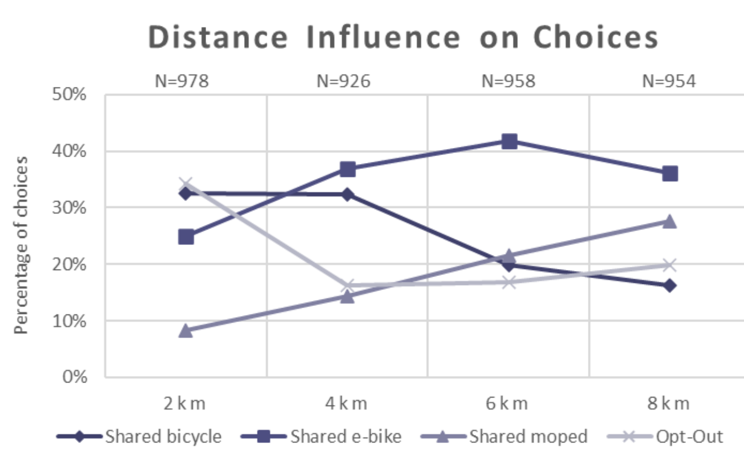


Figure 6.18: Total choices plotted against distance

Regarding the price changes, no visualizations have been created as highlighting the conclusions textually provides better comprehension than presenting them in a graph. Firstly, it can be observed that there is indeed a higher preference for the shared bicycle when the price of this alternative is reduced in price compared to the other two, regardless of the change in distance. On the other hand, the shared bicycle is chosen less frequently when the prices of the other two alternatives are lowered. This effect becomes more pronounced as the distance increases. The preference for the other two alternatives with electric assistance is thus enhanced by price changes.

Secondly, it is noteworthy that the number of choices for the shared e-bike is relatively low when only the shared moped is discounted and, conversely, is high when the shared bicycle is more expensive.

Lastly, a clear increase in the choice for the shared moped is evident in situations where this alternative is offered at half price and notably also when only the e-bike is not discounted. So, by these findings, respondents can indeed be influenced based on price changes.

The whole section about choice statistics is based on the complete dataset. This also applies to the analysis of factors that do not correlate with differences in costs. Using a chi-square test and data visualization, it is examined whether differences are visible between the complete dataset or a subset of the dataset without price changes between the alternatives. The test resulted in a value of $\chi^2 = 4.703$, with 3 degrees of freedom, the critical value is 7.815. Therefore, it can be concluded that subset and the complete dataset do not significantly differ based on a 95% confidence interval. For the subsequent sections of this section, the entire dataset will be used. Moreover, it is beneficial that this set of data is considerably larger than the filtered dataset. All choice statistics can also be found in Appendix F.

6.4.2 Socio-demographics influencing the choices

In the following figures, the relationship between choices and socio-demographic data is presented. Various types of graphs have been used based on the type of information. All significant points are textually mentioned. Starting with age (Figure 6.19), two trends stand out: the rising trend of opting out and the declining trend for choosing the shared moped. This means that as respondents' age increases, they are more inclined to opt out of choosing one of the shared transportation options. And this especially applies to the choice of a shared moped. On the other hand, shared moped is the second most chosen option in both the age groups of 18-24 years and 25-34 years, after which it decreases to the least chosen option for the other age groups.

Subsequently, when looking at gender (Figure 6.20), fewer significant differences can be observed. Male respondents tend to choose the shared bicycle and the opt-out option slightly more compared to females, while females are more inclined to choose the shared e-bike.

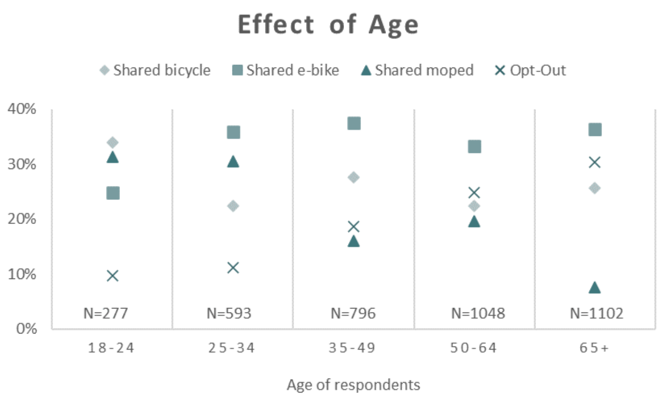


Figure 6.19: Total choices plotted against age

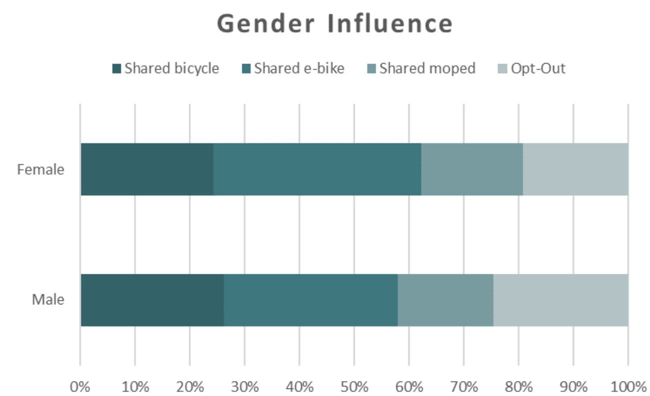
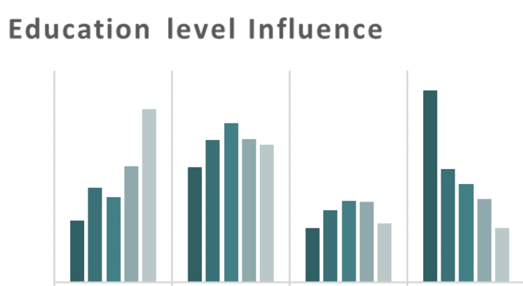


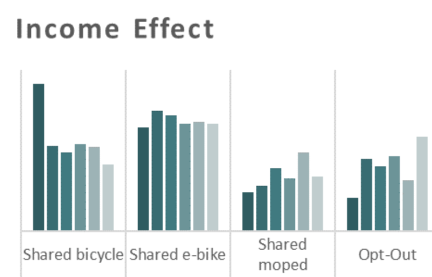
Figure 6.20: Total choices plotted against gender

Next, in Figure 6.21 and 6.22 the effect of level of education and income is visualized. Showing an increase in the choices for the shared bicycle as the level of education rises, but on the other hand a decrease as the annual income grows, which can be seen as contradictory. Furthermore, the bar charts show that the choices for the shared e-bike remain relatively consistent. However, shared mopeds are chosen more often with a higher annual income, and there is a clear decrease in the opt-out option as the level of education increases.



	Shared bicycle	Shared e-bike	Shared moped	Opt-Out
Primary education	14,5%	27,3%	12,7%	45,5%
Secondary education	22,4%	33,7%	17,1%	26,8%
MBO	20,1%	37,5%	19,2%	23,2%
HBO	27,5%	33,9%	19,0%	19,6%
WO	40,9%	32,4%	13,8%	12,8%

Figure 6.21: Total choices plotted against education



	Shared bicycle	Shared e-bike	Shared moped	Opt-Out
< €10.000 per year	45,8%	32,2%	11,9%	10,2%
€10.000 – €29.999 per year	26,4%	37,4%	13,9%	22,3%
€30.000 – €49.999 per year	24,3%	36,0%	19,5%	20,2%
€50.000 – €69.999 per year	27,0%	33,5%	16,3%	23,3%
> €70.000 per year	26,0%	33,9%	24,3%	15,9%
Prefer not to say	20,8%	33,2%	16,8%	29,2%

Figure 6.22: Total choices plotted against income

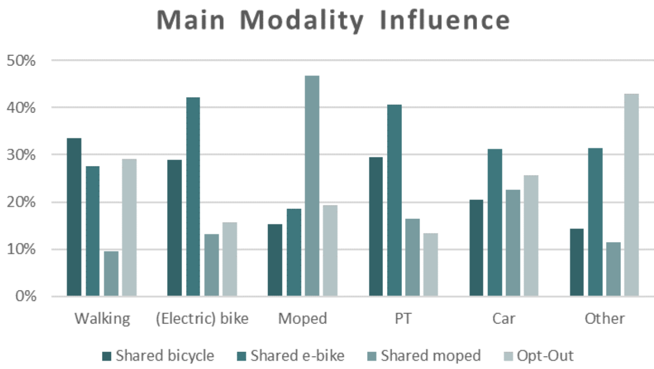


Figure 6.23: Total choices plotted against main modality

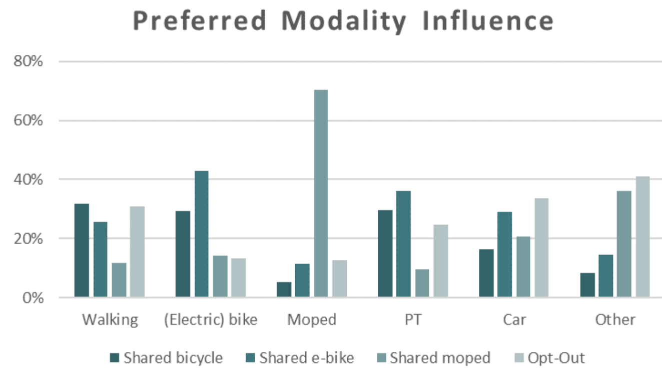


Figure 6.24: Total choices plotted against preferred modality

The above figures also include several interesting observations. For example, Figure 6.23 shows that people who frequently use the car for transportation are the least likely to opt for the shared bicycle but are not significantly inclined to choose the shared moped. Both car users and car enthusiasts opt for the opt-out option relatively frequently. In both figures, the group that selected 'Other' often opts out, instead of making a choice. A big proportion of this group indicates using the mobility scooters and, therefore, cannot use or limited use the shared transportation options. Public transport users (Figure 6.23) tend to choose the shared bicycle or shared e-bike more often.

More straightforward findings include a low number of shared moped choices among those who mainly walk or prefer to walk and, additionally, a significant preference for shared bicycle and shared e-bike among those who mention mainly cycle or prefer to cycle. Another clear finding is the substantial peak in shared moped choices among moped users.

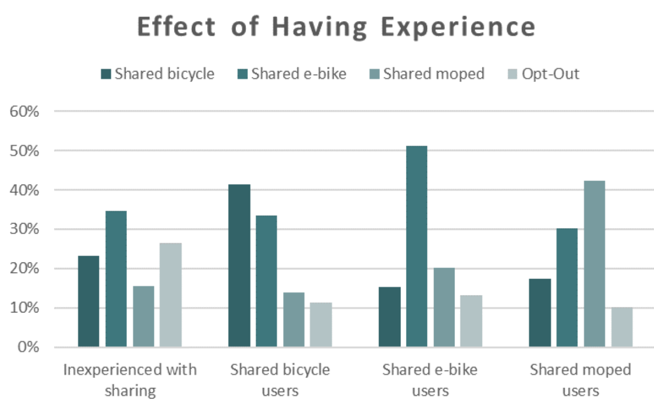


Figure 6.25: Total choices plotted against experience

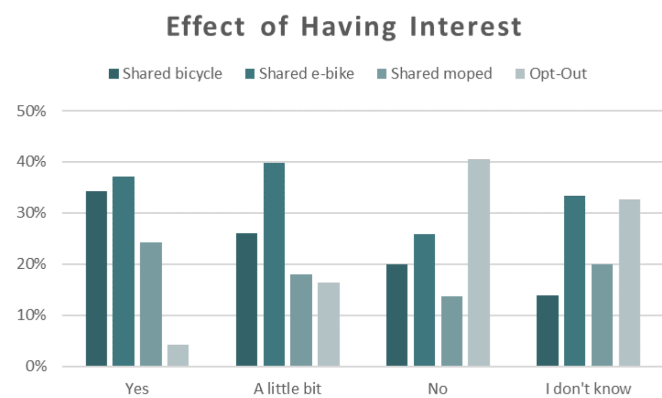


Figure 6.26: Total choices plotted against interest

In addition to the impact of socio-demographic information on the choices, Figures 6.25 and 6.26 show the influence of experience with shared modes and interest in the topic. Notably, most opt-out choices were made by the group of respondents with no prior experience, and each user-group tends to choice for the type of vehicle they have experience with. Furthermore, Figure 6.26 illustrates that disinterested individuals often choose the opt-out option, while those who are interested in the subject tend to avoid this option.

Similar results can be obtained when choices are expressed in terms of the extent to which respondents are experiencing nuisance by shared micromobility. Respondents who are significantly bothered are more likely to opt-out, mostly impacting the choices for shared moped and shared e-bike.

All the before-mentioned data were statistically tested for independence. Since it involves two groups of categorical measuring scales, the chi-square test was used. For all the above-mentioned data, including distance from Figure 6.17, the null hypothesis should be rejected based on the calculated chi-square values. The lowest chi-square value is calculated for the relation between the choices and gender, resulting in a value of $\chi^2 = 25.128$. With 3 degrees of freedom the critical value is 7.815 and lower than the calculated chi-square. All the other chi-square values are relatively high (Above 100), indicating large differences between the observed and expected values. Therefore, with a 95% confidence interval, it can be concluded that there is a relationship between the different subjects and the choices for the shared bicycle, e-bike, moped, or opt-out.

Based on the chi-square results, one might expect significant differences in the discrete choice models; however, this is not necessarily the case. The above-mentioned graph types have been used to effectively illustrate the main differences in the data. Level of education and income show comparable trends across the different alternatives when the axes in Figures 6.23 and 6.24 are reversed. This is, for example, illustrated in the following graph as well, showing the relationship between choices and place of residence. The three variables will be included as parameters in a model, but it is possible that a Multinomial Logit (MNL) model may not detect significant differences.

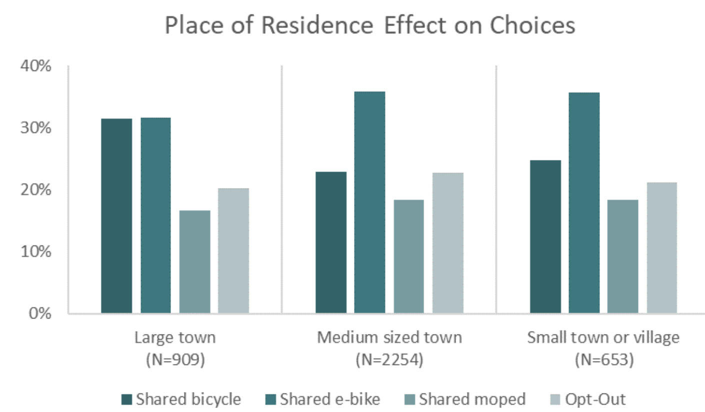


Figure 6.27: Total choices plotted against place of residence

6.5 Scenarios daily-work and non-daily non-work

As described is the stated preference experiment divided into two different scenarios, named daily-work and non-daily non-work. These two different scenarios were introduced to investigate whether respondents would provide different answers to the choice questions based on the context in which they were placed. The daily-work scenario is related to commuting travel, while the non-daily non-work scenario is associated with other travel movements, such as a day trip. The hypothesis was that these two scenarios or mindsets would lead to different choices. With the thought of making the same journey every day is different from traveling to a place occasionally.

Figure 6.28, on the following page, presents the results of the choices divided into the two different scenarios, with the outer ring of the pie chart representing the non-daily non-work scenario choices and the inner ring representing the daily-work scenario choices. The differences are not significant, with the most notable variation observed in the choices for shared moped and the opt-out options. Respondents associated with the Daily-Work scenario tend to choose for shared mopeds more frequently and opt-out less often. They also choose the e-bike slightly more compared to the other scenario, although this difference is less than 2%.

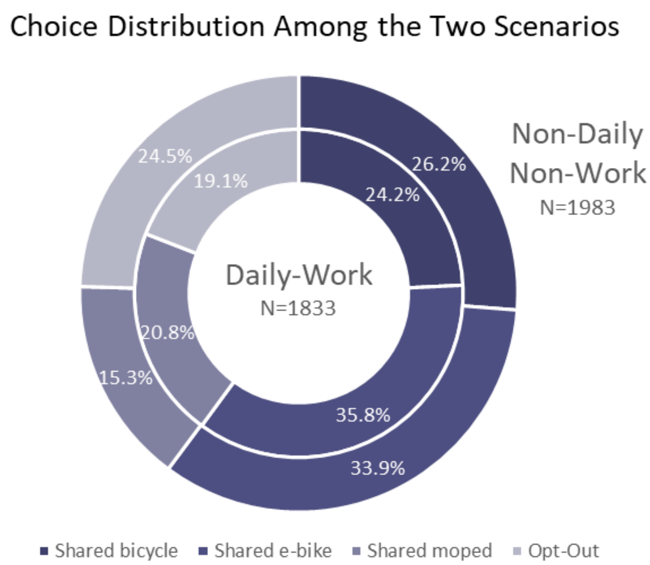
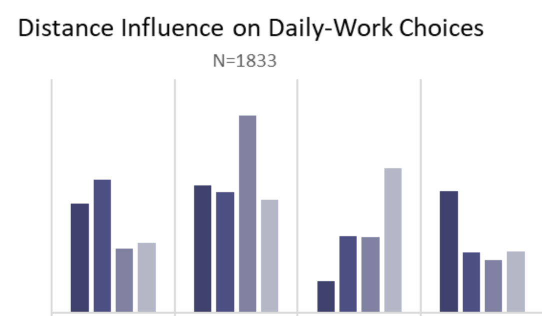


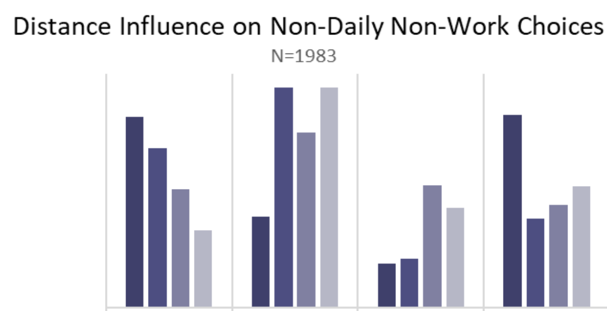
Figure 6.28: Choices distributed over the scenarios

More significant differences can be observed in the next two figures. Again, the choices are expressed in relation to distance. Figure 6.29 only includes options for the daily commute scenario, while Figure 6.30 contains options for the non-daily non-work scenario. In Figure 6.30, the number of shared bicycle choices clearly decreases as distance increases. This trend is not visible in the figure on the left. Both figures show that shared mopeds options increase with distance. Additionally, in the 2 km scenarios, there is a large group opting out instead of choosing one of the three transportation modes.



	Shared bicycle	Shared e-bike	Shared moped	Opt-Out
2km (N=474)	28.1%	32.7%	8.0%	31.2%
4km (N=455)	34.1%	31.0%	19.6%	15.4%
6km (N=454)	16.5%	50.7%	19.4%	13.4%
8km (N=450)	18.0%	29.1%	37.1%	15.8%

Figure 6.29: Daily-work choices plotted against distance; percentages in table sum horizontal to 100%



	Shared bicycle	Shared e-bike	Shared moped	Opt-Out
2km (N=504)	36.7%	17.7%	8.5%	37.1%
4km (N=471)	30.8%	42.5%	9.6%	17.2%
6km (N=504)	22.8%	33.7%	23.6%	19.8%
8km (N=504)	14.9%	42.5%	19.2%	23.4%

Figure 6.30: Non-daily non-work choices plotted against distance; percentages in table sum horizontal to 100%

When observing the tables beneath the bar charts, the option that is most frequently chosen for each distance is highlighted. In Figure 6.30, this provides a clear outcome. For the non-daily non-work-related trip, the shared e-bike is the most popular choice, except for the shortest distance of 2 kilometres. For the other scenario, the most chosen alternative varies by distance and all percentages are really close to each other. However, a clear majority (50.7%) picked the shared e-bike in the 6-kilometer context.

6.6 Conclusion

The results presented in this chapter, without the analysis of the discrete choice models, already give several interesting conclusions. To begin with, the data shows that many respondents are familiar with the shared micromobility (over 90%). On the other hand, 56.4% of the sample does not have any knowledge about the pricing, and 71.8% have never used shared micromobility options. Despite the fact that a substantial majority has not used it, 65.4% express an interest in the subject. Moreover, 32% state that, under certain conditions, shared micromobility could provide additional value for their work or study-related trips. Additionally, a significant majority agrees with the introduction of shared micromobility in the municipality where they currently live. This is most evident for shared bicycles and shared e-bikes and less so for shared mopeds. This can be explained by a group of individuals experiencing nuisance. 42.2% of respondents indicate experiencing occasional or frequent nuisance or problems due to shared micromobility, with 79.6% of those cases mainly being caused by shared mopeds.

Continuing with the subject, whether shared micromobility is a good addition to public transportation or compete with it, this survey provides a clear answer. Over 80% of users express the opinion that it is a valuable addition to public transportation, while a much lower percentage, under 40%, indicates using shared micromobility instead of public transportation. However, it is important to facilitate the possibility to use shared micromobility between different municipalities, agreed by 82.6% of the total sample.

To end with, a general analysis of the choices made in the stated preference experiment provides several insights. For example, the preference for using the shared e-bike over the shared bicycle and shared moped. Only for the 2 km scenario is the shared bicycle more frequently chosen. It is noteworthy that for the 2 km distance, a large group of participants chose not to make a choice (Opt-out). When making the choices, it is indicated that costs and distance are mainly considered decisive factors. However, participant characteristics also significantly influence the choices, such as age, gender, education level, income, current mobility usage, interest, and experience. Additionally, the purpose of the trips leads to different choices as well (Occasional trips compared to commuting).

7 Results discrete choice model (DCM)

This chapter presents the discrete choice model, which analysis the results of the stated preference experiment, the second component of the survey. Its primary aim is to gain insight into the decision-making processes of individual's preferences between three different shared modes of transport. It is explored how various factors impact the choices documented in the experiment. Different Multinomial logit (MNL) models are created. The models are estimated using PandasBiogeme, a Python package specialised in calculating DCM.

7.1 MNL base model

The initial MNL (Multinomial Logit) model serves as the baseline, and consequently, all subsequent models are constructed as modifications of this model, incorporating variations in one or more aspects. The utility functions of the base model are presented below, illustrating the parameters.

$$U(i) = ASC_i + \beta_{COST} * C_i + ASC_{DISTANCE_i} * DISTANCE + \beta_{SCENARIO} * SCENARIO$$

$$U_{Opt-out} = 0$$

Table 7.1: Description of symbols used in utility functions

Symbol	**Description**
i	Shared bicycle, shared e-bike or shared moped
$U(i)$	Utility of alternative i
$U_{Opt-out}$	Utility of shared opt-out (Base)
ASC_i	Alternative specific constant for alternative i
β_{COST}	Parameter for travel costs
$\beta_{SCENARIO}$	Parameter for the scenario
$ASC_{DISTANCE_i}$	Alternative specific parameter related to distance for shared bicycle
C_i	Costs of shared modality i
$DISTANCE$	Distance scenario (2, 4, 6 or 8 km)
$SCENARIO$	Daily-Work (Commuting trip) or Non-Daily Non-Work (Daytrip)

In this model cost and the scenario are both generic parameters, while distance is alternative specific. Furthermore, the ASC of opt-out is set to zero, as this is reference alternative. Costs and distances are most frequently mentioned in the choice model and therefore included in the base model as well. Supplemented with the context scenario, as other important parameter. Table 7.2 shows the results of the model.

Table 7.2: Results of the base model

Name	Value
Number of estimated parameters:	8
Sample size:	3816
Init log likelihood:	-5181.931
Final log likelihood:	-4854.731
Likelihood ratio test for the init. model:	654.4006
Rho-square for the init. model:	0.0631
Rho-square-bar for the init. model:	0.0616
Akaike Information Criterion:	9725.461
Bayesian Information Criterion:	9775.437

Name	Unit	Value	Rob. p-value
Alternative specific constants			
ASC_SHARED_BICYCLE	utils	0.403	0.000826
ASC_SHARED_E_BIKE	utils	-0.0876	0.461
ASC_SHARED_MOPED	utils	-1.36	0
Alternative specific parameters			
ASC_DISTANCE_B	Utils/km	0.0581	0.0127
ASC_DISTANCE_E_B	Utils/km	0.264	0
ASC_DISTANCE_M	Utils/km	0.429	0
Parameters			
β_SCENARIO	utils	0.35	1.22e-05
β_COST	utils/€	-0.548	0

It is important to note that apart from one all the other parameters are statistically significant at a 99% confidence interval. The only parameter that is not significant is the Alternative Specific Constant for the shared e-bike. Additionally, considering the very low value (and the corresponding t-value) for ASC Shared e-bike, there is no strong evidence suggesting that this parameter differs from zero. In other words, the results indicate that this parameter do not play a significant role in mode choice in the context of this study. In combination with the very low rho-square of the model, this suggests that the model perceives the choices for the shared e-bike as too arbitrary. Moreover, the data indicates that this mode is the most chosen under various circumstances (Distance, age groups, education level, etc.). The rho-square is formulated as follows:

$$\rho^2 = 1 - \frac{LL_{final}}{LL_{initial}}$$

In this formula the final log-likelihood (of the estimated model) is divided by the initial log-likelihood (if all the betas were zero), resulting in a value between 0 and 1, presenting the percentage of initial uncertainty explained by the model (Van Oort, 2019).

The relatively low Rho-square of below 10% may be caused by the simplicity of this model. A more complex model, such as mixed logit (ML) instead of multinomial logit (MNL), could address this issue, as observed in various studies (Montes et al., 2023; Limburg, 2021; Geržinič, 2018). Furthermore, improving the Rho-square may involve adding missing relevant variables, which will be done in the next section. Other possible causes could be respondents making random choices or insufficient differentiation between the various alternatives.

To end with, the values of the beta costs suggest that as the costs increase, the respective alternative is less likely to be chosen. Conversely, for the e-bike and moped, as the distance increases, these alternatives become more appealing.

7.2 MNL final model

The choice statistics from Chapter 6 are used as guidance for improving the base model. In order to improve the model various parameters are added, programmed as generic parameter first and changed to alternative specific parameters as well. Another, techniques that is used to improve the base model is including interaction variables in the model. However, the first most logical interaction variables did not result in better goodness of fit and not created new insights, because of this the interaction effects are not further explained in the results. Appendix G.2 includes results of one of the interaction variables, costs with income.

The goodness of fit is used to compare the models, existing of the (McFadden's) rho-square, the Akaike Information Criterion – AIC, and Bayesian Information Criterion – BIC (Train, 2002). When comparing the models, the higher the rho-square and the lower the values of the AIC and BIC the better the model is estimated.

Literature suggested that socio-demographic data also influencing the choices. In combination with the analyses of the choice statistic, all the socio-demographic data is tested for an effect. Dummy coding is used to implement the different categories of the variables. Given the high number of variables and categories some of the categories are bundled to reduce to total number of dummies. Table 7.3 presents a summary of the dummy coding of the categories of the different variables; the full table can be found in Appendix G.1.

Table 7.3: Summary of dummy coding

Variable	**Categories**	**Base**	**1**	**2**	**3**	**4**	**5**
Gender	2	Male	Female	-	-	-	-
Age	5	65+	18-24	25-34	35-49	50-64	-
Income	4	Low	Middle	High	No opinion	-	-
Education	3	Low	Middle	High			
Main modality	6	Walk	Bike	Moped	PT	Car	Other
Preferred modality	6	Walk	Bike	Moped	PT	Car	Other
Usage	2	Non-user	User	-	-	-	-
Interest	2	No	Yes	-	-	-	-
Scenario	2	Non-Daily Non-Work	Daily-work	-	-	-	-
Town	3	City	Town	Village	-	-	-

The above-mentioned variables were added to the model in groups or individually, and through trial and error, the final model was developed. The final utility function applied for the three shared modalities can be found below.

$$U_i = ASC_i + \beta_{COST} * C_i + \beta_{TIME} * TIME + ASC_{SCENARIO_i} * \text{SCENARIO}$$
$$+ ASC_{GENDER_i} * \text{GENDER} + ASC_{AGE(j)_i} * \text{AGE(j)} + \text{ASC}_{\text{DISTANCE}_i} * \text{DISTANCE} + ASC_{INTEREST_i} * \text{INTEREST} + ASC_{USAGE_i}$$

$$U_{opt-out} = 0$$

Table 7.4: Description of symbols used in utility functions

Symbol	Description
i	Shared bicycle, shared e-bike or shared moped
U_i	Utility of alternative i
$U_{Opt-out}$	Utility of shared opt-out (Base)
ASC_i	Alternative specific constant for alternative i
β_{COST}	Parameter for travel costs
β_{TIME}	Parameter for completion time
$ASC_{SCENARIO\,i}$	Alternative specific parameter related to scenario for alternative i
$ASC_{GENDER\,i}$	Alternative specific parameter related to gender for alternative i
j	Age groups: 18-24 year, 25-34 year, 35-49 year, 50-64 year and 65+
$ASC_{AGE(j)\,i}$	Alternative specific parameter related to age group j for alternative i
$ASC_{DISTANCE\,i}$	Alternative specific parameter related to distance for shared bicycle
$ASC_{INTEREST\,i}$	Alternative specific parameter related to interest in topic for alternative i
$ASC_{USAGE\,i}$	Alternative specific parameter related to experience for alternative i
C_i	Costs of shared modality i
$DISTANCE$	Distance scenario (2 to 8 km)
$SCENARIO$	Daily-Work (Commuting trip) or Non-Daily Non-Work (Daytrip)

Compared to the base model, the parameter for scenario is changed to an alternative specific parameter. This creates the possibility of comparing the two scenarios over the three alternatives. Furthermore, age, gender, interest and usage are added to the utility functions as dummy coded parameters. Table 7.3 contains more dummy variables than are ultimately included in the final model. These variables were tested but eventually excluded because they had negative consequences for the level of significance of the model. A complete model with many parameters can achieve a high rho-square, but this model is not informative if not all parameters are insignificant. Furthermore, variables such as nuisance are included in the table. This represents the extent to which people are bothered by shared micromobility vehicles, which, for example, did not have an effect on the model and were therefore excluded as well. The results are presented in Table 7.5 below.

Table 7.5: Results of final MNL model

Name		Value	
Number of estimated parameters:		32	
Sample size:		3816	
Init log likelihood:		-5181.931	
Final log likelihood:		-4503.657	
Likelihood ratio test for the init. model:		1356.5	
Rho-square for the init. model:		0.131	
Rho-square-bar for the init. model:		0.125	
Akaike Information Criterion:		9071.315	
Bayesian Information Criterion:		9271.217	
Name	Unit	Value	Rob. p-value
Alternative specific constants			
ASC_SHARED_BICYCLE	utils	-0,96	8,86E-08

ASC_SHARED_E_BIKE	utils	-1,7	0
ASC_SHARED_MOPED	utils	-3,88	0
Alternative specific parameters			
ASC_DISTANCE_B	utils/km	0,0812	0,000955
ASC_DISTANCE_E_B	utils/km	0,289	0
ASC_DISTANCE_M	utils/km	0,472	0
ASC_SCENARIO_B	utils	0,379	0,000178
ASC_SCENARIO_E_B	utils	0,596	6,64E-10
ASC_SCENARIO_M	utils	0,718	5,76E-10
ASC_AGE1_B	utils	0,792	0,001
ASC_AGE1_E_B	utils	0,21	0,397
ASC_AGE1_M	utils	2,36	0
ASC_AGE2_B	utils	0,381	0,0385
ASC_AGE2_E_B	utils	0,516	0,00379
ASC_AGE2_M	utils	2	0
ASC_AGE3_B	utils	0,353	0,013
ASC_AGE3_E_B	utils	0,3	0,028
ASC_AGE3_M	utils	0,994	4,33E-08
ASC_AGE4_B	utils	-0,12	0,349
ASC_AGE4_E_B	utils	-0,1	0,404
ASC_AGE4_M	utils	0,985	1,65E-09
ASC_GENDER_B	utils	0,203	0,0471
ASC_GENDER_E_B	utils	0,457	3,44E-06
ASC_GENDER_M	utils	0,292	0,0129
ASC_INTEREST_B	utils	1,37	0
ASC_INTEREST_E_B	utils	1,49	0
ASC_INTEREST_M	utils	1,24	0
ASC_USAGE_B	utils	0,5	0,000282
ASC_USAGE_E_B	utils	0,321	0,0189
ASC_USAGE_M	utils	0,566	0,000174
Parameters			
β_COST	utils/€	-0,564	0
β_TIME	utils/sec	0,000325	0,0217

The goodness of fit has significantly improved, with all values showing enhancement. The rho-square-bar has more than doubled, the likelihood ratio test has considerably increased, and both AIC and BIC have improved (decreased in value). Furthermore, from the results, it is observed that, except for three parameters, the others are statistically significantly different from zero at a 99% confidence level. For the age group of 50 to 64 years, two variables are not statistically significant, and the same applies to one parameter of the youngest age category. For the age group 50-64 year this could be caused by the fact that the 65+ age group is the base. The data on choices showed that these largely matched, which, along with the fact that this age group may have chosen more randomly. The youngest age group is the smallest sample, too few choices can also result in an incorrect estimation.

Looking at the parameter values, several conclusions can be drawn. Firstly, the influence of the scenario, utilities are positively influenced by the daily-work scenario, meaning that opt-out is more likely for the day trip. Furthermore, beta time is also positive, suggesting that a short completion time leads to more opt-out. Finally, beta price is negative, a logical conclusion, as a higher price reduces the utility for choosing an alternative. Therefore, if the price for a shared moped is set higher than that for a shared bike, this negatively impacts the choices for a shared moped.

Additionally, user experience, interest in the subject, and gender all have positive values. Having experience, being interested in the subject, and being female all lead to less opt-out. Interest has the strongest impact among these parameters. These parameters are alternative-specific, allowing for a comparison between alternatives. For instance, females are more likely to choose a shared e-bike and less likely to choose a shared bicycle. On the other hand, having experience with shared transportation has the most significant effect on shared mopeds and shared bicycles. Individuals with experience are more inclined to choose a shared moped than inexperienced individuals.

The distance parameters are all positive, making it more likely to choose a shared alternative as the distance increases compared to opt-out. This effect is most noticeable for shared mopeds and least noticeable for shared bicycles. In practice, and also in the stated preference experiment, costs increase as the distance grows. Whether an alternative is chosen more or less depends on the increasing costs.

Finally, the values for the age parameters can be observed. It is important to note that the base category is the oldest age group of 65+. This explains, among other things, why the shared moped is relatively more positive. Furthermore, the comparison is still made with the opt-out, which was frequently chosen by the oldest age category.

8 Implementation of the Model

Using the Multinomial logit model estimated in the previous chapter the probabilities of each alternative in a hypothetical or practical case study situation can be calculated with the multinomial logistic regression formula. The formula for multinomial logistic regression is as follows:

$$P_i = \frac{e^{U_i}}{\sum e^{U}}$$

Where:
P_i is probability of alternative i
U_i is the utility of alternative i

The probabilities calculated using the formula cannot be used as modal split; a much more extensive analysis is required for such results. The calculated probabilities are a representation of the choices made by the complete sample of respondents in which a trip is made with only the three shared modalities available. Percentages are calculated without decimal numbers and can primarily be used for comparison between the three modalities. Additionally, the statistics in this chapter describe what the probability of the sample would be in the presented hypothetical situations and which sociodemographic or other factors influence this.

In Appendix G.3, an overview of various results obtained through the model are available. The compare the results a base situation is estimated that was continuously adjusted based on one single parameter. This way, the adjustments are easy to analyse. Not all visualizations are included in the report, but some key findings are presented on the following page. The figures are divided into two columns, with the left column displaying results for the age category 25 to 34 years and the right column representing the category 35-49 years. As these two age groups are the most important regarding commuting trips and both are significant in the model. Results of the age category above 65 years can be found in Appendix G.3.

The top two graphs, for both age groups, are the base situation: a commuting trip, assuming only males, with interest in the subject and no experience with shared micromobility. The lower graphs show the probabilities for a hypothetical situation where the shared bicycles are offered without fees. Table 8.1 shows the original prices based on actual prices in the Netherlands.

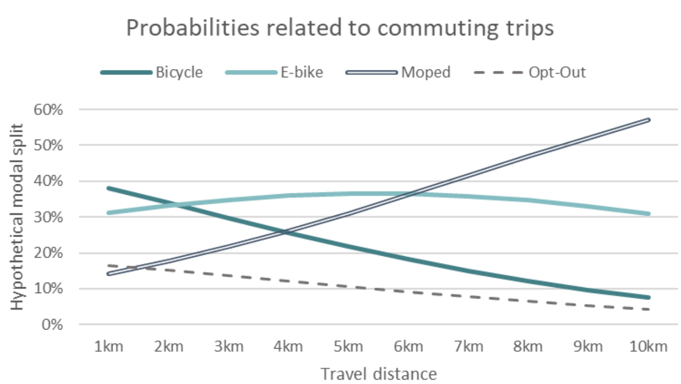
Table 8.1: Price scheme shared modalities for base scenario

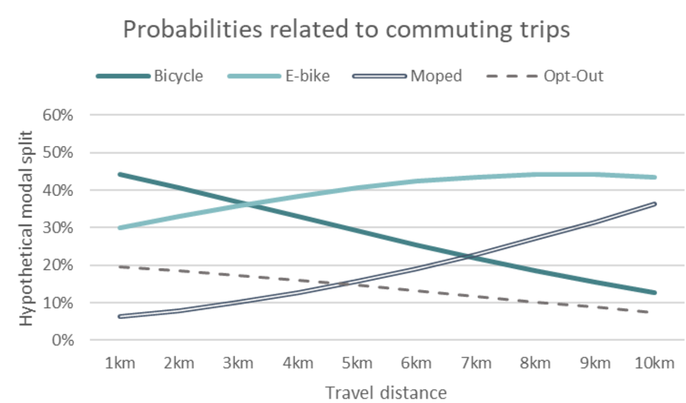
Distance	1	2	3	4	5	6	7	8	9	10
Shared bicycle	1.00	1.20	1.40	1.60	1.80	2.00	2.20	2.40	2.60	2.80
Shared e-bike	1.25	1.50	1.75	2.00	2.25	2.50	2.75	3.00	3.25	3.50
Shared moped	1.50	1.80	2.10	2.40	2.70	3.00	3.30	3.60	3.90	4.20

When comparing the base situation for both age groups with the previously analysed choice statistics, it is noticeable that the results align well. Additional, in the left graph, two intersections stand out. The first intersection, between shared bicycle and shared e-bike, occurs at 2 kilometres, followed by the second intersection for shared e-bike with the rising probability of shared mopeds at 6 kilometres. This pattern differs for the older category, where the first intersection is beyond 3 kilometres, and the second intersection does not occur until past 10 kilometres.

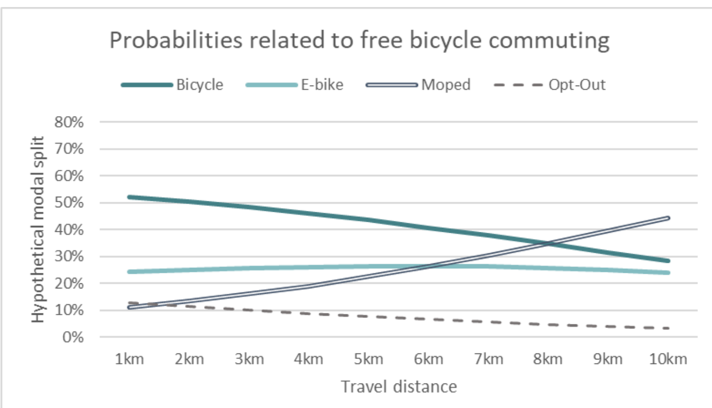
Looking at the results from Table 7.5, these are logical conclusions. With high values for the parameter of distance for shared mopeds and a significant difference between the values for the age parameters linked to shared mopeds. ASC_AGE2_M is at least twice as large as ASC_AGE3_M.

Probability estimations for age group 25-34 year	**Probability estimations for age group 35-49 year**
Base situation: *Commuting trip, males, interest in subject but no experience*	*Base situation:* *Commuting trip, males, interest in subject but no experience*





Adjustment: Free usage for shared bicycle	*Adjustment: Free usage for shared bicycle*



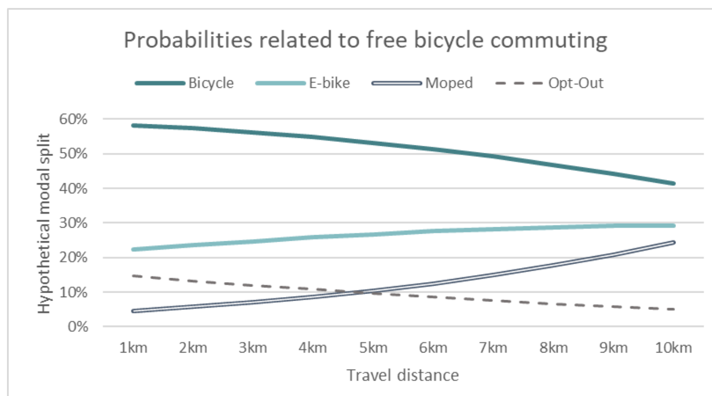


Figure 8.1: Estimated probabilities regarding commuting trips

In the bottom two graphs of Figure 8.1, it can be observed that making the shared bicycle free has significant consequences for the likelihood of someone choosing a shared micromobility modality. For both age categories, the likelihood increases significantly for a shared bicycle in the context of a commuting trip. The implementation of this measure has been mentioned multiple times during the expert interviews and can be very effective in encouraging individuals to choose shared bicycles instead of shared e-bikes or mopeds.

Now comparing the base situation of Figure 8.1 and the day trip scenario below, provides new insight between the differences the sample make in different context. The probabilities for the opt-out alternative are higher and the probabilities for shared moped are slight lower. The day trips scenario for the 35 to 49 age group shows even very low values for the shared moped, making them not relevant among all distances.

As discussed during the expert interviews, it is not recommended to provide a service without fees for leisure or general usage. For that reason, this time the two lower graphs are not estimated without shared bicycle fees, but with a discount, presented in Table 8.2.

Table 8.2: Discount price scheme shared modalities for base scenario

Distance	1	2	3	4	5	6	7	8	9	10
Shared bicycle	0.50	0.50	0.75	0.75	1.00	1.00	1.00	1.00	1.00	1.00
Shared e-bike	1.25	1.50	1.75	2.00	2.25	2.50	2.75	3.00	3.25	3.50
Shared moped	1.50	1.80	2.10	2.40	2.70	3.00	3.30	3.60	3.90	4.20

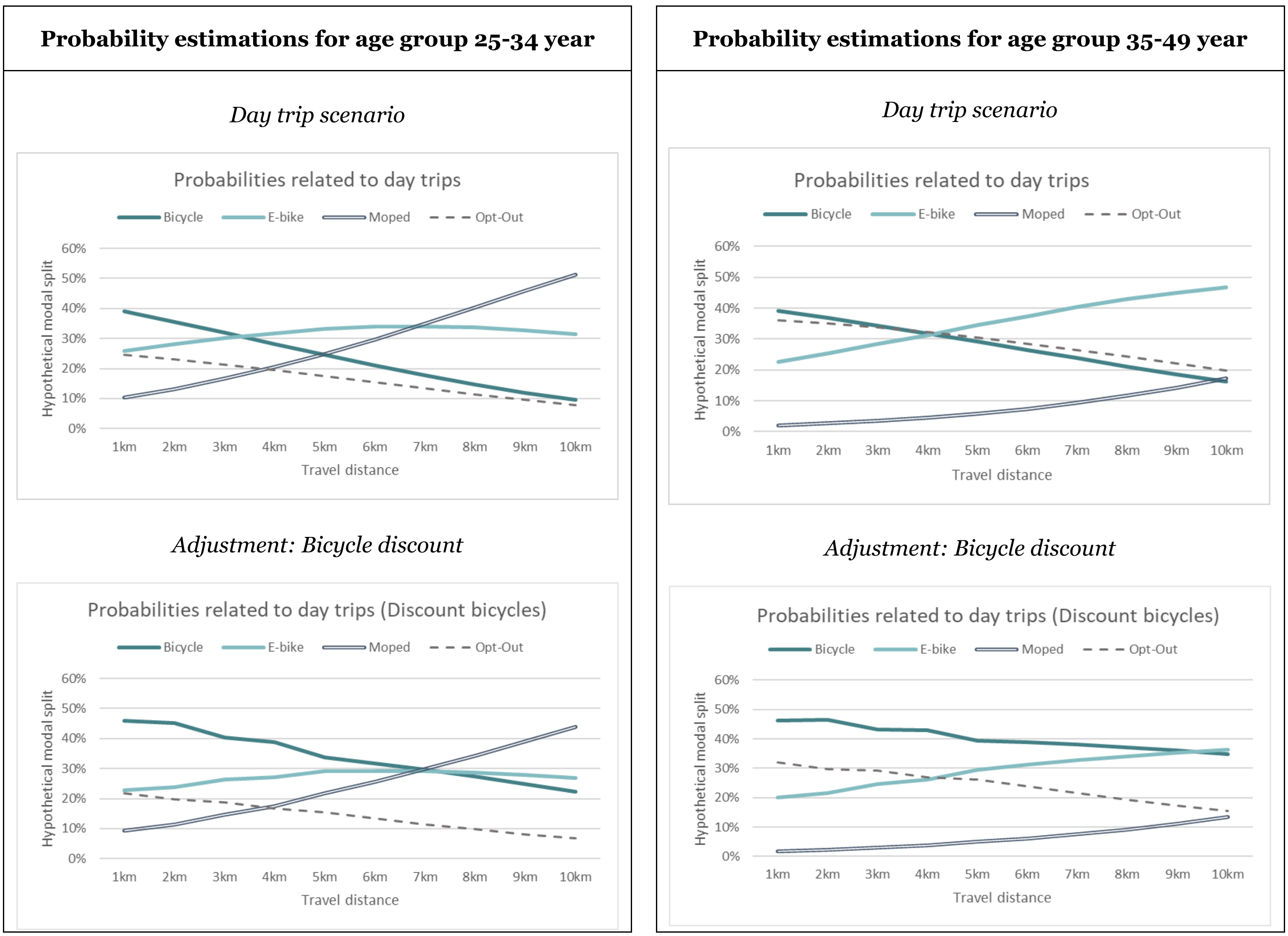


Figure 8.2: Estimated probabilities regarding day trips

As seen in both graphs, the discount for shared bicycles primarily affects the probabilities of shared e-bikes. When applying such a discount for only shared bicycles, a clear preference for shared bicycles is evident. If the decision is made to offer a discount for regular use and free service for commuting, it can be questioned whether it is necessary to add another modality to the sharing service.

Case study

At higher governance level, a decision has been made to start the implementation of shared micromobility in the case study area. For this reason, the results from the model are also applied to three situations in the area, see Figure 8.3 for the locations. Situation 1 represents the commuting movements from Leiden Central (A) to Unmanned Valley (C). The second situation is an alternative way to reach Unmanned Valley by covering the distance from the R-net stop (D). Finally, the third situation is a day trip to the beach, where parking is done at P+R along the A44 (B), and the journey continues to the beach (E). Each situation is discussed separately on the following page.

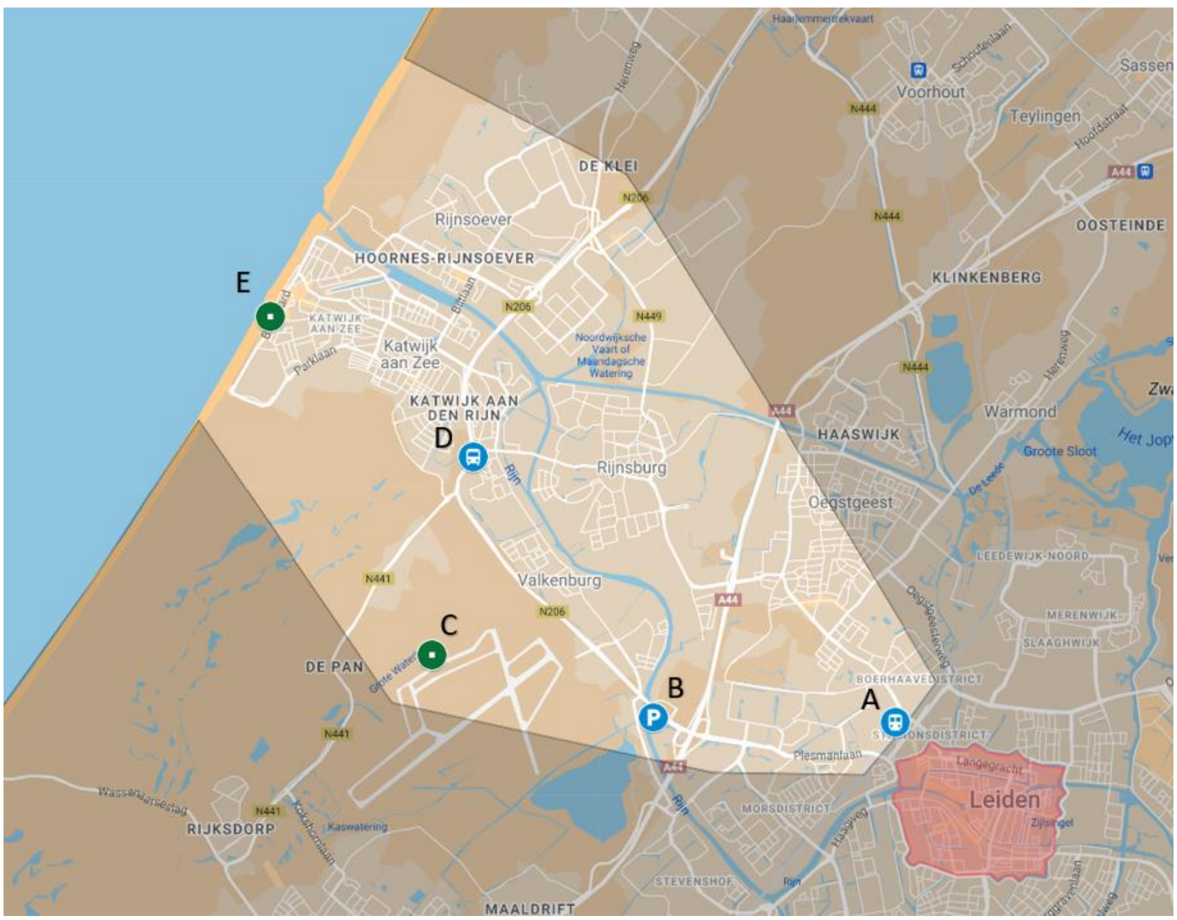


Figure 8.3: Case study area Katwijk/Leiden

The first situation involves a commuting trip with a distance of 7 kilometres. The results are presented in Figure 8.4. All age groups are included in the figure, with the 35-49 age group highlighted in a pie chart. Furthermore, the gender assumed is male, representing a sample of individuals interested in but without experience with shared micromobility. Lastly, the average completion time of 480 seconds has been used.

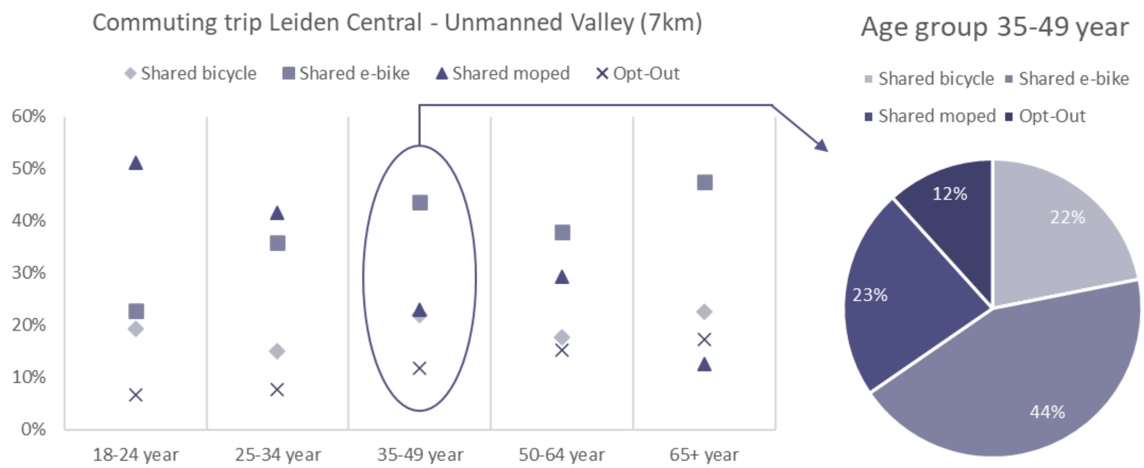


Figure 8.4: Estimated results for a commuting trip from Leiden Central (A) to Unmanned Valley (C)

For the described situation and distance, a shared e-bike emerges as the most attractive option for three out of the 5 age categories. However, the 65+ group is not or merely interesting for commuting. For the youngest two groups, the model suggests that a shared moped is more suitable. The low percentage of opt-out is noteworthy as well.

The second situation involves a 2-kilometer trip, with the other variables unchanged to enable a proper comparison. The results are depicted in Figure 8.5. A clear preference for shared bicycle is visible for all categories, in contrast to a negative change for shared moped. While the opt-out percentage increased as well.

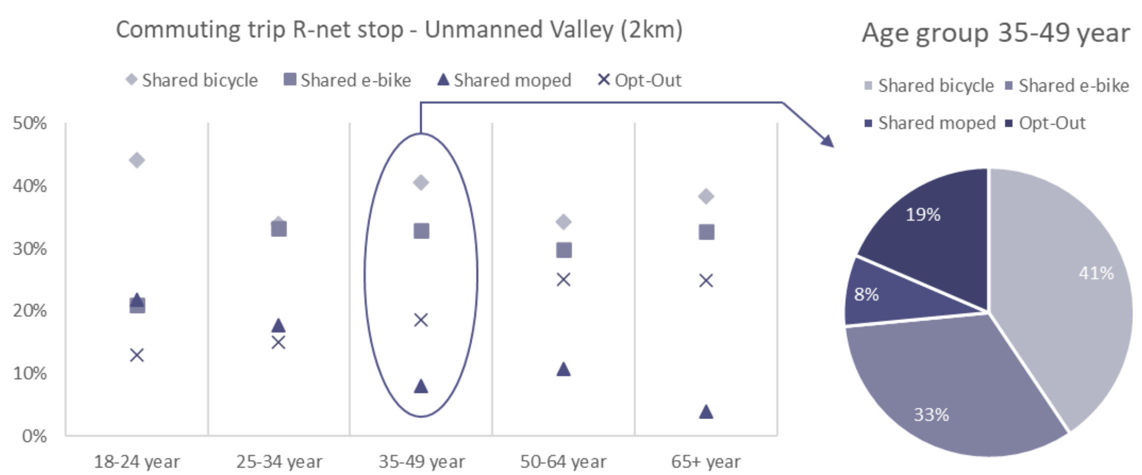


Figure 8.5: Estimated results for a commuting trip from R-net stop (D) to Unmanned Valley (C)

In addition to commuter travel movements, there is also a significant flow towards the beach in the Katwijk/Leiden area, especially during the summer months. This is reflected in the third situation, a day trip from the P+R to the beach in Katwijk. The distance is 5 kilometres, and the results are shown in Figure 8.6. The other variables have been kept constant to ensure a valid comparison once again.

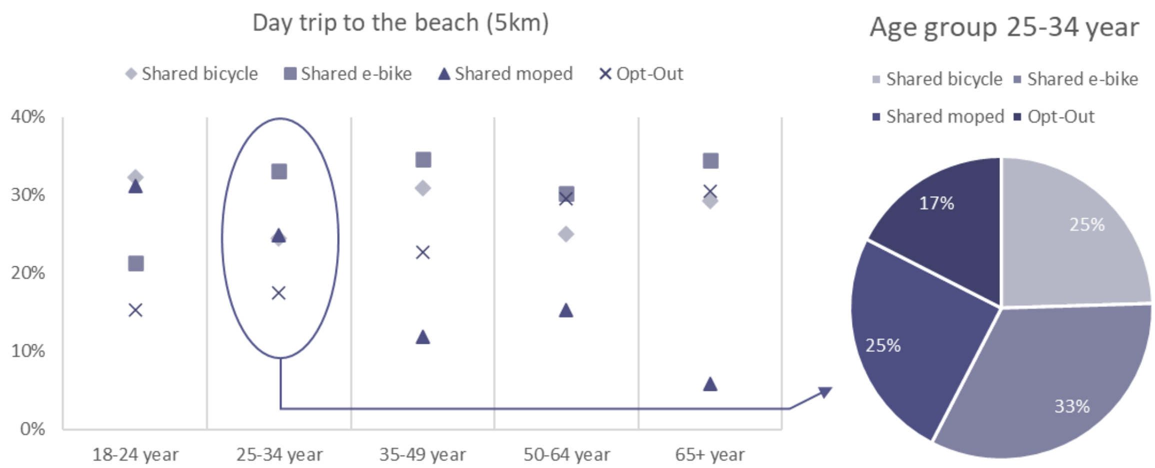


Figure 8.6: Estimated results for a day trip from P+R location (B) to the boulevard (E)

In this situation, the age group 25-34 years is highlighted. The line graph revealed various patterns, these include the decline of shared moped as age increases as well as increasing opt-out. Furthermore, the probability for shared e-bike is the largest, except for the age group 18-24 years.

Conclusie case study

The expert interviews revealed that governments and municipalities aim to promote sustainability, something that is considered as advantage of shared micromobility. Based on this perspective and the results from the three Figures 8.4, 8.5 and 8.6, a recommendation can be formulated for commuter travel and day traveling. A combination of shared bicycles and shared e-bikes would be a well-founded choice. Alternatively, the consideration could be made to exclude shared e-bikes and start only with shared bicycles in this situation. After all, there is an R-net bus service that allows a good combination of public transport and shared bicycles. Shared e-bikes may potentially compete with the R-net, which might not yield a direct positive effect. However, this provides travellers with sufficient travel options, depending on factors such as weather conditions. Something that mainly applies on sunny days, with large crowds heading towards the boulevard of Katwijk. Figure 8.6 shows that this group prefers the shared e-bike; however, the opt-out rate is also high.

The shared moped is not included in the recommendation, partly due to the low preference for the 2-kilometer scenario and the sustainability aspect. The respective municipalities, in this case, Katwijk and Leiden, can still provide possibilities for shared moped providers, but it is not advised to stimulate it with subsidies and other government funds.

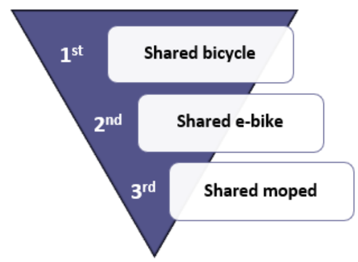
Part IV: Résumé

9 Conclusion

This research indicates promising expectations for initiating shared micromobility within suburban areas. The findings can be specifically applied to suburban regions in the Netherlands (medium and small sized towns) and the investigated case area of Katwijk-Leiden. By considering the following aspects, the likelihood of success is maximized, making the system more appealing to potential users, and causing minimal disruption for local residents. The main conclusions are summarized in Figure 9.1 and 9.2 below, answering the main research question.

Main research question: *"What is the most effective approach for implementing shared micromobility services in towns and suburban communities to maximize the benefits for both users and society?"*

< Based on Literature Review [1], Expert Interviews [2] & Survey [3] >



Sharing type

For the determination of the sharing type, considered from governance perspective, it is recommended to initially follow the order presented in the figure on the right.

However, determining the most suitable modality precisely depends on more detailed specifications. For this purpose, consult to the flowchart illustrated in Figure 9.2.

Shared bicycle:
- ✓ Travel distances below 4km [3]
- ✓ Suitable application for commuting, crowded areas, P+B and combination with national or regional PT [1] & [2]
- ✓ Mainly preferred by high educated individuals or people with low income [1] & [3]

Shared e-bike:
- ✓ Travel distances between 3km and 8km [3]
- ✓ Suitable application at P+B and combination with national or regional PT [1] & [2]
- ✓ Wide target audience [1] & [3]

Shared moped:
- ✓ Travel distances over 6km [3]
- ✓ Reducing car usage and improving the integration with national PT [1] & [2]
- ✓ Mainly preferred by individuals below 35 years or students [1] & [3]

Service area

Shared bicycle:
- ✓ Sharing system: Back-to-Many, including affordable Back-to-One possibility [2]
- ✓ Maximum of 1 shared micromobility operator (OV-bike excluded) [2]
- ✓ Relatively low investment costs [2]
- ✓ Service area connected to surrounding municipalities [2] & [3]

Shared e-bike & shared moped:
- ✓ Maximum of 2 shared micromobility operator [2]
- ✓ Fundamental condition: Connect service area to minimum one large-sized town (> 100.000 inhabitants) [2]
  - City center: Back-to-Many with few hubs (Preferable physical parking for shared vehicles only or parking for general e-bikes/mopeds)
  - City districts: Depending on situation, Back-to-Many with many hubs or Free-Floating
  - Suburban areas (Medium or small sized towns): Back-to-Many

(Figure continues on next page)

Hub locations

- Key destinations within the area, including but not limited to: [1] & [2]
  - ✓ Public transportation stops and stations
  - ✓ Business parks & companies
  - ✓ Shopping and sport centres
  - ✓ Educational campuses
  - ✓ Tourist hotspots & event venues

- Digital and physical hubs:
  The system needs physical hubs at crowded locations, such as railway station and BRT stops. It is recommended to initiate the setup with a limited number of physical hubs, adjusting digital ones based on user data. [2]

- When planning the hub locations, the following favourable walking distances to the vehicles should be considered: [1] & [2]
  - ✓ Shared bicycle: Below 150 meter
  - ✓ Shared e-bike: Below 200 meter
  - ✓ Shared moped: Below 225 meter

Operation & Marketing

- To ensure a healthy business case – An economically feasible service that minimizes the need for continuous subsidies – it is important to target for daily trips per vehicle: [2]
  - ✓ Shared bicycles: Approximately 2 trips per bike per day
  - ✓ Shared e-bikes: Over 2.5 trips per e-bike per day
  - ✓ Shared mopeds: Approximately 5 trips per moped per day

- Starting a new project is ideally undertaken in the spring months, March, April, or May, a time when individuals are more inclined to embrace alternative modes of transportation such as shared bicycles. To ensure a reliable product, it is crucial to offer a year-round service that operates seven days a week, 24 hours a day, preferable for a minimum of four years. [2]

- To accumulate initial interest and engagement, strategic measures such as flyer distribution, information at hubs, and incentive programs, such as discounts for leisure use and free usage for commuting, can be implemented during the project's initial phase or pilot period. These initiatives aim to encourage non-users to participate and contribute to the start of the project. [2]

Figure 9.1: Framework answering the main research question

Figure 9.2 on the next page should be used in combination with the framework above. Both the framework in conjunction with the flow chart answer the main research question, providing guidance for implementing shared micromobility in suburban areas. Further findings from this study are presented after Figure 9.2. Here, the various sub-research questions used to arrive at the final results are answered.

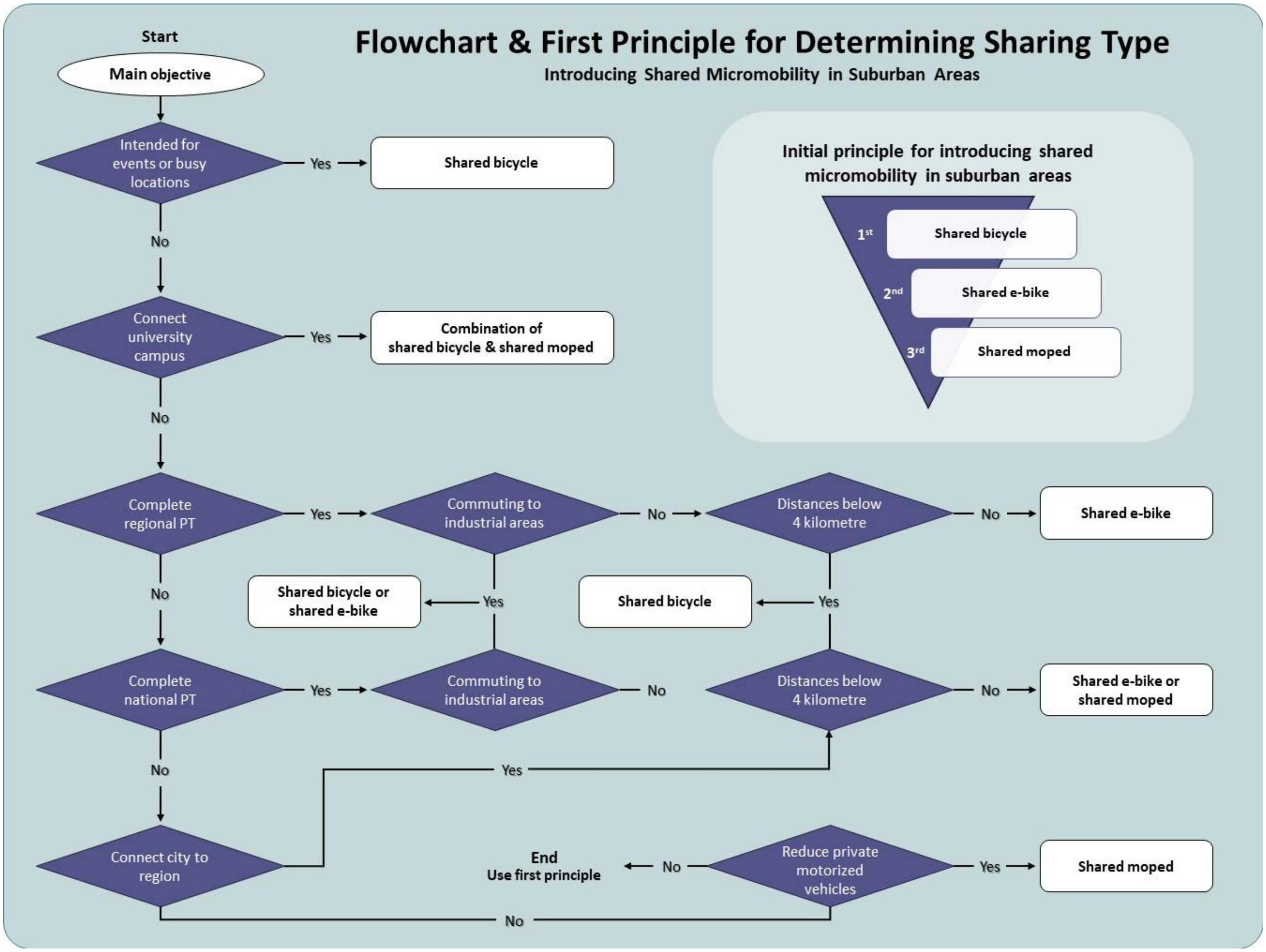


Figure 9.2: Flowchart providing guidance to find the most suitable shared micromobility mode

In the remaining part of this chapter, the seven sub-questions will be address, providing a more in-depth explanation of the framework above.

The first sub-question delved into the evolution of shared micromobility services over time and the underlying causes driving these changes. The literature review revealed a transition from a completely open system without restrictions, to a fully controlled and data-driven system with various usage limitations and nuisance. Three distinct sharing systems have emerged: Back-to-One, Back-to-Many, and Free-Floating, offering shared micromobility with and without docking stations. It all started with Free-Floating without any security measures, forced to stop due to theft and vandalism. Continuing with different Back-to-One system in which for example with coins bicycles could be used from a docking station. Again theft and long usage time made new development necessarily. Recent technological developments have showed that docking stations are unnecessary, due to fully digital hubs and GPS-driven vehicles. This expands the capabilities of a Back-to-Many sharing service beyond connecting fixed physical locations within the service area and also made Free-Floating possible again. At this stage in time all different services are offered, making a comparison very helpful, as in this research.

The second sub-question focused on identifying essential factors influencing the operation of shared micromobility services. This question can be answered based on the findings from the literature review in combination with expert interviews. Literature indicates that user characteristics, geographical location, service area, quality of the infrastructure, trip purpose, trip distance, and fleet size, among other factors like weather, helmet regulations, criminality, and knowledge about the sharing system, influence the usage. Similar results were obtained from expert interviews, highlighting for example, the importance of locations within the service area. Offering shared two-wheelers at public transportation stops and stations, educational campuses, shopping and sports centres, and business parks proves to be highly efficient. User characteristics were frequently mentioned by providers, along with infrastructure quality and the role of marketing. Specific socio-demographic information influencing usage will be further addressed in research question 5, while the influence of price and distance will be explored in detail in sub-research question 6.

Regarding helmet regulations, the various research methods provide consistent conclusions. Internationally, several studies demonstrate that helmet regulations for shared transportation have a negative impact on usage. Reasons include the inconvenience of wearing a helmet and the unavailability of helmets. The latter is not a concern in the Dutch context, where helmets are provided with shared mopeds. However, the expert interviews reveal that the helmet regulation implemented in January 2023 for shared light mopeds has indeed resulted in a significant decrease in usage. This finding is supported by the survey, with over 40% of shared moped users reporting decreased using or even stop using light moped sharing. So, implementing such a measure does have a substantial impact and should be considered in the evaluation of the three sharing modalities.

Another essential factor influencing the operation of shared micromobility services is marketing. Dill et al. (2022) found that using a sharing service requires specific understanding, including the process of registration, checking in and out, the costs, the location for returning it, time limitations, and more. Without this knowledge, or with incorrect information, individuals are less inclined to utilize the shared bike or moped services. Dill et al. (2022) created a model including these aspects, illustrated in Figure 3.2 on page 25. Saying that before using shared two-wheelers individuals first need to have a general knowledge and understanding of the service. This is also conformed by the experts during the interviews. The results of the stated preference experiment reveal that respondents without knowledge of the subject are more inclined to choose the opt-out option. The same effect is observed for those with little or no interest in the subject. A proper announcement and marketing plan are therefore crucial when launching a new project or pilot. Various experts emphasize the importance of effective collaboration among the involved stakeholders.

Exploring the current challenges and potential benefits associated with shared micromobility services constituted **the third** sub-question. The findings highlight the importance of addressing the overall benefits to policymakers and moreover, making clear how potential issues can be mitigated or even prevented. The literature, expert interviews, and the survey align on the fact that the use of shared micromobility offers users the following benefits:

- ✓ Timesaving
- ✓ Reduction of car trips
- ✓ Facilitation of multi-modal trips
- ✓ Provides flexibility
- ✓ Encourages physical activity
- ✓ Promotes a sustainable mindset

Furthermore, according to the experts and the participants of the survey the following benefits should be added to the one mentioned in the literature:

- ✓ Reduction of the need for a second or third bicycle (beneficial for overcrowded station bike storage)
- ✓ No concerns about maintenance or theft of the vehicle, a significant issue in many cities.

Other benefits that have emerged include the following four:

- ✓ Reducing the transportation costs of governments
- ✓ Increase in public transportation usage
- ✓ Providing more travel options
- ✓ Improved accessibility and thus reducing transport poverty, especially within suburban areas

In addition to benefits, there are also drawbacks to the use of shared micromobility, such as increasing user costs, high initial investments, operational complexity, low inclusivity, limited availability, and especially pressure on public space. Sufficient guidelines have been provided in this study to address the last-mentioned issue, which will be elaborated upon at the following sub research question. It is worth noting that not every expert recognizes this problem, and some indicate that the problem is minimal compared to privately-owned vehicles that are poorly or dangerously parked.

Two important topics for municipalities are the relationship with public transport and the fact that shared micromobility actually reduces car usage. The exact effect depends on various variables; however, several studies in both domestic and international contexts show a positive effect on reducing car trips. This varies from a low percentage of 2% in London to over 20% in cities in the United States and Australia (Fishman et al.; 2014). In the Netherlands, even higher findings can be found related to shared mopeds. Moreover, in the survey, 27.5% of users indicate that the use of shared micromobility leads to a reduction of car usage.

Regarding the relationship with public transport, there is concern that shared two-wheelers may have a negative impact on regional public transport. Firstly, literature, as well as expert interviews, emphasize that two-wheelers are mostly used in combination with public transport. Furthermore, the survey shows similar results, with respondents seeing two-wheelers more as a complement to public transport than an alternative. However, the broader story is much more important. Shared micromobility plays a crucial role in the mobility transition, where active forms of transport and public transport are preferred over motorized private vehicles. Simultaneously, regional public transport routes are being upgraded to direct lines, with higher frequencies, shorter routes, and fewer stops. The money saved in this process can be invested in a combination of shared micromobility and customized public transport. Two-wheelers can be used for the increasing distance of the last mile, and customized public transport ensures inclusivity.

Continuing with **the fourth** sub-question aiming to derive guidelines and policy recommendations from the literature and expert interviews to optimize the implementation of shared mobility services in towns and suburban communities. As mentioned before is the pressure on the public space one of the repeated drawbacks of shared micromobility, especially by municipality officials. But also, by residents as evident in the survey results, with over 40% of respondents indicating that they often to sometimes feel bothered or experience issues due to shared micromobility. Among this group, 80% relate these problems primarily to shared mopeds. This problem can largely be solved through the following recommendations:

- Create physical parking facilities at busy locations such as public transportation stations or stops (14 out of 16 experts express a clear positive view towards this solution). However, it is emphasized that these locations should be established based on user data. Furthermore, it is important to ensure sufficient space for private vehicles, so that new problems can be prevented.
- Implementing the Back-to-Many sharing system instead of Free-Floating. This allows for user guidance, such as permitting vehicle parking only at locations with bike racks. This system offers flexibility, providing municipalities the ability to distribute users during crowded periods.
- Implement features in user applications, such as rewarding good behaviour and discipline mistakes. A good collaboration between municipalities and providers creates many possibilities. Shared micromobility providers are willing to implement various measures to address the issue.

Concerning the introduction and subsidy of a shared micromobility service by municipalities or other government institutions in suburban areas, a Back-to-Many approach is most suitable. This enhances the findability of vehicles, provides certainty about locations where they can be found, and, importantly, reduces nuisance. Digital hubs can be pre-determined through an analysis of the area, and based on data, crowded locations can be equipped with physical parking options for sharing vehicles. However, it is essential to consider a maximum distance users are willing to walk, which is around 150 meters for shared bicycles, just below 200 meters for e-bikes, and around 225 meters for shared mopeds.

Furthermore, the choice of vehicle type (shared bicycle, shared e-bike, or shared moped) in such a service, depends on various circumstances. Shared mopeds emerge from this research as the least suitable, unless the target audience is under 35 years old, the distances to be covered are mostly above 6 kilometres, and the main goal of implementation is reducing car usage. For this purpose and longer distances, shared mopeds are the better option. In such a scenario, a few suitable locations per medium or small sized town, linked to shopping or sports centres, educational campuses, and public transport stops, can be considered. It is crucial to connect various municipalities in one service area, including at least one large town or city. This facilitates the possibility of covering large distances with a shared moped, aiming to create an alternative to the car.

A better sharing modality, according to this research, is the application of shared e-bikes. Again, the presence of a large town or city is crucial to enable a healthy operation for the provider, without high subsidies. Shared e-bikes are suitable for distances above 4 kilometres and are preferred by a wide variety of target groups, as evident in Appendix F. No driver's license or helmet is required for this modality, it has pedal assistance, and still promotes physical activity. However, extensive usage or long downtime is not favourable to the product, moreover the vehicles need regular maintenance.

From a sustainability point of view, shared bicycles are the most suitable. Other benefits include lower investment costs, the cheapest operational costs, and ease of relocation. This vehicle is highly suitable for distances between 1 and 4 kilometres. Additionally, this modality is also most appropriate for commuting travel patterns and busy locations such as beaches or events, where often no more than two travel movements are generated per day. This is more than sufficient for a robust business case for shared bicycles, with shared e-bikes slightly above with more than 2.5 trips per day per vehicle, and shared mopeds need to make around 5 movements per day per moped (depending on the distance).

Socio-demographic information associated with (e-)bike and moped sharing were addressed in **the fifth** sub-question. Literature revealed patterns related to age, gender, income and educational level. Primarily for age, strong relationships are found in the choice model between age categories and the choices individuals make. To a lesser extent, these relationships are found for gender, and the model does not recognize significant patterns for income groups and various education levels. Examining the choice statistics, it does show that highly educated individuals are more inclined to choose a shared bicycle, and individuals in higher income classes are more likely to choose a shared moped. However, this is not indicated by the model. Furthermore, the choice statistics indicate that the preference for a particular modality influences the choice of a shared transportation mode. Preference for walking leads to more opting out and frequent moped use lead to more shared mopeds choices for example. Having an interest in the subject or already having experience with shared micromobility also influences the choices.

The sixth sub-question explored the extent to which price and distance influence the use of (e-)bike and moped sharing. In the general question about which attributes in the choice experiment have the most significant effect on choices, distance and price are mentioned the most, by respectively 59.1% and 52.4% of the respondents. Furthermore, these two parameters also emerge as significant in the model. The increase in distance has the most significant effect on shared mopeds and the least on shared e-bikes. This is partly due to the rise in costs proportional to the increase in distance.

As mentioned above, according to the model, the most suitable distance for shared bicycles is from 1 to 3 kilometres, for shared e-bikes from 3 to 8 kilometres, and for shared mopeds above 6 kilometres. This aligns, apart from shared mopeds, with the literature findings and interviews with shared micromobility providers.

The seventh and final sub-question, including the two related questions, focused on the interest and willingness of suburban residents and visitors to accept the introduction of shared micromobility, supplemented with their knowledge, experience, preferences and concerns related to these services. The findings indicate positive intensions of residents and employees against the introduction of shared micromobility, despite the low familiarity rate and most of the respondents not having any experience. At the same time, a significant group indicates being bothered or experiencing inconvenience mainly due to shared mopeds.

The total sample of the survey is comparable to that of small and medium-sized municipalities in South Holland. 55% of respondents would agree to the introduction of shared bicycles in their place of residence, 49% for shared e-bikes, and 38% for shared mopeds. Respectively, 14%, 18%, and 29% of respondents disagree, while others remain neutral. A share of the sample resides in a medium-sized towns like Leiden, Gouda, or Dordrecht, for this group only 6.9% disagreeing with the introduction of shared bicycles. Therefore, the size of the town matters in some extent. In total, 72% of the sample has never used shared micromobility, and 56% are unfamiliar with the costs. However, over 60% express interest in the subject. Finally, 32% of those employed indicate that the addition of shared micromobility could have a positive impact on their commute. In contrast, 42% of the total sample indicates to be bothered by shared two-wheelers and 41% states in another question that it offers them no benefits in general.

To summarise some key findings presented in the conclusions above the following table is added below.

Sharing type	**Service objectives**	**Travel distance**	**Sharing system**	**Healthy business case**	**Society**
	Expert interviews	*Survey*	*Expert interviews*	*Expert interviews*	*Survey*
Shared bicycle  (HTM)	Short trips Supplement to regional public transportation Commuting (B+R) Event locations	Trips below 4km	Back-to-Many (Including affordable Back-to-One system) Favourable walking distances: Below 150m	Maximum of 1 shared micromobility operator (OV-bike excluded) Around 2 trips per bicycle per day Relatively low investment costs	Lowest level of inconvenience Largest share supporting the introduction in local town
Shared e-bike  (Donkey Republic)	Medium to long trips Solve the distance between town and city Wide target audience	Trips between 3km and 8km	Back-to-Many Favourable walking distances: Below 200m	Maximum of 2 shared micromobility operator Above 2.5 trips per e-bike per day High investment costs (Include a city or large town in service area)	Low level of inconvenience Preferred in most situations according to wide target audience
Shared e-moped  (Check)	Long trips Solve the distance between town and city Popular among students Reduce car usage	Trips above 6km	Back-to-Many Favourable walking distances: Below 225m	Maximum of 2 shared micromobility operator Around 5 trips per moped per day High investment costs (Include a city or large town in service area)	High level of inconvenience

Figure 9.3: Summary of key findings

10 Discussion

This chapter discusses the results and presents the most important implementations and recommendations arising from the conducted research. Providing new insights besides already existing research in the field, other findings are in line with the presented information in the literature review and some are in contrast with studies found in the beginning of this project. Mainly the latter is discussed in this chapter, along with any limitations of the study.

The influence of age is prominent in the stated preference experiment, with older individuals opting out more frequently for various scenarios compared to younger respondents. The low opt-out percentage is mainly observed in the 18-34 age group, while the high percentage is noted for the group above 65 years. This is supported by literature indicating that younger people are more willing to use shared modes, with the largest group being between 18-37 years old (Wang et al., 2018; Fishman et al., 2015; Eren & Uz, 2020). Fishman et al. (2015) concluded that individuals between 18 and 34 years old are 3.3 times more likely to use sharing systems compared to all other age groups. The impact of gender appears differently in the literature, and in this study, differences between men and women are not strongly verified.

Regarding income levels and educational levels, no significant patterns are recognized. A statistical analysis based on a survey by Barbour et al. (2019) found that respondents from households with lower income had a higher probability of using shared bikes more often than higher-income users. Similar results were found in Washington, DC, where the system was mainly used by younger individuals with lower levels of income (Buck et al., 2013). Furthermore, bike sharing is usually associated with higher education. These results are from revealed data, which is fundamentally different from the experiment in this study, which is based on stated preference.

10.1 Survey limitations

An important consideration is the degree of generalizability, also known as external validity. It refers to the extent to which the results of a study can be applied to other situations, different groups of people, and various locations. For the survey, an online panel was utilized, focusing on gender, age, and especially location. The use of the online panel ensures that the sample comprises a diverse range of individuals. A substantial sample size and a representative sample for the population in South Holland were ensured as well. Overall, this was successful, with a good gender balance and a distribution across age, income, and educational levels. However, certain groups are either underrepresented or overrepresented. Three groups are underrepresented in the sample: young respondents between 18-24 years old, respondents with only a primary school diploma, and those with an income below €30,000 per year. Additionally, a significant group of 20.9% where not willing to provide their income level, and the age group above 50 is overrepresented. It can be argued that, compared to the population of South Holland, the sample is slightly older, which could have implications for this specific study into shared micromobility.

Most respondents were obtained through PanelClix, a paid online panel where respondents receive compensation for completing the survey. Consequently, respondents may have filled out the survey less accurately than they would on a voluntary basis. However, efforts were made to make the sample as reliable as possible through various measures, which has led to data exclusion of 77 respondents.

Stated preference experiment

The application of a stated preference experiment has various limitations and considerations that should be taken into account when interpreting the results. Respondents may provide different answers to hypothetical scenarios than they would have in the real-world, known as hypothetical bias. The goal of this research is not to determine the modal split since respondents could only choose from three transportation options in the experiment. The aim is to assess the differences for the three different shared two-wheelers in various scenarios, attempting to avoid influencing the choice of respondents who would not choose any of them through the opt-out option.

The focus was primarily on two scenarios: one where respondents make a commuter trip to work and another where they take a day trip. This, of course, does not cover all travel movements and mainly concerns the last-mile. A similar study on first-mile movements would likely yield very different results.

The complexity of the experiment was attempted to be reduced to obtain more reliable results. This was done, among other things, by limiting the experiment to three alternatives with clear attributes. The distance is prominently displayed for each question, and for each alternative the costs and travel time are clearly presented. Each alternative is accompanied by a picture instead of text. By keeping the complexity low, information and familiarity bias are minimized as much as possible. Direct influence of knowledge about the subject was not found in the model, something that is found for experience and interest in the subject. This implies to a certain level that familiarity bias has been limited.

The counter effect to a low-complexity experiment is the risk of a high chance of random answers. The goodness of fit is on the low side for the MNL model, possibly caused among other things by the randomness of answers. The goodness of fit could be improved by estimated a more complex model. Still, a r-squared between 0.1 and 0.5 is acceptable in social science research when most of the explanatory variables are statistically significant as in the final model (Ozili, 2023).

Furthermore, travel time is not included in the model, as it varies too little between choice scenarios. Travel time is determined based on distance and speed of the specific modality. Mentioning this travel time has prevented respondents from filling it in themselves, avoiding incorrect or different interpretations of the speed of shared mopeds compared to other alternatives.

10.2 Other limitations

Each method has different limitations, expert interviews for example deal with personal bias which could affect the expertise of the experts on the subject. Additionally, in comparison to a survey, it is much more challenging to achieve a diverse and valid sample. By conducting interviews with various experts and ensuring a minimum of two experts for each type of expertise, efforts were made to control this limitation.

For the application of the research results in countries other than the Netherlands, the interpretation of the results is of great importance. The Netherlands has a different culture, especially when it comes to cycling and infrastructure. Additionally, at the time of writing, the standing scooter is not allowed in the Netherlands, rising a completely different issue. The results of this study may potentially be influenced by the introduction of shared standing scooters in the Netherlands, especially compared to shared e-bike and shared mopeds.

11 Recommendations for practice

The results of this study can be utilized by policymakers from both small and medium-sized municipalities in the potential validation and implementation of shared micromobility. Throughout the duration of the research, initiating shared micromobility in the Katwijk and Leiden has been investigated. With significant progress due to this specific research, including the decision to allow it at higher governmental level. This makes it possible to effectively apply the results of this study in practice.

For municipalities like Katwijk and many other related municipalities in South Holland and other provinces in the Netherlands, there is insufficient capacity to formulate the frameworks for a robust shared micromobility system. This also underscores the significant value of the research for practical application.

Specifically, the recommendation is to implement free-floating as an exception and to set back-to-many as default related to shared micromobility. This also applies to concepts based on back-to-one. It would be beneficial for the Dutch market if the privilege for OV-fiets were aligned with those of other providers. This encourages development and provides opportunities for improving bike-sharing services in the Netherlands. A significant opportunity lies in the change the system of OV-fiets from back-to-one to back-to-many. Related to the type of shared micromobility, most significant opportunities lie in the application of share bicycles, potentially complemented by shared e-bikes.

In general, this research yields interesting and relevant conclusions regarding the establishment of a shared micromobility service and the associated advantages and disadvantages. However, the information obtained from this study can be further utilized for additional scientific studies. Both data from the expert interviews and the survey, contains possible underexplored aspects that could be further investigated in future research.

For instance, a more in-depth analysis of the differences between daily-work and non-daily non-work scenarios. The data have revealed, for example, that individuals above the age of 50 are more inclined to choose shared mopeds when not commuting daily. This could be to a preference for not using shared mopeds for daily use but finding the convenience appealing for a single trip during leisure activities. Underlying reasons might include having more time in such situations, and factors like the higher price of a shared moped playing a less significant role. Moreover, in the model the context scenario is added as alternative specific parameter, although it is also investigated whether the two scenarios had influence on the perception of distance and costs in the experiment (Interaction variables). Distance resulted in statistically significant findings, in which people placed in the role of commuting have a stronger affection by distance compared to the role of daily trip. The results do not show any interaction effect between the scenario and the costs. These and other interaction effects, such as the perception of distance in correlation to age are interesting to investigate in future research.

Additionally, differences can be examined between locations where shared micromobility has been offered at least once compared to municipalities where it has never been offered. These distinctions are included in the dataset of this research. However, it is essential to note that shared micromobility is not extensively available in any of the municipalities included in this study at present. Nevertheless, this could still impact the residents' attitudes, as they may or may not have had direct exposure to shared micromobility.

Relatedly, another opportunity lies in the differences between small towns, medium-sized towns, and relatively large towns (Cities). Differences in opinion of inhabitants can be further investigated in a follow-up study.

Furthermore, the current discrete choice models are based on MNL. This aspect can be further elaborated in more detail by estimating a model of higher complexity, such as applying Nested Logit Model (NL), Mixed Logit Model (ML), or Latent Class Analysis (LCA). These models are expected to achieve higher goodness of fit which will strengthen the results.

To end with, new studies could investigate the effect of traffic safety and the actual sustainability of shared micromobility. For example, especially the safety and sustainability of shared mopeds, are two topics that could results in interesting findings. People without driving experience for mopeds can still start a trip with shared mopeds, which may result in negative traffic safety effect. Moreover, it would be interesting to substantiate the actual sustainability of shared micromobility. Indicating the level of sustainability of for example shared e-bikes and mopeds compared to private vehicles or public transportation. Conducting a thorough analysis in this regard could provide valuable insights into the environmental impact and sustainability aspects of different shared modes.

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APPENDIX

A. Informed consent

IC Expert interviews

Dutch (English below):

Eerst uitleg per mail, met de vraag of de betreffende deskundige openstaat voor een interview over deeltweewielers in de regio. Vervolgens na goedkeuring kom ik langs bij de betreffende deskundige op kantoor, wordt het interview online gehouden of verwelkom ik de deskundige op het Provinciehuis in Den Haag.

Na ontvangst en toelichting wie ik ben en wat ik doe vervolg ik het gesprek met:
"Voor mijn onderzoek (Master thesis aan de TU Delft) naar deeltweewielers – gedeelde elektrische(fietsen) en scooters – bespreek ik graag een aantal vragen. Hierbij hou ik geen vaste structuur aan en worden uitgebreide antwoorden gewaardeerd. Het interview duurt 50 minuten (60 in totaal met voorstellen) en bij goedkeuring zou ik graag het gesprek opnemen. Dit doe ik met mijn telefoon en uitsluitend geluid wordt opgenomen. Na afloop kan ik dit gebruiken om de besproken onderwerpen te verwerken en zal ik vervolgens het gesprek weer verwijderen. Het wordt niet bewaard en niet gedeeld met andere personen. Daarnaast neem ik graag het gesprek op zodat ik bezig kan zijn met het stellen van de vragen en minder hoef te notuleren tijdens het gesprek."

"Zou u kunnen bevestigen dat u toestaat dat het gesprek wordt opgenomen onder de hiervoor genoemde voorwaarden."

Bij akkoord wordt de opname gestart en begin ik het interview.
Bij twijfel of geen akkoord zal het interview plaatsvinden zonder opname en verwerk ik antwoorden in een Microsoft-Word bestand tijdens het gesprek.

In beide gevallen wordt ook het volgende vermeld:
"Alle verkregen informatie wordt naderhand gefilterd en de informatie die ik wil gebruiken voor mijn onderzoek zal ik per mail opsturen ter controle. De informatie kan hier worden aangepast na de wensen van de deskundige en hier wordt ook aangegeven of de informatie gebruikt mag worden in het onderzoek."

Mail naderhand:
Beste [deskundige],

Bedankt voor uw tijd en deelname aan de interviews voor mijn onderzoek.

Zoals besproken mail u hierbij de informatie die ik wil gebruiken in mijn rapport. Zou u het kunnen doorlezen, eventueel op- of aanmerkingen kunnen plaatsen en het bestand aan mij terug willen sturen. Zou u daarnaast willen aangeven of ik de informatie volledig anoniem mag gebruiken, of dat ik ook uw functie en bedrijfsnaam mag koppelen aan de informatie.

Bij het geven van goedkeuring stemt u in met het gebruik van de (geanonimiseerde) informatie door de verantwoordelijke onderzoekers vanuit de TU Delft en Provincie Zuid-Holland. De informatie uit de expert interviews zullen uitsluitend voor dit onderzoek worden gebruikt.

Alvast bedankt voor uw reactie.

Met vriendelijke groet,

Rody Boting

Inclusief bijlage met de informatie uit het interview

English:

First explanation by email, with the question whether the expert concerned is open to an interview about two-wheeled vehicles in the region. Then, after approval, I will visit the expert at the office, the interview will be held online, or I will welcome the expert at the Provincial House in The Hague.

After explaining who I am and what I do, I continue the conversation with:

“For my research (Master’s thesis at TU Delft) on shared two-wheelers - shared electric (bicycles) and scooters - I would like to discuss a number of questions. I do not adhere to a fixed structure and detailed answers are appreciated. The interview lasts 50 minutes (60 in total with introductions) and if approved, I would like to record the conversation. I do this with my phone and only voices are recorded. Afterwards, I can use this to process the topics discussed and then delete the conversation again. It will not be stored or shared with other people. In addition, I would like to record the conversation so that I can focus on asking questions and do not have to take notes during the conversation.”

“Could you confirm that you allow the conversation to be recorded under the conditions mentioned above?”

If approved, the recording will be started, and I will start the interview.
In case of doubt or no approval, the interview will take place without recording and I will process answers in a Microsoft Word file during the conversation.

In both cases, also mention:
“All information obtained will be filtered afterwards and the information that I want to use for my research will be sent by email for verification. The information can be adjusted here according to the wishes of the expert, and it is also indicated here whether the information may be used in the research.”

Mail afterwards:
Dear [expert],

Thank you for your time and participation in the interviews for my research.

As discussed, I am emailing you the information that I would like to use in my report. Could you please review it, provide any comments or suggestions, and send the file back to me? Additionally, could you indicate whether I may use the information completely anonymously or if I am allowed to associate your job title and company name with the information?

By giving your approval, you consent to the use of the (anonymized) information by the responsible researchers from TU Delft and the Province of South Holland. The information gathered from the expert interviews will be used only for this research.

Thank you in advance for your response.

Sincerely,

Rody Boting

Including attachment with information from interview

IC Online Survey

Dutch (English below):

[Logo TU Delft & Provincie Zuid-Holland]

Welkom!

Beste deelnemer,

Deze vragenlijst is onderdeel van een onderzoek naar deelvervoer binnen de provincie Zuid-Holland. De enquête geeft inzicht in de interesse, houding en voorkeur voor deelvervoer in dorpen en kleine gemeenten. U hoeft geen gebruik gemaakt te hebben van deelmobiliteit, u kunt gewoon uw mening geven over het onderwerp.

Uw deelname aan dit onderzoek is volledig anoniem en vrijwillig. Antwoorden worden vertrouwelijk behandeld en uitsluitend gebruikt voor onderzoeksdoeleinden.

De enquête zal ongeveer 10 minuten in beslag nemen. Bij het starten van de enquête geeft u aan bovenstaande informatie te hebben gelezen en gaat u ermee akkoord dat uw antwoorden mogen worden gebruikt door de verantwoordelijke onderzoekers vanuit de TU Delft en Provincie Zuid-Holland.

Alvast hartelijk bedankt voor uw deelname,

Rody Boting

English:

[Logo TU Delft & Province of South Holland]

Welcome!

Dear participant,

This questionnaire is part of a study on shared micromobility within the Province of South Holland. The survey aims to gather insights into the interest, attitudes, and preferences regarding shared mobility in towns and small municipalities. You do not need to have used shared mobility, you can simply provide your opinion on the subject.

Your participation in this research is completely anonymous and voluntary. Answers will be treated confidentially and used solely for research purposes.

The survey will take approximately 10 minutes to complete. By starting the survey, you indicate that you have read the above information and agree that your answers may be used by the responsible researchers from TU Delft and the Province of South Holland.

Thank you very much for your participation,

Rody Boting

B. Expert interview protocol

Interview …[Company name]…

Expert: …
Date: …
Location: …
Available time: … minutes

List of questions for expert interviews

When I use shared micromobility I refer to the shared use of bikes, e-bikes & mopeds/scooters

(Time indication given for an interview with a total time of 60 minutes, the subject and questions are chosen according to the expertise of the expert)

A. Brief introduction (10 minutes)

1. […Get to know each other, explanation about the research…]
2. Can I record the interview? (Start recording)
3. If I would ask you to rate yourself on the scale from 1 (Familiar with the subject) to 10 (Total expert, on all fronts), which grade would you give yourself?
4. Discussing experience with shared micromobility and the role of the expert/company regarding the subject.
5. […Continue to next section…]

B. Effect and influencing factors of shared micromobility services (15 minutes)

1. Which main benefits/goals would you relate to shared micromobility (Name for example the 3 most important)? Are these advantages mainly for areas in the city or also for the region and medium to small sized towns?
2. Do the introduction of shared micromobility have downsides as well?
3. What are the most important components/factors that play a major role in making a project successful (May the question not be fully understood, use some of the following examples: Number of providers within the service area, the presence of public transport, target group etc.)?
4. Can you name factors that make a project unattractive, or in other words, what are reasons for projects to stop?
5. According to the mentioned benefits and factors, do you recognize differences between behavior/cultures in different areas or countries?

C. The service (15 minutes)

1. Looking at three types of transport; shared bikes, shared e-bikes and shared moped. Which one fits best in the regions outside the city? *Ask for substantiation.*
2. And what about the system (Back-to-one, back-to-many or free-floating)? Which of these three is preferable, based on what reasoning? Or is a combination interesting?
3. What are the impacts and potential pros and cons of implementing free access to shared micromobility?
4. *[Provider of shared micromobility]* How many trips are needed for a good business case (Per bike/e-bike/moped per day), how does this relate the fleet size and total service area?
5. Redistributing vehicles is expensive and time consuming, what measures can be taken to make this happen naturally by the user?
6. When redistributing the shared vehicles, would it be better to only place them at main mobility hubs and PT stops or would it be good to have 1 or 2 bikes at other locations as well?

7. What are the preconditions for allowing shared transport in the municipality?
8. To what extent can shared mobility play a role in the regional function between city and villages, or large and smaller municipalities?

D. Trips and users (15 minutes) *[Mainly for providers of shared micromobility]*

1. What kind of trips are most common outside the city (Suburban areas)? For example commuting (Trips within peak hours), evening trips, day of week, etc.
2. Which specific areas generates high trip demand? (Such as university campuses, beachfronts, shopping centers, and other notable locations)
3. What proportion of the trips involve substituting or complementing of public transportation?
4. Do you see differences between national public transport stops (Train stations) or local stops (Bus stops)?
5. What are the typical users of shared services?
6. How many meters is someone willing to walk to an (electric) shared bicycle/moped?
7. What is the average duration of a trip on an (electric) shared bicycle/moped?
8. What is the average trip length in kilometers on an (electric) shared bicycle/moped?
9. Is there a difference in use between the two types of shared mopeds, for example, is the moped (yellow license plate and 45 km/h) used more or less than the light moped? And how do the average ride lengths in kilometers compare to each other?

E. Other topics (15 minutes)

1. Are you familiar with the concept of 'transport poverty', which refers to situations where individuals face challenges accessing essential services and opportunities due to inadequate transportation options. Considering the extent of transport poverty in the Netherlands (e.g., where 40% of jobs are difficult or impossible to reach without a car), to what degree do you believe shared micromobility can play a role in mitigating transport poverty in the country?
2. What impact would the implementation of designated physical parking spaces for shared micromobility have? Do you prefer this approach, or do you think it would be better to allow shared bicycles to be placed in general bicycle racks without specific signage or lines?
3. Shared parking spaces per operator or one dedicated place for all operators?
4. What do you think about the application of MaaS, what are potential benefits or downsides?
5. What would be a good approach for implanting MaaS, according to your opinion and expertise? Do you have real-life examples?
6. In your perspective, should shared micromobility be classified as part of public transportation or as a distinct transportation modality?

F. Finalizing (5 minutes)

1. What are your insights into the future of shared bicycles and scooters in the Netherlands? And how do you see the role of ...[Company/Concept]... in this?
2. Interesting documents or other persons that I could contact for an interview?

C. Interviewee statements

- Next page -

Expert	Expert Group	ID	Statements	Code	Subcategory
Anne van der Veen	Consultancies	[1:1]	*9*	Expert scale	
		[1:2]	*Hoofddoel deeltweewielers: Toename in mobiliteitsopties, wat bijdraagt aan het verkleinen van de afhankelijkheid van de auto.*	Benefit shared micromobility	Effect shared micromobility
		[1:3]	*Andere voordelen: Duurzame mobiliteit, beter ruimtegebruik.*	Benefit shared micromobility	Effect shared micromobility
		[1:4]	*Deel E-bike & Deelscooter kunnen een goede brug zijn tussen de regio en de stad, dus tussen dorpen en stadcentra.*	Benefit shared micromobility	Effect shared micromobility
		[1:5]	*Back-to-one systeem is momenteel alleen gekoppeld aan een normale fiets, voor e-bikes en scooters is de prijsstelling daarvoor te hoog.*	Back-to-One	Sharing system
		[1:6]	*Voor deelaanbod in dorpen en andere laag stedelijke gebieden is een combinatie van back-to-one en back-to-many het meest voor de hand liggend, free-floating is minder geschikt. Hierbij is het belangrijk dat er op regionaal OV wordt aangesloten.*	Hybrid system	Sharing system
		[1:7]	*Voordelen van MaaS zijn o.a., vindbaarheid van deelvoertuigen en het daadwerkelijk simpel kunnen boeken van je gehele reis*	Pros MaaS	MaaS
		[1:8]	*Nadelen van MaaS zitten hem vooral in het contractbeheer, de overeenkomsten, abonnementen en digitale overname van nieuwe features.*	Cons MaaS	MaaS
		[1:9]	*Voordeel van Back-to-one is dat het laag in kosten zit, goed voor forensen, waarbij vanaf een centrale plek een gegarandeerde terugrit wordt gemaakt.*	Back-to-One	Sharing system
		[1:10]	*Uit ervaring blijkt het gebruik in het buitengebied tegen te vallen, mogelijke redenen: Te weinig marketing, te moeilijk, drempel voor het downloaden van een app te hoog.*	Suburban demand	Influencing factors
		[1:11]	*Succesfactoren van OV-fiets: Gemak en vindbaarheid, herkenning!*	OV-bike	Type of shared micromobility
		[1:12]	*Voorbeeld Zwolle: E-bikes aanbieder A werden goed gebruikt, maar stonden op een minder logische plek dan e-bike aanbieder B, welke niet tot nauwelijks werden gebruikt. Naamsbekendheid van een project is dus ook een belangrijke factor!*	Familiarity	Service promoting
		[1:13]	*Marketing is een onwijs belangrijk onderdeel, besteed hieraan veel tijd en moeite, bij voorbaat in combinatie met de betreffende gemeente (Voorbeeld flyers in bus).*	Marketing	Service promoting
		[1:14]	*Terughoudend over het gratis aanbieden van de dienst, geeft indruk van een slechte service. Het is belangrijk dat de deelvoertuigen van goede kwaliteit zijn, daarvoor mag betaald worden.*	Free service	Service promoting
		[1:15]	*Verrommeling is minimaal, uit onderzoek in Amsterdam is gebleken dat het aantal verkeerd geparkeerde deelvoertuigen verwaarloosbaar is in vergelijking tot persoonlijke voertuigen.*	Nuisance & cluttering	Public service area
		[1:16]	*Voor één deelvoertuigtype zijn twee aanbieders meer dan voldoende (Per servicegebied).*	Number of operators	Public service area
		[1:17]	*Mogelijke halvering bij overgang free-floating naar back-to-many (Voorbeeld Amsterdam 40%, voorbeeld Utrecht 50%), onder gebruikers heeft free-floating dus wel de voorkeur. Echter heeft back-to-many bij een goede toepassing ook veel potentie. Back-to-many wordt vaak beperkt door het aantal hups, te weinig.*	Free-Floating	Sharing system
		[1:18]	*Back-to-many kent bij een goede toepassing veel potentie. Back-to-many wordt vaak beperkt door het aantal hups (Te weinig).*	Back-to-One	Sharing system
		[1:19]	*Fysieke parkeerplaatsen verhoogd vindbaarheid, maar verlaagd flexibiliteit en verhoogd kosten. Eerst testen op gebruik voordat er dient over te gaan op een fysieke hub.*	Physical parking spaces	Public service area
		[1:20]	*Voorkeur voor meer digitale hubs dan 1 fysieke hub.*	Physical parking spaces	Public service area
		[1:21]	*Voor grote drukke OV locaties kan er worden gekozen voor één logische maar kleine parkeervoorziening en één grotere op grotere afstand.*	Physical parking spaces	Public service area
		[1:22]	*50% van de deelscooter ritten vervangt een auto in Amersfoort.*	Shared moped	Type of shared micromobility
		[1:23]	*40% van ondervraagde in Amersfoort ziet met huidige openbaar vervoer en aanbod van deelvoertuigen geen reden om eigen auto te kopen.*	Benefit shared micromobility	Effect shared micromobility
		[1:24]	*Belangrijkste motief voor deelscooter is het besparen van tijd.*	Shared moped	Type of shared micromobility
		[1:25]	*Klachten van overlast door scooters voor mensen met een visuele beperking of mensen met een rolstoel of rollator, hoe hier mee om gaan?*	Nuisance & cluttering	Public service area
		[1:26]	*Duidelijke afspraken voor klantvriendelijkheid (Klantenservice en handhaving) zijn ook van groot belang voor een goed werkend aanbod: Voorbeelden, verplichte Nederlandse website en bereikbaarheid. Ook telefonisch contact kunnen opnemen voor foutgeparkeerde voertuigen zou verplicht moeten worden. Gemeente dient extra capaciteit vrij te maken bij het accepteren en omarmen van deelmobiliteit.*	Nuisance & cluttering	Public service area
		[1:27]	*Uit onderzoek van gemeente Amersfoort blijkt dat veel mensen een eigen fiets hebben en de elektrische deelfiets gebruiken voor langere afstanden, maar lopen tegen het probleem aan dat ze de fiets niet altijd kunnen gebruiken tot de gewenste locatie.*	Geofencing	Public service area
		[1:28]	*Ritten deelfietsen en scooters namen toe per voertuig per dag toen de omliggende plaatsen Leusden en Soest werden opgenomen in het service gebied, dit zorgde ook voor een toename van de ritlengte.*	Geofencing	Public service area
		[1:29]	*Flyeren aan de deuren kan een goede methode zijn om klanten te overtuigen.*	Marketing	Service promoting
Mobility Advisor	Municipalities	[2:30]	*8*	Expert scale	
		[2:31]	*Uit ervaring is gebleken dat twee aanbieders voor deelscooters binnen één gemeente meer dan voldoende is. Per aanbieder worden er 100 scooters toegelaten.*	Number of operators	Public service area
		[2:32]	*Geofancing wordt gebruikt om gebruikers speciale zones ter beschikking te stellen waar zij hun voertuigen kunnen parkeren. Het doel is te voorkomen dat het stadcentrum vol staat met deelscooters.*	Geofencing	Public service area
		[2:33]	*Deelsysteem van vervoermaatschappij moet gekoppeld zijn aan de systemen van het openvaar vervoer, anders is er geen aansluiting en is het geen verlening voor bus en tram.*	Completing PT	Connection with public transport
		[2:34]	*Hoofdvoordelen van deelvervoer: Bevorderen van bereikbaarheid en leefbaarheid. Efficiënt benutten van de openbare ruimte.*	Benefit shared micromobility	Effect shared micromobility
		[2:35]	*Overige doelen: Verlagen autobezit en autogebruik*	Benefit shared micromobility	Effect shared micromobility
		[2:36]	*Het succes van de OV-fiets laat zien dat er een sterke behoefte is aan mobiliteit die aansluit op het openbaar vervoer om de laatste kilometer naar de bestemming op te vangen.*	Completing PT	Connection with public transport
		[2:37]	*Door het bestaande, hoge fietsgebruik in Nederland is een veel gestelde vraag of er behoefte is aan deelfietsen in Nederland. Toch zijn er diverse situaties waarin deelfietsen een bijdrage kunnen leveren aan het stedelijke mobiliteitssysteem. Denk aan de aanvulling op het voor- en natransport van het openbaar vervoer.*	Completing PT	Connection with public transport
		[2:38]	*Voor een belangrijk deel gelden voor elektrische fietsen dezelfde overwegingen als voor reguliere fietsen. Door het grotere fietsgemak en de actieradius zal een elektrische fiets een brede doelgroep aanspreken dan de reguliere fiets, en zowel een stedelijke als regionale functie kunnen vervullen.*	Shared e-bike	Type of shared micromobility
		[2:39]	*Nog meer dan bij de elektrische fiets zullen elektrische brom- en snorfietsen door hun gebruiksgemak en actieradius kunnen voorzien in regionale verplaatsingen. Deze voertuigen zijn vooral populair onder jongeren en studenten.*	Shared moped	Type of shared micromobility
		[2:40]	*MaaS kent veel potentie, waarbij voornamelijk gebruiksvriendelijkheid centraal staat. 9292 zou een voordehand liggende app zijn om als MaaS te fungeren.*	Pros MaaS	MaaS
		[2:41]	*Eén app voor de gehele randstad zou interessant kunnen zijn. Jelbi in Berlijn is een mooi voorbeeld van MaaS, net als RATP Bonjour van Parijs. Beide apps worden gepubliceerd door de lokale vervoerders. In deze steden wordt deelmobiliteit gezien als onderdeel van het OV.*	Pros MaaS	MaaS
		[2:42]	*Delft gaat aan de slag met fysieke deelparkeerplaatsen. Naast Berlijn en Parijs is Wenen een goed voorbeeld voor de toepassing van hubs. Verdeling tussen stationhubs, bushubs en mini hubs (Buurt hub).*	Physical parking spaces	Public service area
		[2:43]	*Het gratis maken van deelvervoer is niet de oplossing. Het is belangrijk dat het product in goede staat is, dit voorkomt dat gebruikers niet goed omgaan met het product. Een op een station gebaseerde oplossing lijkt vandalisme te verkleinen.*	Free service	Service promoting
Sven Boor	Consultancies	[3:44]	*8*	Expert scale	
		[3:45]	*Deelmobiliteit maakt OV robuuster, het biedt een alternatief voor bijvoorbeeld de privéauto, een combinatie van beide (Deelvervoer en OV) geeft het beste alternatief.*	Benefit shared micromobility	Effect shared micromobility
		[3:46]	*Andere voordelen gedeelde tweewielers: Flexibiliteit, meer opties, geen overstaptijd, verminderen 2e en 3e fiets.*	Benefit shared micromobility	Effect shared micromobility
		[3:47]	*Beperkte invloed op de vervoersarmoede in Nederland, huidige gebruiker is namelijk jonge laagopgeleide man (Merendeels).*	Transport poverty	Effect shared micromobility
		[3:48]	*Modaliteit aanbieden buiten de stad: Normale deelfiets meest voor de hand liggend, lage kosten (In combinatie met OV).*	Shared bike	Type of shared micromobility
		[3:49]	*OV-fiets werkt marktverstorend en remt nieuwe ontwikkeling.*	OV-bike	Type of shared micromobility
		[3:50]	*Een eigen fiets in elke stad (Voordeel deelmobiliteit)!*	Benefit shared micromobility	Effect shared micromobility
		[3:51]	*De beschikbaarheid van een aanbieder over Nederland is ook belangrijk voor het gebruik, dit stimuleert herkenbaarheid.*	Familiarity	Service promoting
		[3:52]	*Nadeel OV-fiets: Grote instapdrempel om OV-fiets te mogen gebruiken (Lastig voor toeristen).*	OV-bike	Type of shared micromobility
		[3:53]	*Deelsysteem: Back-to-many in combinatie met mogelijkheid van fiets langer vast te houden.*	Hybrid system	Sharing system
		[3:54]	*Voor regio en dorpen zou het interessant zijn lokale mensen bij het aanbod te betrekken, gratis gebruik door bepaalde groep mensen.*	Free service	Service promoting
		[3:55]	*Gewone deelfiets meest kosteneffectief en duurzaam voor regio en dorpen.*	Shared bike	Type of shared micromobility
		[3:56]	*Deelsysteem: Back-to-many geschikt voor hoog stedelijk gebied en laag stedelijk en free-floating goed geschikt voor gematigd stedelijk gebied (Stad opgedeeld in drie schillen).*	Hybrid system	Sharing system
		[3:57]	*Lokale mensen zelf zorg laten bijdragen aan het systeem, eigenaarschap en verantwoordelijkheid ondervangen.*	Resident participation	Public service area
		[3:58]	*Stations fiets niet meer nodig, hiervoor is de deelfiets aantrekkelijker.*	Benefit shared micromobility	Effect shared micromobility
		[3:59]	*Swapfiets 18,50 per maand, deelfiets voor bijvoorbeeld 20 euro in de maand als abonnement.*	Marketing	Service promoting
		[3:60]	*Willingness to pay is lager voor een deelfiets dan voor een deelscooter.*	Marketing	Service promoting
		[3:61]	*Bij het starten van een nieuw project is het verstandig om te starten met weinig fietsen per locatie, maar met meer geografische spreiding. Op deze manier testen waar er behoefte is en daar uitbreiden.*	Mobility hubs	Public service area
		[3:62]	*Tegen nieuwe deelfiets projecten van OV aanbieders: Momenteel geen koppeling tussen deelfiets en OV, geen combi abonnementen etc.*	PT shared bike	Connection with public transport
		[3:63]	*MaaS geen heilige graal meer.*	Status MaaS	MaaS
		[3:64]	*Nadeel MaaS: Alle nieuwe ontwikkelingen van deelaanbieders dienen overgenomen te worden door MaaS-partij.*	Cons MaaS	MaaS
		[3:65]	*Voordeel MaaS : Drempel verlagen voor gebruik in nieuwe omgeving met een nieuwe aanbieder.*	Pros MaaS	MaaS
		[3:66]	*De overheid de meest aangewezen partij voor een ontwikkeling van MaaS.*	Status MaaS	MaaS
		[3:67]	*Fysieke parkeerplaatsen zorgen voor herkenning van de digitale werkelijkheid. Zeker rondom stations erg interessant.*	Physical parking spaces	Public service area
		[3:68]	*Foto maken kan zorgen voor naleving en dus vermindering van deelvoertuigen op ongewenste locaties.*	Nuisance & cluttering	Public service area
Bram Nieuwstraten	Transport authorities	[4:69]	*7*	Expert scale	
		[4:70]	*Deelmobiliteit is vanuit het Rijk (Den Haag) nog niet geregeld, wat betekend dat het een gemeentelijke aangelegenheid is, want het valt onder de openbare ruimte.*	Responsibility SMM	Regulations shared micromobility
		[4:71]	*Belangrijk om bepaalde randvoorwaarden op te nemen in een artikel in de APV per gemeente. Zonder deze voorwaarden is elke aanbieder welkom in de betreffende gemeente. Veel gemeente weten dit wel, maar hebben dit vaak niet geregeld, afgezien van grote gemeente zoals Amsterdam, Leiden, etc.*	Regulations SMM	Regulations shared micromobility
		[4:72]	*Landelijke regeling zou beter zijn, gemeente grens zou geen gebruikersgrens moeten zijn!*	Geofencing	Public service area
		[4:73]	*Uniformiteit op de achtergrond, zodat de gebruiker gemak heeft op de voorgrond.*	Regulations SMM	Regulations shared micromobility
		[4:74]	*Voordelen deelmobiliteit: Flexibiliteit, minder gebonden aan dienstregeling en routes (Ontsluitende lijn: Basis voorziening of OV hoogwaardig maken).*	Benefit shared micromobility	Effect shared micromobility
		[4:75]	*OV Gaat naar waar je niet wilt zijn, naar een andere plek waar je niet wilt zijn (Kortgezegd). Deelvervoer kan dit gedeeltelijk verbeteren.*	Benefit shared micromobility	Effect shared micromobility
		[4:76]	*Een auto leasen is heel aantrekkelijk, dit zou anders geregeld moeten zijn, beloning OV of deelmobiliteit, auto leasen wordt momenteel (Bedoeld of onbedoeld) gestimuleerd.*	Regulations SMM	Regulations shared micromobility
		[4:77]	*Fiets op eigen kracht past goed buiten de stad, maar elektrische fiets wint het waarschijnlijk van eigen kracht, mensen zoeken comfort en snelheid.*	Shared e-bike	Type of shared micromobility
		[4:78]	*Geen groot onderscheid tussen scooter en elektrische fiets.*	Shared e-bike; Shared moped	Type of shared micromobility
		[4:79]	*Ruimte en leefbaarheid: Kleinste voertuig in de stad en grotere voertuigen buiten de stad.*	Sharing type	Type of shared micromobility
		[4:80]	*Centrum stedelijk: Free-Floating, hoog stedelijk alleen back-to-many (Grote regulatie). Voorbeeld Antwerpen: Binnen gebied beperkt parkeren, schil vrij parkeren en weer erbuiten vaste gebieden (Eilanden).*	Hybrid system	Sharing system
		[4:81]	*Bij een tekort aan parkeerplaatsen voor privéfietsen is het niet handig om deelfietsparkeerplaatsen te realiseren.*	Physical parking spaces	Public service area
		[4:82]	*Noorwegen: gemeenten bepaald zelf geofencing en kan dat handmatig aanpassen per moment.*	Geofencing	Public service area
		[4:83]	*Mobiele fietsenrekken interessant voor deelfiets plekken.*	Physical parking spaces	Public service area
		[4:84]	*Niet elke aanbieder eigen fietsenstalling geven (Verandering van naam, komen en gaan van aanbieders, etc).*	Physical parking spaces	Public service area
		[4:85]	*Vindbaarheid deelvoertuigen vergroten door bijvoorbeeld het voertuig een geluid te laten maken bij het reserveren.*	Parking vehicles	Public service area
		[4:86]	*Voordeel van MaaS is het verminderen van het aantal apps op mobiel, maar dit is in meeste gevallen niet mogelijk bij MaaS.*	Pros MaaS	MaaS
		[4:87]	*Markt in het geheel vooruit helpen door in de huidige apps van de aanbieders mogelijkheden te creëren om ook andere aanbieders te gebruiken.*	Status MaaS	MaaS
		[4:88]	*Alle mobiliteit ontsluiten via 1 app is te moeilijk (Te moeilijk gebleken).*	Cons MaaS	MaaS
		[4:89]	*Goed voorbeeld: Berlijn Jelbi: Bijnaam vervoersbedrijf.*	Status MaaS	MaaS
		[4:90]	*Belangen per partij te groot voor de MaaS.*	Cons MaaS	MaaS
		[4:91]	*Op een bepaalde manier stimulans creëren bij de aanbieder is goed. Vanaf zoveel ritten krijg je een bepaalde hoeveelheid geld en tot op een bepaald aantal ritten vervalt dat weer.*	Funding	Service promoting
		[4:92]	*Pilot van 1 jaar is te kort, 3 of 4 jaar is meer voor de hand liggend met een grotere kans van succes.*	Project duration	Sharing service

Manager	Shared micromobility operators	[5:93]	*7*	Expert scale	
Manager	Shared micromobility operators	[5:94]	*8*	Expert scale	
		[5:95]	*Main goal of shared micromobility (e-bikes) is replacing the car, providing an alternative, applicable for the city as well as for the region*	Benefit shared micromobility	Effect shared micromobility
		[5:96]	*Another benefit is reducing space, applicable for the city as well as for the region*	Benefit shared micromobility	Effect shared micromobility
		[5:97]	*To reduce costs Bondi tries out new ideas, for example automatic recharge tiles*	Innovation	Public service area
		[5:98]	*2 operators within the same region is enough for good operation, in our opinion this applies for the operator as well as for the users of the system.*	Number of operators	Public service area
		[5:99]	*The average trip length is 11 minutes for the shared e-bikes*	Trip duration	Trips and behavior
		[5:100]	*You can see morning and afternoon peaks in the data, so one of the uses is the so called commuting trip (From/to work)*	Trip moment	Trips and behavior
		[5:101]	*Most trips are generated around the train stations*	Trip location	Trips and behavior
		[5:102]	*Considering the high operational costs, shared e-mopeds may be disproportionate for suburban and rural areas, the same applies for e-bikes. E-steps would be a more feasible option or normal bikes.*	Shared bike	Type of shared micromobility
		[5:103]	*Back-to-many creates understanding for the users, where to find the vehicles and where to put them after using it. Example of London: With a Back-to-many system, including a lot of hubs*	Back-to-Many	Sharing system
		[5:104]	*Regarding business parks, we recommend creating one spot in the middle of a working area, instead of free-floating*	Back-to-Many	Sharing system
		[5:105]	*Designated physical parking spaces for shared vehicles needs to be an iterative process; in which the first step is to check the data, after which the main locations can be equipped with physical parking spaces.*	Physical parking spaces	Public service area
		[5:106]	*We are both positive to outside physical parking spaces*	Physical parking spaces	Public service area
		[5:107]	*Free use of shared bikes only works by making the first 20 minutes for free, as a trial offer for a certain period or a number of times. Don't make the time too long for the free bikes/scooters.*	Free service	Service promoting
		[5:108]	*Currently the Netherlands have too many MaaS-apps. The concept of MaaS could work in the particular case that one big area (Randstad or the Netherlands) have one main app.*	Status MaaS	MaaS
		[5:109]	*For the operator MaaS would work by creating more users, but at the moment it have no benefits at all.*	Pros MaaS	MaaS
		[5:110]	*Downside of MaaS is the loss of control over the users.*	Cons MaaS	MaaS
		[5:111]	*2.5+ e-bike trips per day on average (min. 100 fleet size) for a good business case*	Trips per day	Sharing service
		[5:112]	*Automatic redistribution of bikes could be arranged by giving bikes a discount (For example, if they stand still for a long time or have been left behind in outside areas)*	Redistribution	Sharing service
		[5:113]	*Avoiding small streets in the geofencing, because bikes will be overlooked in smaller streets*	Geofencing	Public service area
		[5:114]	*Redistribution of bikes: Only place bikes at bigger hubs and public transport stops, but this is depending on the day of the week (For example place bikes in the malls on the weekends)*	Redistribution	Sharing service
		[5:115]	*People are willing to walk around 250 meter to an E-Bike, if the distance is larger, more than 50% of the people close the app*	Willingness to walk	Trips and behavior
		[5:116]	*The average trip distance is 2.1km*	Trip distance	Trips and behavior
		[5:117]	*Taking photo after trip: Works already as human psychology, and do random checks, furthermore you can introduce thumps up and down for the way of parking of the previous user*	Parking vehicles	Public service area
Business Developer	Shared micromobility operators	[6:118]	*7*	Expert scale	
		[6:119]	*Belangrijkste voordelen deelfiets: Flexibel vervoer op alle plekken in Nederland, Last-mile voor openbaar vervoer.*	Benefit shared micromobility	Effect shared micromobility
		[6:120]	*Ander voordeel: Verbinding tussen relatief kleine gemeenten, hierbij is de samenwerking tussen de gebieden (Gemeenten) erg belangrijk (Mooi voorbeeld Antwerpen).*	Benefit shared micromobility	Effect shared micromobility
		[6:121]	*Het klinkt voor de handliggent, maar de belangrijkste factor voor een succesvolle dienst is het daadwerkelijke gebruik, zonder gebruik geen deelfietsen.*	Usage suburban areas	Influencing factors
		[6:122]	*Gezonde business: 2 ritten per fietsen per dag, onder de 1 rit per fiets per dag is onvoldoende. Gemiddeld gebruik per fiets per dag hangt niet af van de vlootgrootte.*	Trips per day	Sharing service
		[6:123]	*Bij wens van deelfiets aanbod kan laag gebruik worden opgevangen door subsidies.*	Funding	Service promoting
		[6:124]	*Analyse van nieuwe interessante gebieden kan worden gedaan op basis van app-openingen, regio zonder hubs kunnen op basis van deze informatie worden aangevuld.*	Geofencing	Public service area
		[6:125]	*Toerisme en studenten zorgen voor een grote vraag van deelfietsen (Ook Expats).*	Demand	Influencing factors
		[6:126]	*Abonnementen op deelfietsen zijn een goed alternatief op eigen fiets of Swap fiets. Een eigen fiets in elke stad van Nederland (En zelfs buiten Nederland).*	Marketing	Service promoting
		[6:127]	*Forensen (Woon-werkverkeer) zijn ook interessant voor de deelfiets. Ook te zien aan succes OV-fiets, echter geeft een back-to-many meer flexibiliteit t.o.v. back-to-one.*	Demand	Influencing factors
		[6:128]	*Infrastructuur heeft grote impact op het gebruik (Boedapest genoeg toerisme, maar onvoldoende fietspaden). Daarnaast gaan veel toerisme naar Nederland toe om te fietsen en ook cultuur is belangrijk (Nederlanders ademen het fietsen)*	Geography	Influencing factors
		[6:129]	*Aanbieders: 2 en maximaal 3 aanbieders en in kleine gemeenten is 1 aanbieder per modaliteit meer dan voldoende.*	Number of operators	Public service area
		[6:130]	*Maak de operationele papierwerk zo makkelijk mogelijk, Amsterdam creëert een te moeilijke situatie voor fietsaanbieders (En tevens de gebruikers). Toegang verlenen tot delen van de stad en niet tot binnenstad, zoals in Amsterdam, is een ongewenste situatie.*	Geofencing	Public service area
		[6:131]	*Goed organiseren van de deelfietsen wordt steeds belangrijker, d.m.v. rapportages maandelijks bespreken en goede communicatie tussen gemeente en aanbieder is belangrijk.*	Organize SMM	Regulations shared micromobility
		[6:132]	*Diefstal relatief laag in Nederland voor deelfietsen.*	Robbery	Sharing service
		[6:133]	*Regio gebieden zijn meest geschikt voor E-bikes (populairder en meer vraag), uit ervaring in andere landen.*	Demand	Influencing factors
		[6:134]	*Verwachting is dat de doelgroep van autogebruik eerder zal overstappen naar E-bikes t.o.v. deelfietsen.*	Alternative to car	Influencing factors
		[6:135]	*Een mix tussen normale fietsen en elektrische fietsen zou goed zijn, door het verschil in prijs en afstand.*	Shared bike; Shared e-bike	Type of shared micromobility
		[6:136]	*Aanbevolen wordt een back-to-many, waarbij zeer hoog bevolkte gebieden een aantal centrale hubs heeft, hoog bevolkte gebieden meer hubs hebben en laag bevolkte gebieden opnieuw minder hubs hebben.*	Back-to-Many	Sharing system
		[6:137]	*Informatie over mogelijkheden belangrijk, je kan de fiets gebruiken voor een korte rit van bijvoorbeeld een kwartier of half uur, maar je kan ook de fiets de gehele dag bij je houden, net als een OV-fiets (Open de fiets, sluit de app en kijk aan het eind van de dag weer, creëer interessante prijs hiervoor). Back-to-many kan dus altijd worden aangevuld met een back-to-one systeem.*	Hybrid system	Sharing system
		[6:138]	*Data geeft inzicht in twee grote groepen: Veel Last-mile gebruik en ook dagjes mensen. Veel gebruik kwartier of half uur en vervolgens een grote groep gebruik hele dag.*	Trip duration	Trips and behavior
		[6:139]	*Toekomstplannen voor fietsen die zonder telefoon geopend kunnen worden, onderzoek markt naar de mogelijkheden.*	Innovation	Public service area
		[6:140]	*Toekomstplannen: Korting geven aan fietsen die zich bevinden in het buitengebied*	Innovation	Public service area
		[6:141]	*Deelfietsen stimuleren door het gebruik gratis te maken kan interessant zijn, bijvoorbeeld om vervoersarmoede te verlagen, zeker voor landelijke gebieden.*	Free service	Service promoting
		[6:142]	*Voor E-bikes is het gratis ritten maken veel lastiger, meer ritten is niet perse beter voor de aanbieder, dit is niet het geval bij normale deelfietsen*	Shared bike; Shared e-bike	Type of shared micromobility
		[6:143]	*Werknemers moeten echt gestimuleerd worden om de deelfiets te gebruiken, alleen bij gratis gebruik vanuit subsidie of werk zal een werknemer elke dag de deelfiets gebruiken in de ketenreis.*	B2B	Sharing service
		[6:144]	*MaaS heeft voordelen en mogelijkheden, maar op dit moment teveel problemen. Op dit moment in Nederland nog een succesvolle MaaS-app.*	Status MaaS	MaaS
		[6:145]	*Weinig tot geen gebruik vanuit MaaS, functionaliteit minder in MaaS dan in eigen app*	Cons Maas	MaaS
		[6:146]	*Fysieke locaties buiten: Positief voor herkenbaarheid voor drukke locaties, of locaties met druk op de openbare ruimte. Enige nadeel is het verminderen van flexibiliteit. Eerst aftasten en aan de hand van ervaring definitief maken.*	Physical parking spaces	Public service area
		[6:147]	*Meer verantwoordelijkheid leggen bij aanbieder, hen de vertrouwen geven dat ze hun best doen om het systeem op een goede manier zonder klachten te laten draaien en bij teveel overlast aansturing vanuit de gemeente (Niet andersom).*	Responsibility SMM	Regulations shared micromobility
		[6:148]	*Bij een reguliere fiets zijn mensen 150 meter bereid te lopen, wanneer de afstand naar een deelfiets meer dan 150 meter is haken 80% van de gebruikers af.*	Willingness to walk	Trips and behavior
		[6:149]	*Voor e-bikes is de afstand die gebruikers bereid zijn te lopen 225 meter.*	Willingness to walk	Trips and behavior
		[6:150]	*Gemiddeld huren gebruikers een E-bike 239,8 minuten, dit hoge gemiddelde komt door het relatief hoge percentage (8%) van verhuringen van 24 uur of langer, het gemiddelde over de verhuurperiodes 15 minuten, 30 minuten & 1 uur bedraagt 22,8 minuten (Gelijk aan 73% van de ritten)*	Trip duration	Trips and behavior
		[6:151]	*Gemiddeld huren gebruikers een pedal-bike 198,3 minuten, dit hoge gemiddelde komt door het relatief hoge percentage (5%) van verhuringen van 24 uur of langer, het gemiddelde over de verhuurperiodes 15 minuten, 30 minuten & 1 uur bedraagt 20,7 minuten (Gelijk aan 76% van de ritten)*	Trip duration	Trips and behavior
		[6:152]	*Gemiddeld gebruiken ze de E-bike voor 9,1km, waarbij 53,7% van de ritten meer dan 5 kilometer lang zijn*	Trip distance	Trips and behavior
		[6:153]	*Gemiddeld gebruiken ze de pedal-bike voor 4,8km, waarbij 25,0% van de ritten meer dan 5 kilometer lang zijn*	Trip distance	Trips and behavior
Commercial Transportation Manager	Public transport providers	[7:154]	*8*	Expert scale	
		[7:155]	*Vanuit de openbaar vervoer aanbieder willen wij de gehele ketenreis faciliteren, van deur tot deur. Hier past deelvervoer goed bij.*	PT shared bike	Connection with public transport
		[7:156]	*Een aantrekkelijker ketenreis is snel en comfortabel, first en last mile lopen maakt de reis te lang en daardoor onaantrekkelijk. Slecht alternatief t.o.v. de auto.*	Alternative to car	Influencing factors
		[7:157]	*Nadeel van deelmobiliteit, momenteel alleen te verkrijgen op gebieden waar veel openbaar vervoer is.*	Downside shared micromobility	Effect shared micromobility
		[7:158]	*Succesfactoren zijn groot bij Witte OV vlekken: Afgelegen bedrijventerreinen, maar ook bij woonwijken die minder goed zijn ontsloten*	Success factors	Influencing factors
		[7:159]	*Afstappen van Free-Floating in drukke binnensteden, maar in buiten wijken zou free-floating misschien weer wel mogelijk zijn. Wanneer deelmobiliteit ingezet wordt in woonwijken die minder goed ontsloten zijn is Free Floating echt een must.*	Free-Floating	Sharing system
		[7:160]	*Deelmodaliteit heel erg afhankelijk van de afstand, korte ritten goed te doen met deelfiets.*	Shared bike	Type of shared micromobility
		[7:161]	*Deelscooter niet bedoeld voor first en last mile oplossing voor regionaal vervoer.*	Shared moped	Type of shared micromobility
		[7:162]	*Subsidie belangrijk om te zorgen voor een deelsysteem als aanvulling op het openbaar vervoer.*	Funding	Service promoting
		[7:163]	*Gemiddeld 2 ritten per dag per fiets voor break-even-point.*	Trips per day	Sharing service
		[7:164]	*2 ritten per dag gratis gebruik voor forensen zou een oplossing kunnen zijn voor het stimuleren van de gehele ketenreis.*	Free service	Service promoting
		[7:165]	*Negatieve factoren deelfietsen: Geen garantie op een fiets, te weinig zones, woongebieden minder behoefte.*	Downside shared micromobility	Effect shared micromobility
		[7:166]	*Deelmobiliteit gebruiken als OV niet rijdt, flexibiliteit.*	Benefit shared micromobility	Effect shared micromobility
		[7:167]	*Meer fietsen bij zones die populairder zijn, klinkt logisch, maar is niet altijd mogelijk.*	Trip location	Trips and behavior
		[7:168]	*Hoog aantal diefstal of vandalisme bij Deelfiets project in Den Haag (verschilt per stad/gebied/wijk), werd verminderd door toevoeging GPS.*	Robbery	Sharing service
		[7:169]	*Deelaanbieders krijgen niet dezelfde kansen bij grote treinstations, remt ontwikkeling en gebruik andere fietsen.*	Organize SMM	Regulations shared micromobility
		[7:170]	*Vervoeraanbieder ziet voordelen in het kenbaar maken van deelparkeerplaatsen. Hiervoor zijn aanpassingen noodzakelijk aan de buitenruimte, waar de gemeente voor open moet staan.*	Physical parking spaces	Public service area
		[7:171]	*Fysieke dropzones pas realiseren na goed gebruik en goede ervaringen.*	Physical parking spaces	Public service area
		[7:172]	*Huidige MaaS integraties kennen geen grote voordelen. Werkt alleen met volledige integratie. Faciliteren van gehele ketenreis zou erg prettig zijn, maar of dat gaat lukken met een externe partij? Het grote OV bedrijf uit de regio zou hiervoor een betere oplossing zijn, blijkt ook uit diverse voorbeelden uit andere Europese steden.*	Status MaaS	MaaS
		[7:173]	*Seizoenspartonen zijn duidelijk te zien bij het gebruik van deelfietsen*	Trip moment	Trips and behavior
		[7:174]	*Belangrijkste factoren voor een goed werkend systeem: Zekerheid belangrijk, garantie van een fiets.*	Success factors	Influencing factors
		[7:175]	*De verrommeling van deelfietsen is verwaarloosbaar t.o.v. alle auto's in de steden en dorpen. Toch is het imago van auto's in het straatbeeld beter dan van deelfietsen.*	Nuisance & cluttering	Public service area
Dennis Vlught	Public transport providers	[8:176]	*8*	Expert scale	
		[8:177]	*Van bezit-economie naar deel-economie: Duurzame mobiliteit voor iedereen beschikbaar maken.*	Benefit shared micromobility	Effect shared micromobility
		[8:178]	*Risico's: Zonder goede organisatie, meer overlast dan gemak.*	Organize SMM	Regulations shared micromobility
		[8:179]	*Grote invloed op vervoersarmoede, vanuit de praktijk, zowel voor de stad als de regio. Ook in de stad locaties die minder bereikbaar zijn.*	Transport poverty	Effect shared micromobility
		[8:180]	*Onderdeel van openbaar vervoer: Deelmobiliteit valt binnen OV.*	Completing PT	Connection with public transport
		[8:181]	*Aparte concessie of binnen OV concessie: Geen directe voorkeur.*	Regulations SMM	Regulations shared micromobility
		[8:182]	*We moeten doen waar we goed in zijn en daar valt momenteel deelvervoer niet onder, wij zijn goed in openbaar vervoer en zoeken voor andere zaken partners.*	Responsibility SMM	Regulations shared micromobility
		[8:183]	*Gekozen voor de toepassing van reguliere deelfiets, vanwege lagere operationele kosten. Laagdrempelig systeem. Minder risico op diefstal en vandalisme.*	Shared bike	Type of shared micromobility
		[8:184]	*Gekozen voor Back-to-Many, maar met de mogelijkheid om het product relatief goedkoop te kunnen aanbieden als Back-to-One.*	Back-to-Many	Sharing system
		[8:185]	*Altijd de voorwaarden gehad om geen free-floating te gebruiken. Waar aanbieders en gebruikers veeal wel de voorkeur aan geven.*	Free-Floating	Sharing system
		[8:186]	*Voordeel: Alternatief voor tweede fiets of station fiets.*	Shared bike	Effect shared micromobility
		[8:187]	*Vrijheid van alternatieve terugreis bij Back-to-Many, meer flexibiliteit.*	Back-to-Many	Sharing system
		[8:188]	*Het idee is om OV abonnement koppelen aan deelfietsen.*	Role of PT	Connection with public transport
		[8:189]	*Streven naar minimum 1 rit per fiets per dag.*	Trips per day	Sharing service
		[8:190]	*Er gaat niet voldoende aandacht naar het belang van de deelfietsen.*	Funding	Service promoting
		[8:191]	*Elke hub krijgt aantal voorkeursfietsen en een maximum aantal (Gebaseerd op het aantal mogelijk parkeerplaatsen).*	Mobility hubs	Public service area
		[8:192]	*Gehele organisatie betrekken bij het instandhouding van de fietsen, dus controleren, melden, herplaatsen, goed zetten, etc.*	Nuisance & cluttering	Public service area
		[8:193]	*Ingeregeld dat er via de gemeenteapp melding kan worden gedaan voor overlast (Meldingsapp).*	Nuisance & cluttering	Public service area
		[8:194]	*Toerisme positief voor deelsysteem, ook bij evenementen, geen significant gebruik bij MBO of HBO scholen.*	Trip location	Trips and behavior
		[8:195]	*Veel gebruik in combinatie met OV en P+R.*	Trip location	Trips and behavior
		[8:196]	*Geen stimulans voor automatische herverdeling door gebruikers.*	Redistribution	Sharing service
		[8:197]	*Gratis gebruik alleen voor korte uitzonderlijke periode. Geen geloof in gratis beschikbaar stellen van diensten voor langere periode, er mag betaald worden voor een goed product.*	Free service	Service promoting
		[8:198]	*Moeilijk om bedrijven te betrekken bij de deelfietsdienst, geen effect om bedrijven zelf aan te schrijven, mogelijk in combinatie met gemeente meer succes.*	B2B	Sharing service
		[8:199]	*Combinatie waterbus ook zichtbaar.*	Completing PT	Connection with public transport
		[8:200]	*Observatie: Minder ritten in de ochtend, meer in middag en avond.*	Trip moment	Trips and behavior
		[8:201]	*Handhaving belangrijk bij fysieke locaties buiten. Zonder handhaving geen goede ervaring bij fysieke locaties buiten, worden veel gebruikt door privé fietsen. In ieder geval toepassen op grote locaties, zoals OV hubs, daar is 'misbruik' het grootst.*	Physical parking spaces	Public service area
		[8:202]	*Weinig gebruik via MaaS-app, hierdoor momenteel weinig toegevoegde waarden.*	Cons MaaS	MaaS
		[8:203]	*Stadslijn (Bus) minder combinatie met deelfietsen dan bij treinstation of R-net.*	Completing PT	Connection with public transport

Mobility Advisor	Municipalities	[9:204] *7*	Expert scale	
Task Manager Sustainable Mobility	Municipalities	[9:205] *8*	Expert scale	
		[9:206] *Ervaring deelfietsen Leiden: Deelfiets project Hellobikes: Zonder marketing en zonder goede kwaliteit: Dus geen goed resultaat, slechte start in gemeente Leiden. Fietsen werden gestald in kelder zonder GPS*	Negative influences	Influencing factors
		[9:207] *Leiden hanteert een streng vergunningstelsel om verrommeling te voorkomen.*	Nuisance & cluttering	Public service area
		[9:208] *Randvoorwaarden om deeltweewielers toe te laten; geen free-floating en maximum aantallen. Daarnaast duidelijk overstap vanuit de auto naar deelmobiliteit (Stomp-principe).*	Pre-conditions	Sharing service
		[9:209] *Openbare ruimte erg belangrijk in Leiden; autoparkeerplaatsen inruilen voor deelmobiliteit.*	Resident participation	Public service area
		[9:210] *Deelfiets potentie voor OV-locaties en P+R.*	Shared bike	Type of shared micromobility
		[9:211] *Scooter alleen mogelijk voor regionale deelfunctie.*	Shared moped	Type of shared micromobility
		[9:212] *Free-floating geen optie in de binnenstad, wellicht in de buitenwijken. Back-to-many heeft de voorkeur waarbij sturing vanuit inwoners mogelijk is.*	Back-to-Many; Free-Floating	Sharing system
		[9:213] *Groot voordeel: Deelfietsen kunnen druk op fietsenstallingen verminderen*	Benefit shared micromobility	Effect shared micromobility
		[9:214] *Park-Bike locaties ook interessant*	Innovation	Public service area
		[9:215] *Overige voordelen deelmobiliteit: Ruimtemaker, verminderen autogebruik, duurzame mobiliteit*	Benefit shared micromobility	Effect shared micromobility
		[9:216] *Belangrijke rol in de ketenreis voor de gehele regio, stad plus regiogemeenten*	Suburban application	Sharing service
		[9:217] *Vraagtekens bijdrage van deelmobiliteit voor ontsluiting bedrijventerreinen. Geen beeld hoe bedrijven over deelmobiliteit denken: Belangrijk dat het onderdeel van mobiliteitsbeleid wordt.*	Demand	Influencing factors
		[9:218] *Goed als voor en na transport naar Centraal station: Deelvervoer als onderdeel/aanvulling op het openbaar vervoer.*	Completing PT	Connection with public transport
		[9:219] *Deelfiets parkeren in normale fietsparkeerplaatsen; Deelscooter wel voorzien van deelscooter parkeervakken.*	Parking vehicles	Public service area
		[9:220] *Fysiek parkeerplaatsen trekken aandacht en interesse: Zorgt voor marketing. Voorstander van uniformiteit, zelfde hub uitstraling (Landelijke groene borden).*	Physical parking spaces	Public service area
		[9:221] *Grote gemeenten hebben grote rol in regio functie m.b.t. deelvervoer.*	Suburban demand	Influencing factors
		[9:222] *Potentie van MaaS: Onderlinge verbintenis van netwerken, parkeren auto, openbaar vervoer en deelfiets afsluiten in 1 app. Gemeente Leiden heeft geen rol in de ontwikkeling van MaaS.*	Pros MaaS	MaaS
		[9:223] *MaaS zou drempel moeten verlagen om deelmobiliteit te gebruiken voor gebruikers, koppelen van diverse abonnementen en verminderen gegevensuitwisseling, momenteel niet mogelijk. Ook te moeilijk gebleken om alle losse bedrijven aan elkaar te koppelen.*	Status MaaS	MaaS
Manager Public Affairs	Shared micromobility operators	[10:224] *8*	Expert scale	
		[10:225] *Voordelen deelscooters (Stedelijke gebieden): Beter leefbare stad, elektrische voertuigen, minder geluidsoverlast, meer ruimte, minder vervuiling in de stad, verkeersdrukte verminderen.*	Shared moped	Type of shared micromobility
		[10:226] *Mooie quote: "Leefbaarheid door delen"*	Benefit shared micromobility	Effect shared micromobility
		[10:227] *Hoofddoel: Vervangen gemotoriseerde privé voertuigen*	Benefit shared micromobility	Effect shared micromobility
		[10:228] *Nadelen: Momenteel zorgen de deelvoertuigen nog niet voor een directe vermindering van het aantal voertuigen in de stad, dus meer voertuigen i.p.v. minder op het moment. Daarnaast bestaat de kans op verrommeling van de openbare ruimte.*	Downside shared micromobility	Effect shared micromobility
		[10:229] *Ander nadeel: Financieel niet aantrekkelijk voor iedereen, deelvervoer is op dit momenteel een luxeproduct. Openbaar vervoer is in veel gevallen goedkoper, echter moet daarbij wel worden gezegd dat OV in Nederland ook goed wordt gesubsidieerd vanuit de overheid. Dit maakt het voor iedereen financieel toegankelijk. Deelmobiliteit wordt grotendeels ingevuld door de private sector en dienen er dus bepaalde prijzen gerekend te worden om de kosten te kunnen betalen.*	Downside shared micromobility	Effect shared micromobility
		[10:230] *Potentie voor het verminderen van vervoersarmoede, gebieden (Voornamelijk in de regio) kunnen beter worden bereikt door de toepassing van deelscooters.*	Transport poverty	Effect shared micromobility
		[10:231] *Deelscooters zijn geen directe vervanging van buslijnen, tevens krijgen bussen veel subsidie en is dit niet geregeld voor deelvervoer.*	Role of PT	Connection with public transport
		[10:232] *Belangrijk om nationaal duidelijke vergunningen te maken, eenduidigheid!*	Regulations SMM	Regulations shared micromobility
		[10:233] *Regionale gebieden (Ervaring): Gecentraliseerde plekken, wat makkelijk maakt voor onderhoud en vervangen accu's en geeft herkenbaarheid van gebruikers.*	Suburban application	Sharing service
		[10:234] *Regionale gebieden (Ervaring): Samenwerking met gemeente belangrijk, budget voor gratis gebruik deelscooters (kennismakingsaanbod), aanwakkeren was noodzakelijk, waarna de vraag vanzelf ontstond.*	Suburban demand	Influencing factors
		[10:235] *Uitrollen naar dorpen moet langzaam worden opgebouwd, in goede samenwerking met lokale partijen en gemeenten.*	Suburban application	Sharing service
		[10:236] *Aanbieder wilt niet ergens starten waarbij het gevoel heerst dat er na 6 maanden weer kan worden gestopt, zekerheid is belangrijk!*	Project duration	Sharing service
		[10:237] *+100.000 inwoner steden zijn interessant voor scooter aanbieders!*	Pre-conditions	Sharing service
		[10:238] *Regio: Langere afstanden, dus elektrische ondersteuning noodzakelijk. Toepassing van E-scooter of e-bike dus interessant t.o.v. deelfiets.*	Suburban application	Sharing service
		[10:239] *Meer gemeenten gaan over naar Back-to-many en stoppen met free-floating. Hier zijn wij flexibel in en gaan mee met de vraag van de gemeente/gebruiker.*	Back-to-Many	Sharing system
		[10:240] *Deelscooter aanbieder geeft niet te voorkeur aan free-floating in regio gebieden, hubs zijn hier voor de handliggender (Back-to-many), met fysiek aangemerkte locaties en landelijke vormgeving en richtlijnen*	Back-to-Many	Sharing system
		[10:241] *Deelscooter aanbieder is voorstander van fysieke plekken buiten, noodzakelijk voor grote hubs (Of regionale hubs), bijvoorbeeld drukke binnensteden of grote OV-halten. Dit verminderd overlast.*	Physical parking spaces	Public service area
		[10:242] *Erg drukke stadkernen met hoge dichtheid kunnen worden ingericht met diverse hubs, wijken eromheen met relatief hoge dichtheid en ruimere opzet kan worden bediend met free-floating.*	Hybrid system	Sharing system
		[10:243] *MaaS: Zien, boeken, rijden: Tomp api level 5*	Status MaaS	MaaS
		[10:244] *Begrip voor MaaS: Hoe kunnen we deelmobiliteit makkelijker maken en meer toegankelijk (Gedacht vanuit gebruiker). Echter zorgt MaaS momenteel niet voor de beoogde voordelen en kost het wel veel inspanning en tijd. Ook geen grip op gebruiker (Hoe scooter wordt gebruikt, overlast, gehele product vervalt bij MaaS ritjes). Geen data over MaaS gebruikers, geeft groot risico. Kan moeilijk worden opgetreden tegen deze gebruikers.*	Cons MaaS	MaaS
		[10:245] *Gedoe-factor MaaS: Externe en interne boetes afhandeling per MaaS partij, veel regels, afspraken per Maas-partij en volumes veel te laag om hierin aan mee te doen.*	Cons MaaS	MaaS
		[10:246] *Was verplichting bij veel gemeenten. Voor vervolg: Alle gemeenten kies dezelfde MaaS!*	Status MaaS	MaaS
		[10:247] *Loopafstand van circa 200 meter is acceptabel voor veel gebruikers. Een Back-to-many systeem i.p.v. free-floating is dus mogelijk mits deze 200 meter in zekere zin haalbaar blijft voor het aanbieden van deelscooters. Tevens zorgt dit voor een betere grip op openbare ruimte, wat uiteindelijk voorbestaan deelvervoer ten goede komt.*	Willingness to walk	Trips and behavior
		[10:248] *Max. loopafstand van 225 meter. Meer dan 225 meter is de kans groter dat de rit niet wordt gemaakt dan wel.*	Willingness to walk	Trips and behavior
		[10:249] *Streven is circa 5 ritten per deelscooter per dag voor een gezonde business. (Aanbieder geeft geen exacte getallen voor break-even-point)*	Trips per day	Sharing service
		[10:250] *Aanbieder verdeeld geen scooters handmatig, alleen na reparatie. (Vanuit kostenoogpunt en ook duurzaamheid). Niet voertuigen laten rondrijden om te verplaatsen, maar werken met kortingen, zodat gebruikers deze verdeling regelen en hier voor worden beloond.*	Redistribution	Sharing service
		[10:251] *Maatregel voor voorkomen van overlast: Een stilstaand voertuig zorgt voor overlast, dus vanaf bijvoorbeeld 8 uur kan een voertuig al in prijs worden verlaagd.*	Nuisance & cluttering	Public service area
		[10:252] *OV knooppunten zijn erg populair, rond 24% van de ritten start of stopt binnen 125 meter van een OV knooppunt.*	Completing PT	Connection with public transport
		[10:253] *Succesfactoren verschillen erg per stad.*	Success factors	Influencing factors
		[10:254] *Minder fijne omstandigheden zijn bijvoorbeeld evenementen, hele drukke locaties (Strand in Scheveningen) of bedrijventerreinen. Deze locaties zorgen voor eenmalig gebruik en vervolgens lange stilstand. Daarbij ontstaat de kans dat voertuigen te lang blijven stilstaan en uit noodzaak dienen opgehaald te worden.*	Negative influences	Influencing factors
		[10:255] *Bedrijvenparken buitenaf: Niet interessant, wel binnen de stad, niet erbuiten. 2 ritten per deelscooter per dag is te weinig.*	Negative influences	Influencing factors
		[10:256] *Gebruik: Geen onderscheid tussen mannen en vrouwen en na langer actief wordt de gemiddelde leeftijd hoger van het algemene gebruik.*	Users	Trips and behavior
		[10:257] *Autorijbewijs noodzakelijk voor gebruiker deelscooters en 18+.*	Users	Trips and behavior
		[10:258] *Gratis gebruik is krachtige methode om product uit te proberen, maar doe dit voor korte periode en vermijd gewenning aan gratis gebruik. Bij kennismakingstarief voor langere periode is een hoge korting effectiever.*	Free service	Service promoting
		[10:259] *Eigen app is heel erg gefocust op B2C en in mindere mate (niet) op B2B.*	B2B	Sharing service
		[10:260] *Verschil brom-/snorfiets: Er is een toename zichtbaar van deelbromfietsen (45 km/h) t.o.v. deelsnorfietsen (25 km/h) na de invoering van de helmplicht*	Different mopeds	Type of shared micromobility
		[10:261] *De rit duur van deelbromfietsen is circa 17 procent hoger in vergelijking tot deelsnorfietsen, een hoger verschil is zichtbaar voor het verschil in rit lengte, namelijk circa 43%.*	Different mopeds	Type of shared micromobility
Country Manager Netherlands	Shared micromobility operators	[11:262] *9*	Expert scale	
		[11:263] *Voordelen: Bijdrage aan duurzamere samenleving, alternatief voor privéauto (Zeker combinatie met OV). Minder uitstoot, zeker op locaties in de stad. Publieke ruimte kan efficiënter worden ingedeeld, vermindering grote percentage autostilstand. Veiligheid verbeteren.*	Benefit shared micromobility	Effect shared micromobility
		[11:264] *Nadelen: Beschikbaarheid niet altijd naar vraag, betrouwbaarheid niet gegarandeerd & prijs kan voor belemmering zorgen.*	Downside shared micromobility	Effect shared micromobility
		[11:265] *De combinatie OV en deelmobiliteit kunnen elkaar versterken. Met mooie dagen is deelvervoer misschien meer aantrekkelijk en minder mooie dagen kiest men sneller voor OV, drukte in OV kan zorgen voor gebruik deelvervoer en ontbreken deelvervoer kan zorgen voor gebruik OV. De combinatie samen kan zorgen voor meer gebruik in totaal, waarbij dus de combinatie zorgt voor minder gebruik van de auto. Meer deelmobiliteit hoeft niet te leiden tot automatisch minder openbaar vervoer gebruik.*	Completing PT	Connection with public transport
		[11:266] *Aanbieder bood deelscooters aan in een compacte stad met weinig ruimte (Ingericht op de fiets), kortere afstanden voor fiets t.o.v. auto of scooter.*	Geography	Influencing factors
		[11:267] *Conclusie scooter gebruik: Gebruik e-bikes was hoger, afstanden gebruik nagenoeg gelijk en meer overlast van de scooter t.o.v. deelfiets.*	Shared moped; Shared e-bike	Type of shared micromobility
		[11:268] *Nederland deelscooters meest populair, onder andere door ontbreken deelstep.*	Shared moped	Type of shared micromobility
		[11:269] *Deelscooter duur in onderhoud, deelstep aanzienlijk goedkoper.*	Shared moped	Type of shared micromobility
		[11:270] *Deelsnorfiets mag op fietspaden, extra aantrekkelijk hierdoor t.o.v. deelbromfiets*	Shared moped	Type of shared micromobility
		[11:271] *Welke modaliteit meest aantrekkelijk is, is afhankelijk van de afstand, scooter en e-bike voor langere afstanden en deelfiets voor relatief kortere afstanden.*	Sharing type	Type of shared micromobility
		[11:272] *Gebruik in regio lager en operationele kosten hoger, dus minder interessant voor aanbieders, simpelweg in de meeste gevallen te duur om de regio te bedienen.*	Suburban application	Sharing service
		[11:273] *Schaal en dichtheid zijn de belangrijkste factoren -> Schaal: Voldoende voertuigen in een bepaald gebied en met een bepaalde schaal moet je een bepaalde dichtheid kunnen garanderen. Dichtheid belangrijk voor 2 redenen: 1. Betere dichtheid, hogere betrouwbaarheid, waardig alternatief om mee te nemen als reisoptie. 2. Dichtheid belangrijk voor operatie, meeste kosten zit hem in operatie, ophalen, reparatie voertuigen en wisselen accu's. Om efficiënt te kunnen uitvoeren moeten medewerkers korte afstanden afleggen. (Voor heel Berlijn klinkt 800 voertuigen goed, maar niet qua dichtheid)*	Operational factors	Sharing service
		[11:274] *Utrecht 1.000 E-bikes, schaal is goed, maar dichtheid kan beter. Servicegebied verkleinen of aanpassen. Geen voertuigen op plekken waar ze lang stilstaan.*	Operational factors	Sharing service
		[11:275] *Stilstaande voertuigen zijn onderdeel van het overlast & vandalisme + stilstaande voertuigen kosten geld, esthetisch minder aantrekkelijk: Fiets/scooter wordt vies.*	Nuisance & cluttering	Public service area
		[11:276] *Gebruikersperspectief: Flexibiliteit (Free-floating of heel uitgebreid back-to-many) & zekerheid van deelvoertuigen op bepaalde plekken. Hybride model (Combinatie)! Of back-to-many met voldoende dichtheid.*	Hybrid system	Sharing system
		[11:277] *Utrecht volledig back-to-many (800 zones op 1000 voertuigen), gebaseerd op alle fietsvoorzieningsplaatsen.*	Back-to-Many	Sharing system
		[11:278] *Eindhoven: Free-floating rondom het stad centrum, erbinnen een back-to-many systeem.*	Hybrid system	Sharing system
		[11:279] *Aanbieder heeft veel integratie in MaaS, geloven in potentieel van MaaS, maar ziet dat het nog geen vruchten afwerpt. 2% van de ritten gaat vanuit de MaaS platformen.*	Status MaaS	MaaS
		[11:280] *Probleem MaaS: Integratie kost veel geld en tijd. Aanbieder is geen voorstander van een andere MaaS-aanbieder in elke stad van Nederland.*	Cons MaaS	MaaS
		[11:281] *Subsidie: Aanbieder ziet geen succes in extra subsidie bij gebruik, hierdoor ligt het risico bij de aanbieder. Alternatief subsidie stelsel: Uitbetalen subsidie en afbouwen bij goed gebruik. Als er goed gebruik wordt gemaakt, wordt dat al beloond, dan is er geen subsidie nodig, er is subsidie nodig voor het begin.*	Funding	Service promoting
		[11:282] *Als gemeente en aanbieder is het belangrijk om ten alle tijden een goed aanbod te creëren, dus hiervoor wordt betaald, vervolgens is het aan de gebruiker of ze hier van willen gebruiken.*	Funding	Service promoting
		[11:283] *Goede business case: 2 ritten per dag per e-bike*	Trips per day	Sharing service
		[11:284] *B2B markt staat nog in de kinderschoenen voor deelmobiliteit, bedrijven verlenen nog traditioneel Ov-kaart of leaseauto. Zeker mogelijkheden in de woonwerk-stromen voor gedeeld e-bikes (Forensen).*	B2B	Sharing service
		[11:285] *Deelmobiliteit is een verlengstuk van het openbaar vervoer en in sommige gevallen vervangt het openbaar vervoer.*	Role of PT	Connection with public transport
		[11:286] *Ruim 50% van ritten wordt gemaakt in combinatie met openbaar vervoer.*	Completing PT	Connection with public transport
		[11:287] *Populairste plekken zijn grote treinstations.*	Completing PT	Connection with public transport
		[11:288] *Ook langs tramlijnen is meer gebruik van deel e-bikes.*	Completing PT	Connection with public transport
		[11:289] *150 tot 200 meter ligt het bereik om maximaal te lopen tot een voertuig (e-bike).*	Willingness to walk	Trips and behavior
		[11:290] *Herverdeling is altijd data gedreven, programma berekent hoeveel fietsen op welke dag noodzakelijk zijn, verschilt per dag, maand, seizoen, weer. Ook op basis van app openingen.*	Redistribution	Sharing service
		[11:291] *Herverdelen fietsen: Kortingen (Incentives) zorgen voor automatisch herverdelen van de fietsen door gebruikers.*	Redistribution	Sharing service
		[11:292] *Foutparkeren tegen gaan: 1. Parkeerfoto of scan omgeving met AI kan het worden gecontroleerd of voertuig goed staat. 2. Geofencing, gebieden uitsluiten. 3. Gebruikers educatie, uitleg.*	Parking vehicles	Public service area
		[11:293] *Geen gratis gebruik voor lokale mensen, externe geen toegang geven: Tijdens het verplaatsen van foutgeparkeerde fietsen/scooters een ongeluk veroorzaken of schade rijden: Wie is er dan aansprakelijk? Wie is verantwoordelijke? Fietsen kunnen worden verplaatst door achterwiel op te tillen. Goed systeem met dashboard op basis van GPS systeem per minuut belangrijk.*	Resident participation	Public service area
		[11:294] *Voorstander van fysieke parkeerlocaties buiten: Gebruikers parkeren fietsen automatisch waar andere deelfietsen staan geparkeerd, tevens zorgt het voor herkenning.*	Physical parking spaces	Public service area
		[11:295] *Fysieke locaties aantrekkelijk maken. Hierdoor weten gebruikers gemakkelijk te vinden waar ze de fietsen mogen achterlaten, zonder gebruik van de app.*	Physical parking spaces	Public service area
		[11:296] *Voertuigen aanbieden waar vraag is: Centrum gebieden, onderwijslocaties, OV knooppunten, werklocaties, etc. Gebied opdelen in deze onderdelen.*	Trip location	Trips and behavior
		[11:297] *Gebruik van deelvervoer niet over regulieren (Iets wat deels is ontstaan door de sector zelf), echter zorgt dit ervoor dat deelvervoer minder interessant wordt voor de gebruiker. Auto wel parkeren naast bestemmingen, maar deelvervoer niet?*	Regulations SMM	Regulations shared micromobility
		[11:298] *Duidelijk toename van gebruik bij staking OV.*	Demand	Influencing factors

Strategic Advisor for Smart Mobility	Municipalities	[12:299]	*8*	Expert scale	
		[12:300]	*Door slechte start van deelvervoer in Nederland, hangt er rondom deeltweewielers een slecht imago. Teveel investeringsgeld en geen plan.*	Negative influences	Influencing factors
		[12:301]	*Momenteel is markt meer volwassen. Aanbieders zeggen niet zomaar ja tegen nieuwe projecten.*	Sector SMM	Sharing service
		[12:302]	*Kwaliteit van de deelfietsen is erg belangrijk, gemiddelde Nederlander is goede kwaliteit fiets gewend. Fietsen zonder lucht in de banden zijn voor korte afstanden en niet comfortabel.*	Sharing type	Type of shared micromobility
		[12:303]	*Iedere relatief kleine gemeente heeft geen vast personeel voor deelmobiliteit, zeker ook niet voor alle gemeente relevant.*	Suburban application	Sharing service
		[12:304]	*Voordeel deelmobiliteit: Meer verplaatsingsmogelijkheden, beperken tweede of derde auto, of zelfs de enige auto.*	Benefit shared micromobility	Effect shared micromobility
		[12:305]	*Groot voordeel deelfiets: Fietst wordt frequent meer gebruikt dan eigen fiets, overlast neemt af zolang hij gebruikt blijft worden.*	Benefit shared micromobility	Effect shared micromobility
		[12:306]	*Ander voordeel: Beperken fietsenstallingen, verminderen 2e en 3e fiets*	Benefit shared micromobility	Effect shared micromobility
		[12:307]	*Bus in Katwijk bediend groot gebied, inkomende reigers hebben dus last-mile oplossing nodig. Transitie naar nieuwe vormen van openbaar vervoer (Toepassing van R-netlijnen, i.p.v. lange regio bussen) geven meer mogelijkheden voor deelvervoer.*	Completing PT	Connection with public transport
		[12:308]	*Geen groot gevaar voor verrommeling in regiogemeenten, kleine kans op negatief effect op de openbare ruimte.*	Nuisance & cluttering	Public service area
		[12:309]	*Goede organisatie: Balans tussen gebruiksgemak en effect op openbare ruimte, optimale gebruiksgemak van A naar B, maar als dat helemaal wordt losgelaten leidt dat tot ongewenste situatie.*	Organize SMM	Regulations shared micromobility
		[12:310]	*Deeltweewielers kan wel degelijk effect hebben op bereikbaarheid van de banen in Nederland en daarmee vervoersarmoede verminderen.*	Transport poverty	Effect shared micromobility
		[12:311]	*Nieuwe wetgeving over forensen (Werkgevers moeten meer verantwoordelijkheid nemen over reisgedrag van werknemers, CO2 uitstoot in kaart brengen, vervolgstap is verminderen)*	B2B	Sharing service
		[12:312]	*Bedrijven moet het eerst kunnen uitproberen en voordelen inzien, alvorens ze dit willen omarmen. In zo'n situatie is gratis gebruik een must (in combinatie met subsidie is dit mogelijk).*	Free service	Service promoting
		[12:313]	*Gemak van aanvragen leaseauto moet gelijk worden getrokken aan openbaar vervoer i.c.m. deelmobiliteit (Werkgever ontzorgen)*	Regulations SMM	Regulations shared micromobility
		[12:314]	*Deelvervoer is geen echt onderdeel van openbaar vervoer, maar zeker wel een aanvulling op. Verschil tussen stad en regio: Binnen de stad van A naar B vervangt OV, maar in Katwijk kan het een goede combinatie zijn met OV. Deelvervoer vult het OV op verschillen fronten aan. Drukte OV kan ook worden opgevangen met deelvervoer.*	Completing PT	Connection with public transport
		[12:315]	*Modaliteit afhankelijk van de af te leggen afstand, tevens is het verbonden aan het doel vanuit de gemeente, meer gebruik OV -> Deelfiets. Versnellen reis naar en van de stad -> Deelscooter of deel(e-)bike. Ook deelfiets beste vanuit duurzaamheid gedachten.*	Sharing type	Type of shared micromobility
		[12:316]	*Back-to-many meest passend bij regio gebied, combinatie met OV-haltes, daarbij flexibiliteit wel mogelijk t.o.v. back-to-one.*	Back-to-Many	Sharing system
		[12:317]	*MaaS is een tool om alle netwerken aan elkaar te koppelen, zeker gericht aan werknemers, mobiliteitspakket bedrijf onderbrengen onder 1 MaaS-app. Ook individuele gebruiker geeft het mogelijkheden om verschillende mobiliteitsvormen te combineren.*	Pros MaaS	MaaS
		[12:318]	*Fysieke locaties buiten: Niet overal, drukke locaties wel, duidelijkheid creëren, maar sommige gevallen alleen in app aangeven.*	Physical parking spaces	Public service area
		[12:319]	*Nadeel gereserveerde plekken in openbare ruimte is het creëren van extra problemen, dubbele fout bij normale fietsen in gereserveerde ruimte en deelfietsen in publieke ruimte. Alternatief is het geven van extra/voldoende parkeermogelijkheden zodat deelfietsen kunnen worden geparkeerd, maar ook voldoende parkeerplekken zijn voor private fietsen.*	Physical parking spaces	Public service area
		[12:320]	*In gebieden met veel parkeerverboden voor fietsen dient het wel fysiek geregeld te worden, zodat duidelijk is waar het mag en waar niet, zodat dit niet alleen digitaal hoeft. (Digitaal inregelen dat de fiets in een vak moet, met pop-up)*	Physical parking spaces	Public service area
		[12:321]	*Geen voorstander van gratis deelfietsen, alleen gratis aanbieden bij uitzondering. Voor kwaliteit mag worden betaald.*	Free service	Service promoting
		[12:322]	*Promotie systeem: Rol neerleggen bij aanbieder, zij kunnen immers hun eigen product het beste verkopen. Gebruik kan wel worden gestimuleerd vanuit de gemeente (Inwoners duurzaam laten reizen), door faciliteren van extra of fysieke parkeerplaatsen etc.*	Sector SMM	Sharing service
		[12:323]	*Overlast is niet altijd terecht. Een goed geparkeerde deelfiets in fietsenrek wordt als overlast gezien, maar een private deelfiets niet? Ervaring uit meldingen.*	Nuisance & cluttering	Public service area
		[12:324]	*Niet logisch om de bereikbaarheid van witte OV locaties (Locaties welke slecht of niet te bereiken zijn met OV) over te laten aan marktpartijen, deelaanbieder misschien beter te verschuiven naar operators, die het allemaal onderhoud en de kennis heeft, maar overige zaken neerleggen bij OV-bedrijven.*	Role of PT	Connection with public transport

Traffic Management Policy Advisor	Transport authorities	[13:325]	*6*	Expert scale	
Mobility Advisor	Transport authorities	[13:326]	*7*	Expert scale	
		[13:327]	*Zijn openbaar vervoer aanbieders geschikt voor het aanbieden van deelmobiliteit, of kan iedereen beter doen waar ze in zijn gespecialiseerd?*	Role of PT	Connection with public transport
		[13:328]	*Rol van Transport authorities: Opdrachtgever OV (Concessie verlener). Opstellen van regionale visie en strategie deelmobiliteit voor groot gebied. Verlenen van subsidie.*	Responsibility SMM	Regulations shared micromobility
		[13:329]	*Rol van Transport authorities t.o.v. gemeenten: 1. Niks doen, 2. Kennismakelaar, of 3. Markt regisseur: Stimuleren en grotere rol.*	Responsibility SMM	Regulations shared micromobility
		[13:330]	*Wel of niet deelmobiliteit meenemen in OV Concessie: Grip houden op kwaliteit en delen van data.*	Regulations SMM	Regulations shared micromobility
		[13:331]	*Concessie is een alleen recht, wil je 1 aanbieder per gebied? (Meerdere concessies: Telecom)*	Regulations SMM	Regulations shared micromobility
		[13:332]	*Deelmobiliteit aanjagen door middel van Subsidie (Ook veel verschillende mogelijkheden; aanbieder, gebruiker, werkgever)*	Funding	Service promoting
		[13:333]	*Vergunningsstelsel lijkt op een concessie.*	Regulations SMM	Regulations shared micromobility
		[13:334]	*Huis naar OV: Eigen fiets. Transitie naar nieuw wijze van OV aanbieden(Gestrekte lijnen etc.), biedt kansen voor de deelfiets in de last-mile oplossing.*	Benefit shared micromobility	Effect shared micromobility
		[13:335]	*Ander voordeel: Alternatief voor de auto, CO2 reductie. Aanvulling op Openbaar vervoer. Ruimte creëren. Kosten besparend!*	Benefit shared micromobility	Effect shared micromobility
		[13:336]	*Deelscooters, erg duur. Utrecht: In de stad niet, wel in de regio. De drie verschillende modaliteiten hebben verschillende doelen/kansen.*	Shared moped	Type of shared micromobility
		[13:337]	*Deelscooters mogen gratis parkeren, wel een rijbewijs nodig.*	Shared moped	Type of shared micromobility
		[13:338]	*Deelvervoer moet niet worden tegengehouden door gemeente grenzen, om het gebruik niet te remmen dient het mogelijk te zijn het deelvervoer te starten en eindigen binnen het gehele service-gebied.*	Geofencing	Public service area
		[13:339]	*Peak shaving: Druk OV afvlakken door deelmobiliteit.*	Benefit shared micromobility	Effect shared micromobility
		[13:340]	*Behoefte heel belangrijk bij het bepalen van deelmobiliteit (Kan helpen bij lagere parkeerbalans).*	Demand	Influencing factors
		[13:341]	*Meerdere voorwerpen/vervoersmiddelen delen in een wijk (E-bike, auto, bakfiets, etc.)*	Sharing type	Type of shared micromobility
		[13:342]	*MaaS: Plannen, boeken + reserveren (Geen aanbod). Niks meer niks minder.*	Status Maas	MaaS
		[13:343]	*Voordeel MaaS: Makkelijker data delen, maar dat is niet het geval.*	Pros MaaS	MaaS
		[13:344]	*Willen de gebruikers overal 1 app voor? Of is dit een aanname?*	Status Maas	MaaS
		[13:345]	*Fysieke parkeerplaatsen helpt bij het tegengaan van verrommeling. Gebruikers gebruiken automatisch deze vakken. Herkenbaarheid verbetert door fysieke locaties.*	Physical parking spaces	Public service area
		[13:346]	*Hybride variant voor het deelsysteem interessant -> Geheel free-floating niet succesvol.*	Hybrid system	Sharing system
		[13:347]	*Minst potentie in Back-to-one, werkt wel goed als OV-fiets, maar kan verbetert worden.*	Back-to-One	Sharing system
		[13:348]	*Koppeling met OV belangrijk! Tot op heden nog niet (goed) gemaakt.*	Role of PT	Connection with public transport

D. Survey questions (Dutch)

- Next page -

Survey distributed using PanelClix

Start block 1: Introduction

Intro **Welkom!**

Beste deelnemer,

Deze vragenlijst is onderdeel van een onderzoek naar deelvervoer binnen de provincie Zuid-Holland. De enquête geeft inzicht in de interesse, houding en voorkeur voor deelvervoer in dorpen en kleine gemeenten. U hoeft geen gebruik gemaakt te hebben van deelmobiliteit, u kunt gewoon uw mening geven over het onderwerp.

De enquête zal ongeveer 10 minuten in beslag nemen. Het is niet mogelijk om terug te keren naar de vorige vraag. Uw deelname aan dit onderzoek is volledig anoniem en vrijwillig. Antwoorden worden vertrouwelijk behandeld en uitsluitend gebruikt voor onderzoeksdoeleinden. Bij het starten van de enquête geeft u aan bovenstaande informatie te hebben gelezen en gaat u ermee akkoord dat uw antwoorden mogen worden gebruikt door de verantwoordelijke onderzoekers vanuit de TU Delft en Provincie Zuid-Holland.

Alvast hartelijk bedankt voor uw deelname,

Rody Boting
Afstudeerder TU Delft, master Transport & Planning

Selectie Bent u 18 jaar of ouder en inwoner van een dorp (Bijv. Katwijk, Gorinchem, Naaldwijk, etc.) of middelgrote stad (Gouda, Leiden, etc.) binnen de provincie Zuid-Holland?

- ○ Ja
- ○ Nee

End block 1: Introduction

Start block 2: Part 1: Knowledge

1.1 In hoeverre bent u bekend met deelfietsen, elektrische deelfietsen en elektrische deelscooters?

- ○ Nooit van gehoord
- ○ Van gehoord, maar niet gebruikt
- ○ Een keer (Of een aantal keer) gebruikt
- ○ Regelmatig gebruik

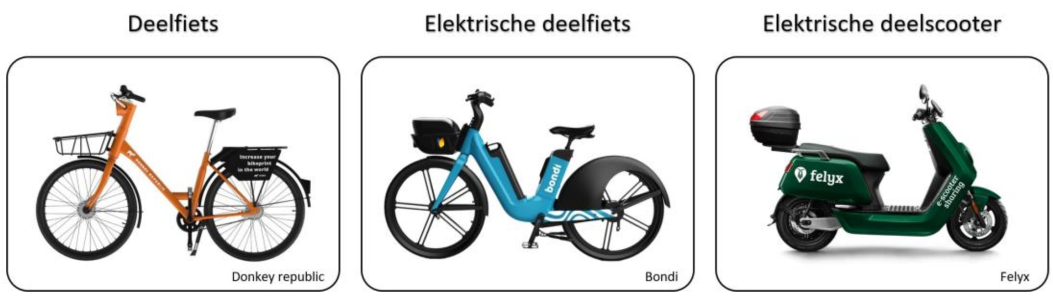
1.2 Van welke bedrijven/concepten heeft u wel eens gehoord?
[Meerdere antwoorden mogelijk]

- ☐ OV-fiets
- ☐ Donkey Republic
- ☐ Check.
- ☐ Bondi
- ☐ GO-Sharing
- ☐ HTM-fiets
- ☐ TIER
- ☐ (Geen)

End block 2: Part 1: Knowledge

Start block 3: Extra Information

Uitleg Denk bij het beantwoorden van de volgende vragen alleen aan deelfietsen, elektrische deelfietsen en elektrische deelscooters, aangeduid met **'Deeltweewielers'**. Voorbeelden zijn: OV-fiets, Donkey Republic, TIER, Bondi, Check, of Felyx.



In Nederland zijn deeltweewielers in veel steden te vinden, deze kan je tegen verschillende tarieven gebruiken. Hoe je de deeltweewielers kan huren verschilt per aanbieder. Vaak kan je door gebruik te maken van een app de deelfiets of deelscooter vinden, betalen en gebruiken.

Einde blok: Extra informatie

Start block: Part 2.1: Experience

2 Kunt u op basis van de uitleg aangeven van welke deeltweewieler u wel eens gebruik heeft gemaakt? *[Meerdere antwoorden mogelijk]*

- ☐ Deelfiets
- ☐ Elektrische deelfiets
- ☐ Elektrische deelscooter
- ☐ Geen van bovenstaande

---

3 Bent u in het algemeen geïnteresseerd in dit onderwerp (Het delen van fietsen, e-bikes en e-scooters)?

- ○ Ja
- ○ Een beetje
- ○ Nee
- ○ Weet ik niet

Deze vraag weergeven:

If Kunt u op basis van de uitleg aangeven van welke deeltweewieler u wel eens gebruik heeft gemaakt?... = Elektrische deelscooter

4.1 Welke deelscooter kiest u bij voorkeur?

- ○ Deelsnorfiets (Deelscooter met blauw kenteken - 25 km/u)
- ○ Deelbromfiets (Deelscooter met geel kenteken - 45 km/u)
- ○ Geen voorkeur
- ○ Weet ik niet

Deze vraag weergeven:

If Kunt u op basis van de uitleg aangeven van welke deeltweewieler u wel eens gebruik heeft gemaakt?... = Elektrische deelscooter

4.2 Is uw gebruik van de deelsnorfiets (Deelscooter met blauw kenteken) verminderd door de helmplicht?

- ○ Ja, mijn gebruik is afgenomen
- ○ Ja, ik ben gestopt met gebruiken
- ○ Nee, geen effect op mijn gebruik
- ○ Ik heb nog nooit een deelsnorfiets gebruikt

Deze vraag weergeven:

If Kunt u op basis van de uitleg aangeven van welke deeltweewieler u wel eens gebruik heeft gemaakt?... = Deelfiets

Or Kunt u op basis van de uitleg aangeven van welke deeltweewieler u wel eens gebruik heeft gemaakt?... = Elektrische deelfiets

Or Kunt u op basis van de uitleg aangeven van welke deeltweewieler u wel eens gebruik heeft gemaakt?... = Elektrische deelscooter

5.1 Heeft u wel eens deeltweewielers gebruikt met een andere gemeente als eindbestemming, dan de gemeente waar u begon?

- ○ Ja, dat ging goed
- ○ Ja, maar dat zorgde voor problemen
- ○ Nee, nooit geprobeerd
- ○ Weet ik niet

Deze vraag weergeven:

If Kunt u op basis van de uitleg aangeven van welke deeltweewieler u wel eens gebruik heeft gemaakt?... = Deelfiets

Or Kunt u op basis van de uitleg aangeven van welke deeltweewieler u wel eens gebruik heeft gemaakt?... = Elektrische deelfiets

Or Kunt u op basis van de uitleg aangeven van welke deeltweewieler u wel eens gebruik heeft gemaakt?... = Elektrische deelscooter

5.2 Vindt u het belangrijk dat het mogelijk is deeltweewielers te gebruiken van en naar verschillende gemeenten?

- ○ Ja
- ○ Weet ik niet
- ○ Nee

End block: Part 2.1: Experience

Start block: Part 2.2: Support & Usage intention

6.1 De toevoeging van onderstaand vervoersmiddel in de gemeente waar u **woont** is een goede ontwikkeling:

	Helemaal mee eens	Enigszins mee eens	Neutraal	Enigszins mee oneens	Helemaal niet mee eens	Geen mening
Deelfiets	○	○	○	○	○	○
Elektrische deelfiets	○	○	○	○	○	○
Deel e-scooter	○	○	○	○	○	○

6.2 In welk dorp/plaats bent u woonachtig?

____

6.3 Waar werkt of studeert u?

- ○ In een grote stad (Rotterdam, Den-Haag, etc.)
- ○ In een middelgrote plaats (Delft, Leiden, Gouda, Dordrecht, etc.)
- ○ In een dorp of relatief kleine gemeente (Katwijk, Gorinchem, Nootdorp, etc.)
- ○ Landelijk gebied
- ○ Ik werk of studeer niet
- ○ Zeg ik liever niet

Deze vraag weergeven:

If Waar werkt of studeert u? = In een grote stad (Rotterdam, Den-Haag, etc.)

Or Waar werkt of studeert u? = In een middelgrote plaats (Delft, Leiden, Gouda, Dordrecht, etc.)

Or Waar werkt of studeert u? = In een dorp of relatief kleine gemeente (Katwijk, Gorinchem, Nootdorp, etc.)

Or Waar werkt of studeert u? = Landelijk gebied

Or Waar werkt of studeert u? = Zeg ik liever niet

6.4 In hoeverre zal de toevoeging van deeltweewielers in de buurt van uw **studie-/werklocatie** zorgen voor een verbetering van de reis naar uw werk/studie (Bijv. bereikbaarheid)?

- ○ Goede aanvulling voor mijn dagelijkse reis
- ○ Goede aanvulling onder bepaalde omstandigheden (Bijv. aanvulling op openbaar vervoer)
- ○ Geen effect op mijn dagelijkse reis
- ○ Anders: ____

Deze vraag weergeven:

If Kunt u op basis van de uitleg aangeven van welke deeltweewieler u wel eens gebruik heeft gemaakt?... = Deelfiets

Or Kunt u op basis van de uitleg aangeven van welke deeltweewieler u wel eens gebruik heeft gemaakt?... = Elektrische deelfiets

Or Kunt u op basis van de uitleg aangeven van welke deeltweewieler u wel eens gebruik heeft gemaakt?... = Elektrische deelscooter

6.5 Wat is uw mening over de volgende stellingen:

	Helemaal mee eens	Enigszins mee eens	Neutraal	Enigszins mee oneens	Helemaal niet mee eens	Weet ik niet
Deeltweewielers zijn een goede aanvulling op openbaar vervoer	○	○	○	○	○	○
Deeltweewielers gebruik ik in plaats van openbaar vervoer	○	○	○	○	○	○

End block: Part 2.2: Support & Usage intention

Start block: Part 3: Attitude

7 Met welke stellingen over deeltweewielers bent u het eens?
[Meerdere antwoorden mogelijk]

- ☐ Aanmelden is teveel gedoe
- ☐ De kosten zijn te hoog
- ☐ Ik weet niet wat het kost om deeltweewielers te huren
- ☐ Deeltweewielers bieden mij geen voordelen
- ☐ Het wordt op te weinig verschillende locaties aangeboden
- ☐ Er zijn te weinig voertuigen beschikbaar

Deze vraag weergeven:

If Kunt u op basis van de uitleg aangeven van welke deeltweewieler u wel eens gebruik heeft gemaakt?... = Deelfiets

Or Kunt u op basis van de uitleg aangeven van welke deeltweewieler u wel eens gebruik heeft gemaakt?... = Elektrische deelfiets

Or Kunt u op basis van de uitleg aangeven van welke deeltweewieler u wel eens gebruik heeft gemaakt?... = Elektrische deelscooter

8 Met welke antwoorden bent u het eens?
[Meerdere antwoorden mogelijk]

Eventueel gebruik van deeltweewielers....

- ☐ Besparen mij kosten ten opzichte van andere opties
- ☐ Besparen mij tijd ten opzichte van andere opties
- ☐ Zorgen ervoor dat ik geen 2e of 3e (stations)fiets nodig heb
- ☐ Zorgen ervoor dat ik minder ga autorijden
- ☐ Zorgen ervoor dat ik meer beweeg
- ☐ Zorgen ervoor dat ik mij niet druk hoef te maken over onderhoud en diefstal
- ☐ Anders, namelijk: ____

9.1 In hoeverre ondervindt u hinder of stoort u zich wel eens aan deel(elektrische)fietsen of deelscooters?

- Vaak
- Regelmatig
- Soms
- Zelden
- Nooit
- Geen mening

Deze vraag weergeven:

If In hoeverre ondervindt u hinder of stoort u zich wel eens aan deel(elektrische)fietsen of deelsco... = Vaak

Or In hoeverre ondervindt u hinder of stoort u zich wel eens aan deel(elektrische)fietsen of deelsco... = Regelmatig

Or In hoeverre ondervindt u hinder of stoort u zich wel eens aan deel(elektrische)fietsen of deelsco... = Soms

9.2 Kunt u aangeven aan welk vervoersmiddel u zich het meest stoort:

- Deelfiets
- Elektrische deelfiets
- Deelscooter

---

10 Bent u in bezit van een autorijbewijs?

- Ja
- Nee, maar wel scooterrijbewijs
- Nee en ook geen scooterrijbewijs
- Zeg ik liever niet

End block: Part 3: Attitude

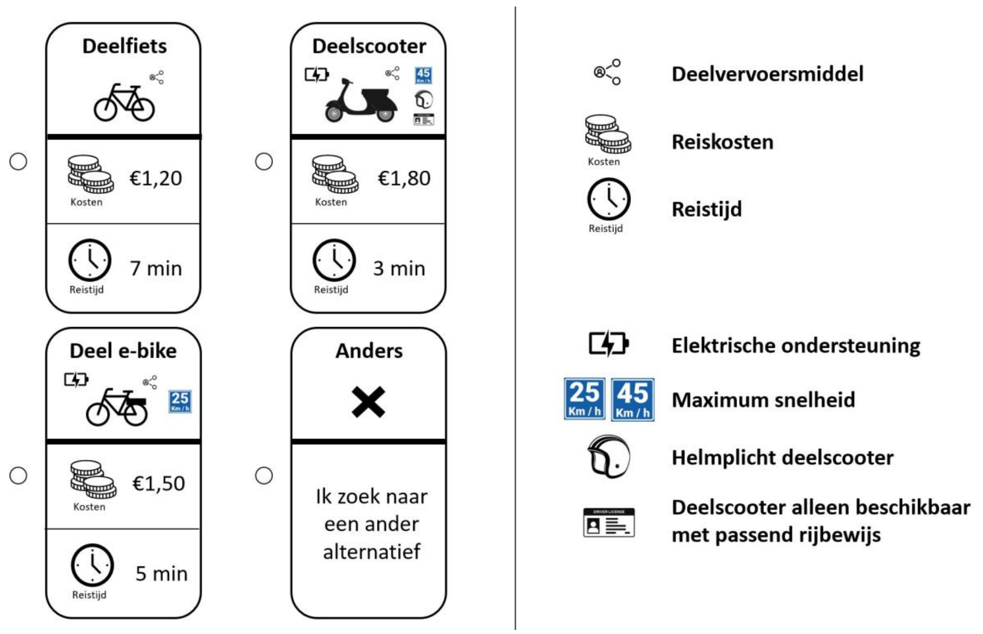
Start block Choice Experiment: Introduction Daily-Work

Daily-Work **Vervoerskeuzen**

In dit deel van het onderzoek krijgt u 8 keuzes voorgelegd voor een voorbeeldreis, waarbij de afstand, prijs en reistijd veranderen. Veronderstel de volgende situatie:

- Elke dag maakt u een rit naar uw werk en terug.
- De auto is **niet** beschikbaar.
- U maakt gebruik van openbaar vervoer (betaald door werkgever) en u moet vanuit de laatste halte verder reizen naar uw werk. Deze afstand varieert tussen 2 km en 8 km.
- U heeft keuze uit 3 vervoersmiddelen: deelfiets, elektrische deelfiets of deelscooter.
- Daarnaast heeft u de keuze om deze 3 niet te gebruiken en de afstand vanaf de laatste halte tot uw werk op een andere manier af te leggen.
- Het is droog en niet koud.
- U reist in de spits.

Hieronder ziet u een voorbeeld met extra toelichting:



End block Choice Experiment: Introduction Daily-Work

Start block choices

8 choices are presented out of a list of 16 questions

Einde blok: Block 1_8km

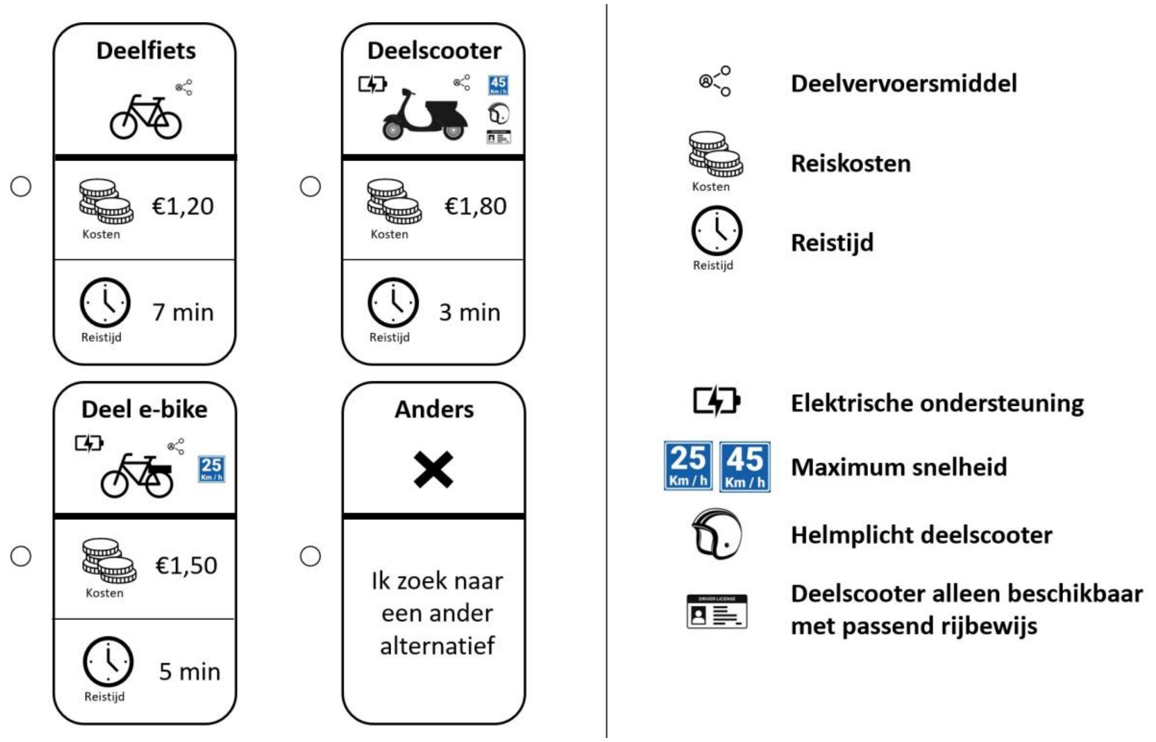
Start block Choice Experiment: Introduction Non-Daily Non-Work

Non-Daily Non-Work **Vervoerskeuzen**

In dit deel van het onderzoek krijgt u 8 keuzes voorgelegd voor een voorbeeldreis, waarbij de afstand, prijs en reistijd veranderen. Veronderstel de volgende situatie:

- U gaat een dagje weg. U gaat weg per auto of wordt gebracht.
- Parkeren bij de bestemming is niet mogelijk. Na de autorit moet u dus nog een stuk afleggen. Deze afstand varieert tussen 2km en 8km.
- U heeft keuze uit 3 vervoersmiddelen: deelfiets, elektrische deelfiets of deelscooter.
- Daarnaast heeft u de keuze om deze 3 niet te gebruiken en de afstand op een andere manier af te leggen.
- Het is droog en niet koud.

Hieronder ziet u een voorbeeld met extra toelichting:



End block Choice Experiment: Introduction Non-Daily Non-Work

Start van blok: Block 2_2km

8 choices are presented out of a list of 16 questions

Einde blok: Block 2_8km

Start block: Extra question choice experiment

11 Wat heeft invloed gehad op uw keuzes van de vorige 8 vragen?
[Meerdere antwoorden mogelijk]

- ☐ Prijs
- ☐ Afstand
- ☐ Tijd
- ☐ Helmplicht deelscooters
- ☐ Geen ervaring met scooter rijden
- ☐ Comfort (Elektrische ondersteuning e-bike of e-scooter)
- ☐ Anders: ____

End block: Extra question choice experiment

Start block: Part 5: Demographic data

12.1 Hoe verplaatst u zich het vaakst?

- ○ Wandelen
- ○ (Elektrische) fiets
- ○ Scooter
- ○ Openbaar vervoer
- ○ Auto
- ○ Anders ____
- ○ Zeg ik liever niet

12.2 Hoe zou u zich bij voorkeur het meest willen verplaatsen?

- ○ Wandelen
- ○ (Elektrische) fiets
- ○ Scooter
- ○ Openbaar vervoer
- ○ Auto
- ○ Anders ____
- ○ Zeg ik liever niet

12.3 Wat is uw geslacht?

- Man
- Vrouw
- Overig
- Zeg ik liever niet

12.4 Wat is uw leeftijd?

- 18-24 jaar
- 25-34 jaar
- 35-49 jaar
- 50-64 jaar
- 65 jaar of ouder
- Zeg ik liever niet

12.5 Wat is het hoogste opleidingsniveau dat u heeft afgerond?

- Basis onderwijs
- Middelbaar onderwijs
- MBO
- HBO
- WO
- Zeg ik liever niet

12.6 Wat was uw totale bruto gezinsinkomen per jaar in euro?

- Minder dan €10.000 per jaar
- €10.000 tot €29.999 per jaar
- €30.000 tot €49.999 per jaar
- €50.000 tot €69.999 per jaar
- Meer dan €70.000 per jaar
- Zeg ik liever niet

End block: Part 5: Demographic data

Bedankt voor de tijd die u heeft genomen om aan deze enquête deel te nemen.
Meer informatie over waar u deeltweewielers kunt vinden in Nederland?
Zie: Dashboarddeelmobiliteit.nl

Voor vragen of algemene interesse in het onderzoek kunt u mailen naar:
r.boting@student.tudelft.nl of r.boting@pzh.nl

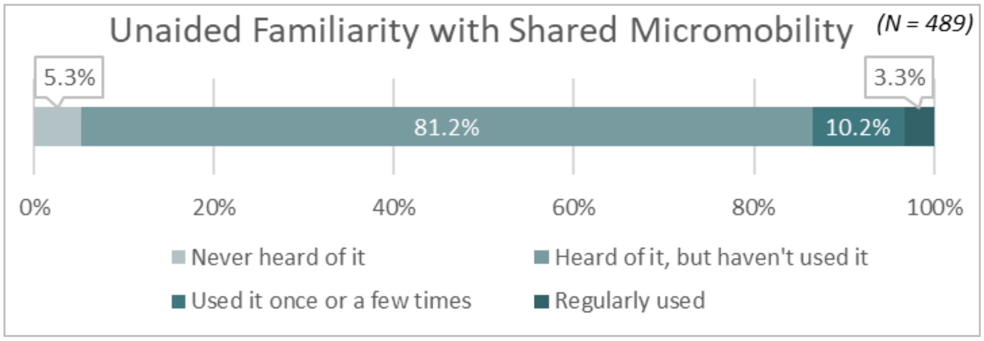
Uw antwoord is geregistreerd!

E. Survey results

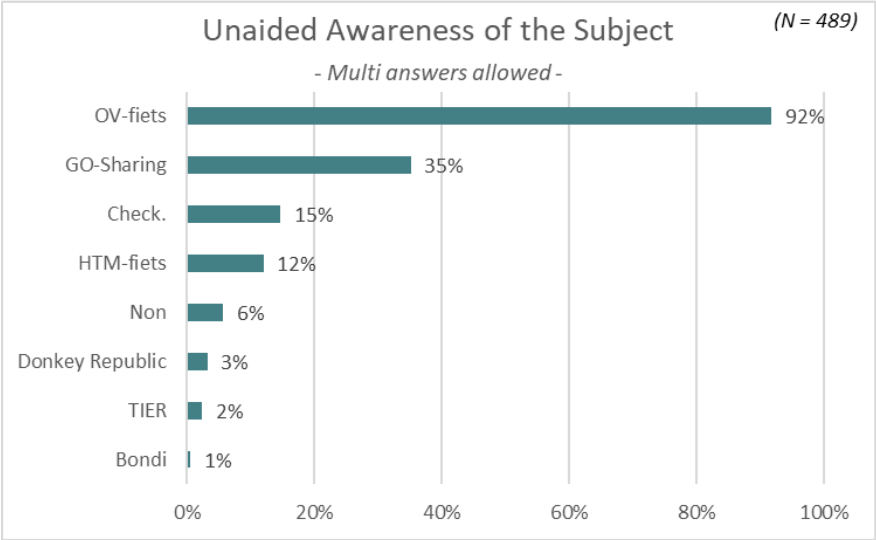
- Next page -

Questions presented before the subject explanation:

1.1
To what extent are you familiar with shared bicycles, shared e-bikes, and shared mopeds?



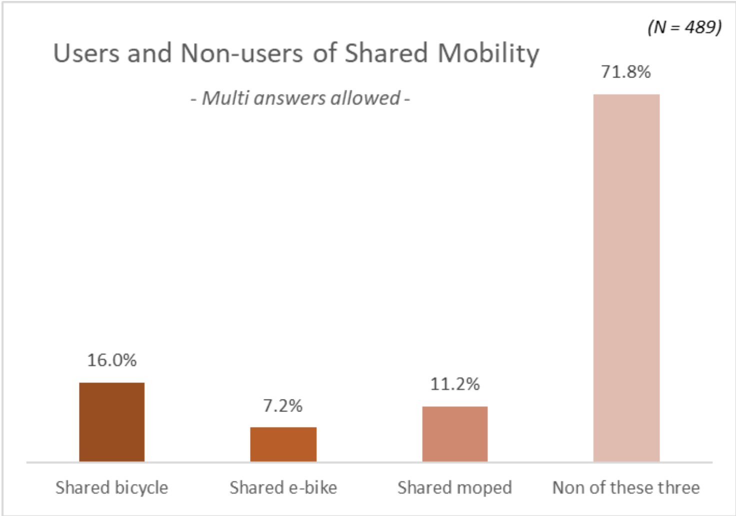
1.2
From which companies/concepts have you heard before?
[Multiple answers possible]



Questions presented after the subject explanation:

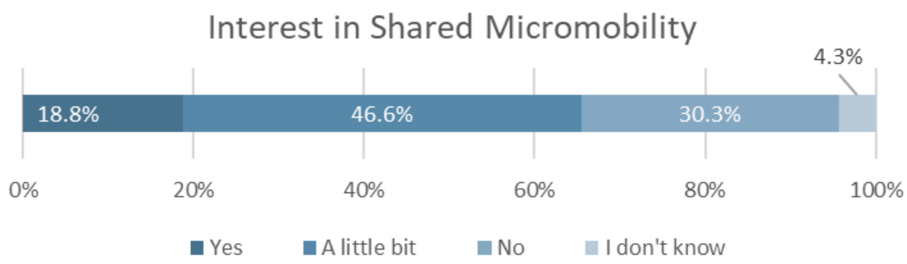
2

Based on the explanation, can you indicate which shared two-wheeler you have used before?
[Multiple answers possible]



3

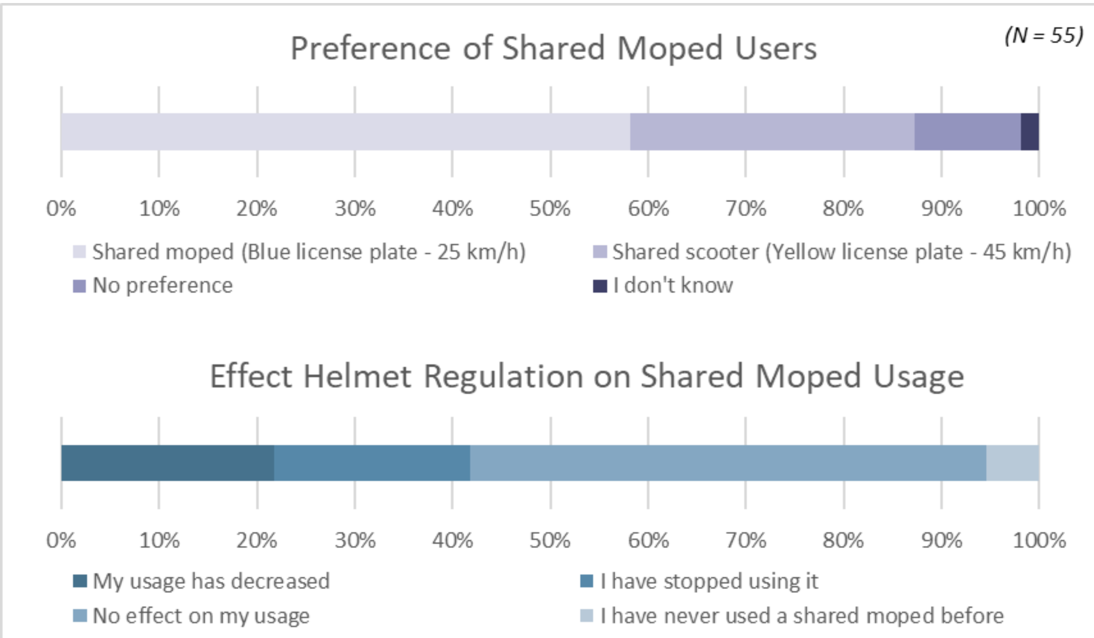
Are you generally interested in this topic (bike sharing, e-bike sharing, and moped sharing)?



4.1 & 4.2
Which shared moped do you prefer?
Has the helmet requirement led to a reduction in your use of shared mopeds (Blue license plate)?

Only display these questions:

If the following answer is given to question 2 = “Shared moped”



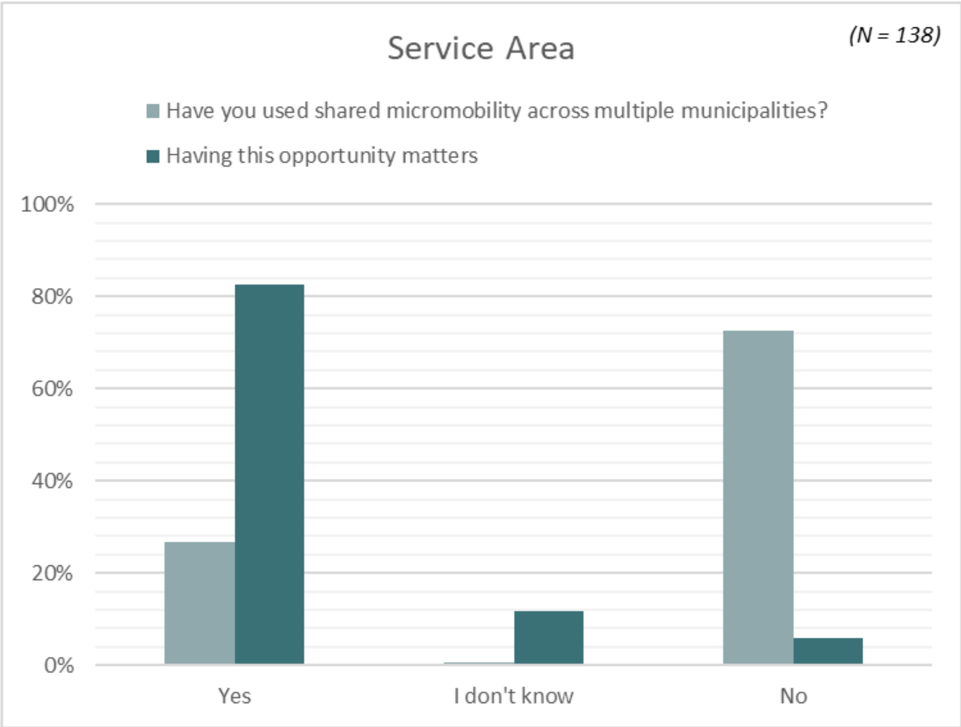
5.1 & 5.2

Have you ever used shared two-wheelers with a destination in a different municipality than where you started?

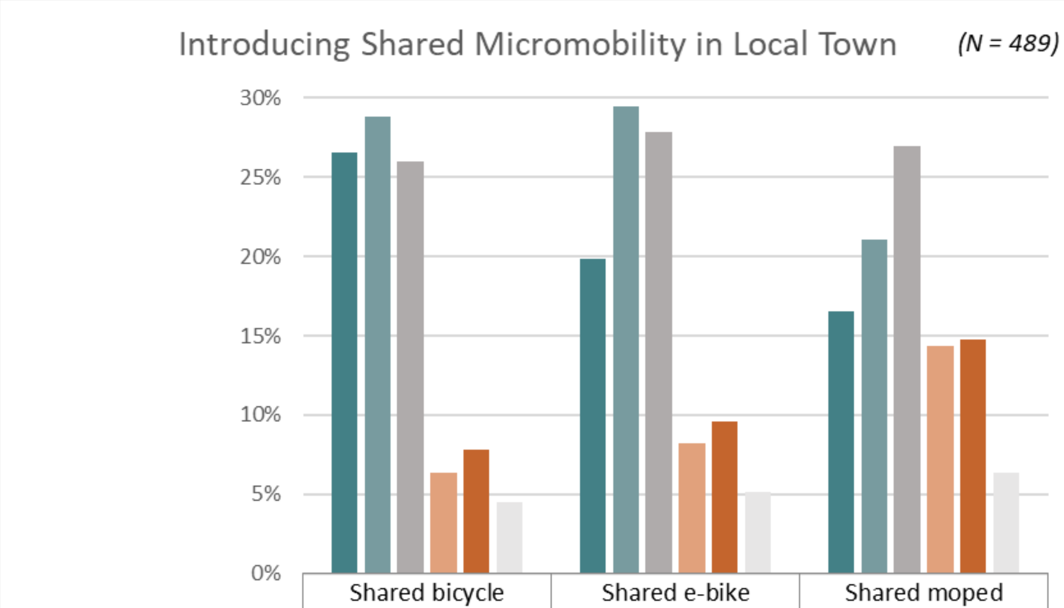
Do you consider it important that it is possible to use shared two-wheelers to and from different municipalities?

Only display these questions:

If the following answer is given to question 2 = "Shared bicycle", "Shared e-bike" and/or "Shared moped"

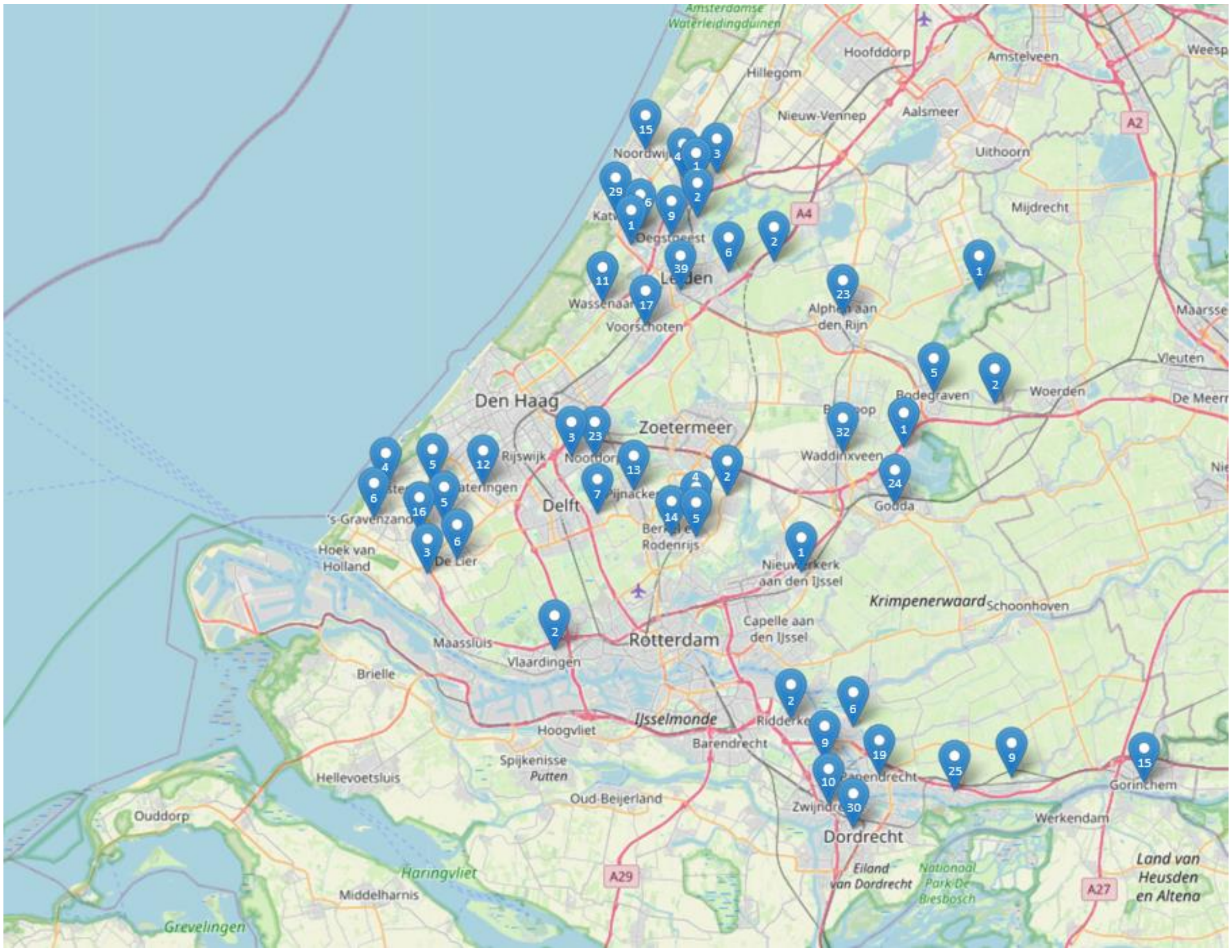


6.1
The addition of the following means of transportation in the municipality where you live is a positive development:

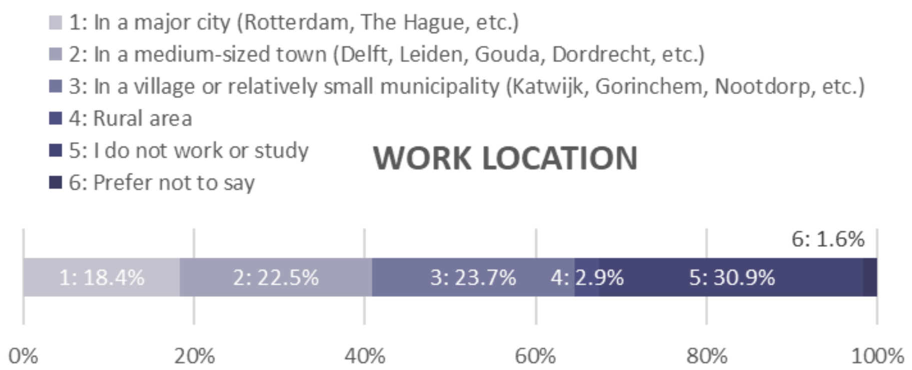


	Shared bicycle	Shared e-bike	Shared moped
Completely agree	26.6%	19.8%	16.6%
Slightly agree	28.8%	29.4%	21.1%
Neutral	26.0%	27.8%	27.0%
Slightly disagree	6.3%	8.2%	14.3%
Completely disagree	7.8%	9.6%	14.7%
No opinion	4.5%	5.1%	6.3%

6.2
In which village/town do you reside?



6.3
Where do you work or study?

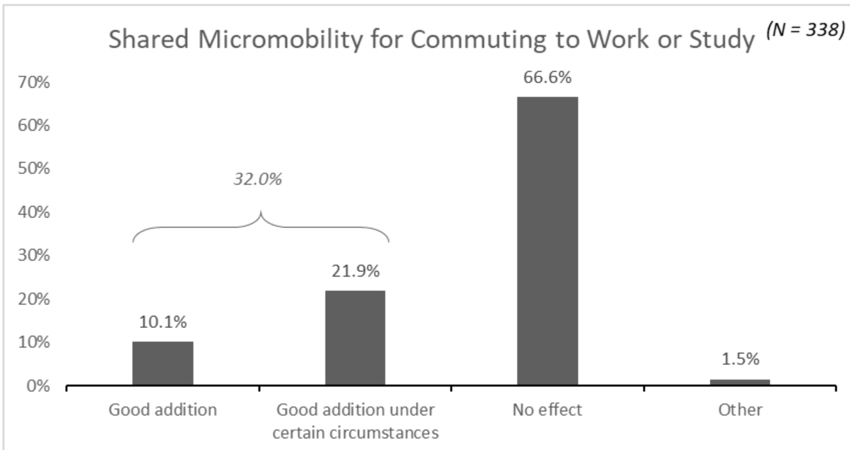


6.4

To what extent do you believe the addition of shared two-wheelers near your study or work location will enhance your commute trip (e.g., accessibility)?

*Do **not** display this question:*

If the following answer is given to question 6.3 = "I do not work or study"



6.5

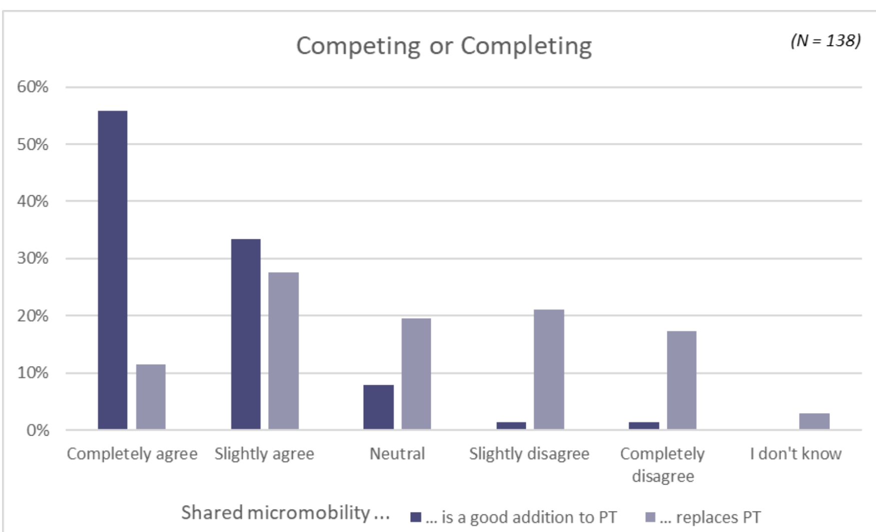
What is your opinion on the following statements:

"Shared two-wheelers are a good complement to public transportation"

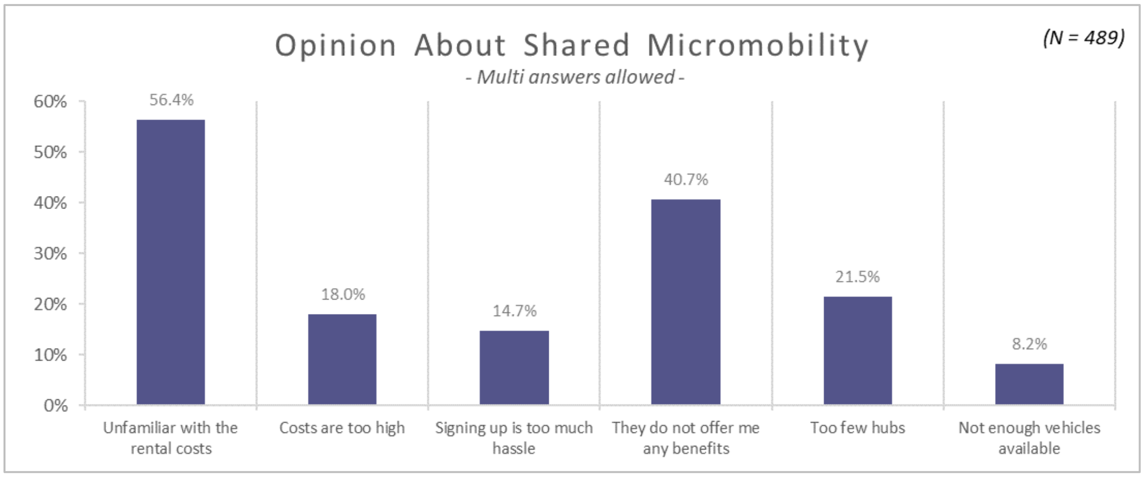
"I use shared two-wheelers instead of public transportation"

Only display this question:

If the following answer is given to question 2 = "Shared bicycle", "Shared e-bike" and/or "Shared moped"



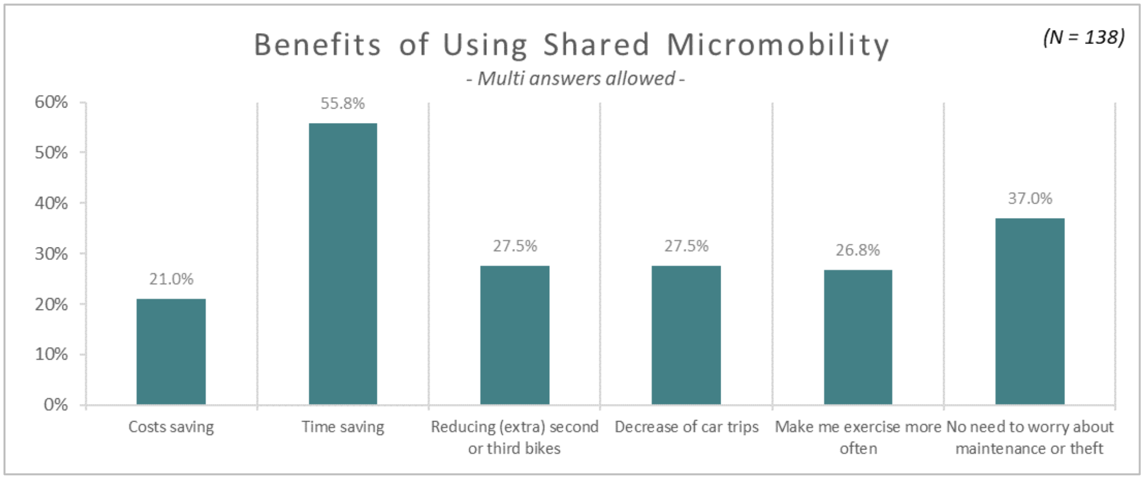
7
Which statements about shared two-wheelers do you agree with?
[Multiple answers possible]



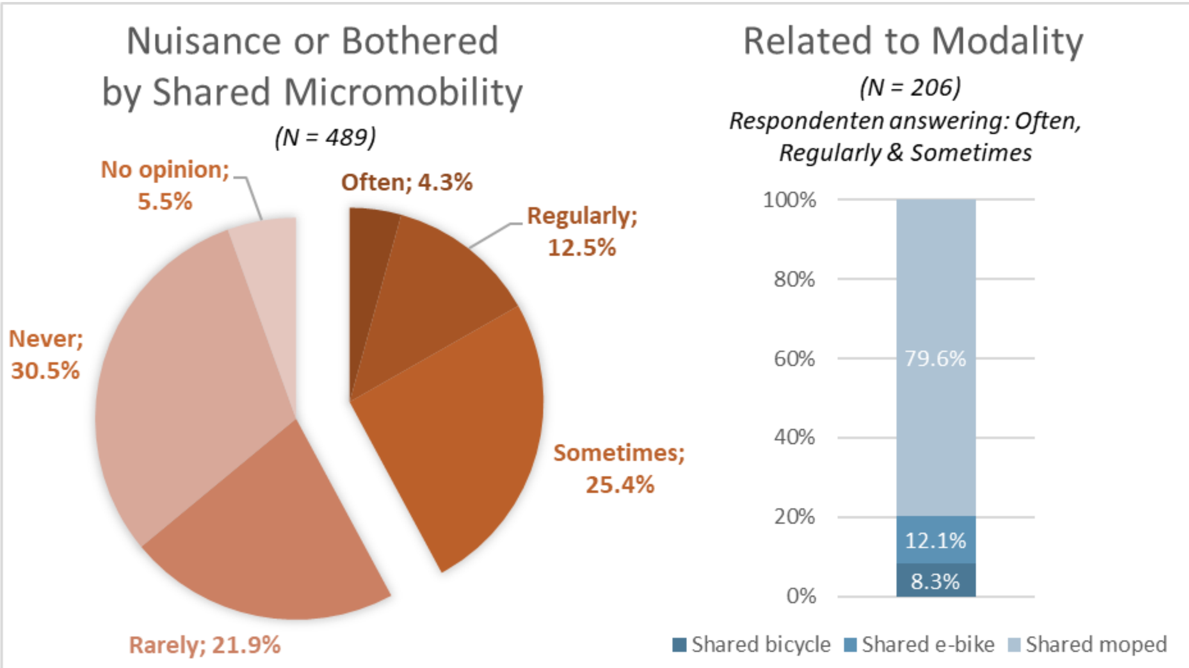
8
With which answers do you agree?
[Multiple answers possible]

"Potential use of shared two-wheelers is ..."

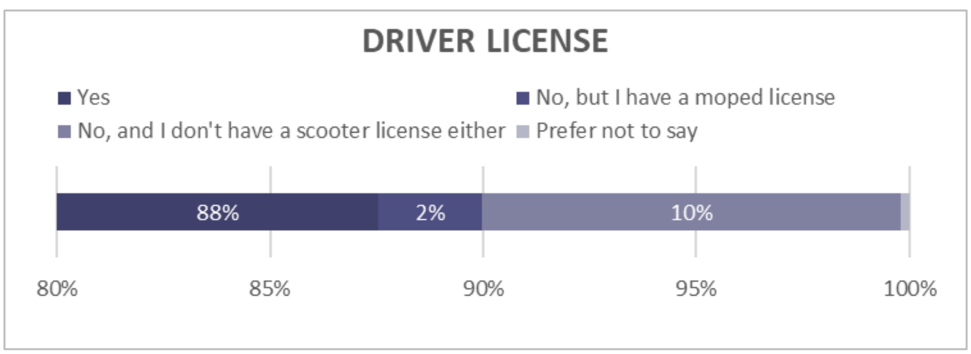
Only display this question:
If the following answer is given to question 2 = "Shared bicycle", "Shared e-bike" and/or "Shared moped"



9.1 & 9.2
To what extent do you experience inconvenience or are you occasionally bothered by shared (electric) bicycles or scooters?
Can you specify which mode of transportation bothers you the most:



10
Do you possess a driver's license for a car?

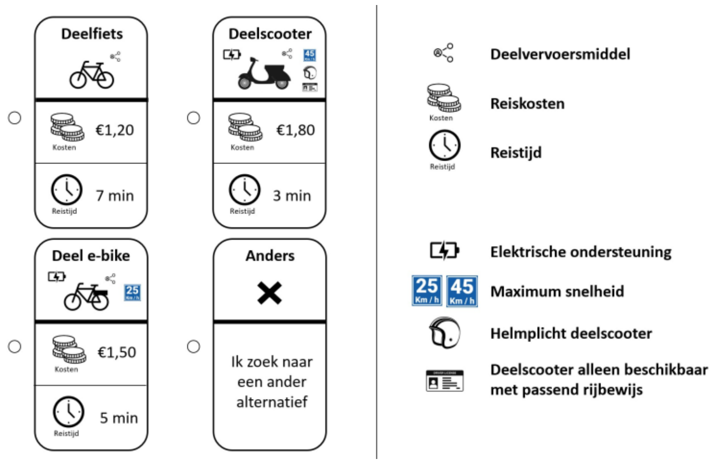


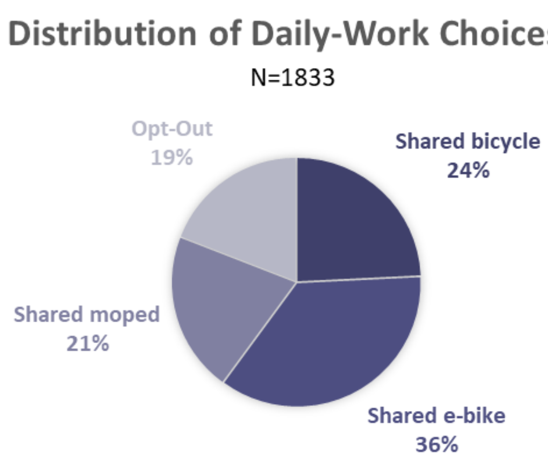
Daily-Work **Stated preference experiment**

In this part of the study, you will be presented with 8 choices related to a daily commuting trip, where the distance, price, and travel time change. Assume the following situation:

- *You make a daily commute to and from your workplace.*
- *The car is not available.*
- *You use public transportation (paid by your employer) and have to continue from the last stop to your workplace. This distance varies from 2 km to 8 km.*
- *You must choose between 3 modes of transportation: shared bicycle, electric shared bicycle, or shared scooter.*
- *Additionally, you have the choice not to use any of these 3 options and cover the distance from the last stop to your workplace in another way.*
- *The weather is dry and not cold.*
- *You are traveling during rush hour.*

Below, you will find an example with additional explanation (Dutch):



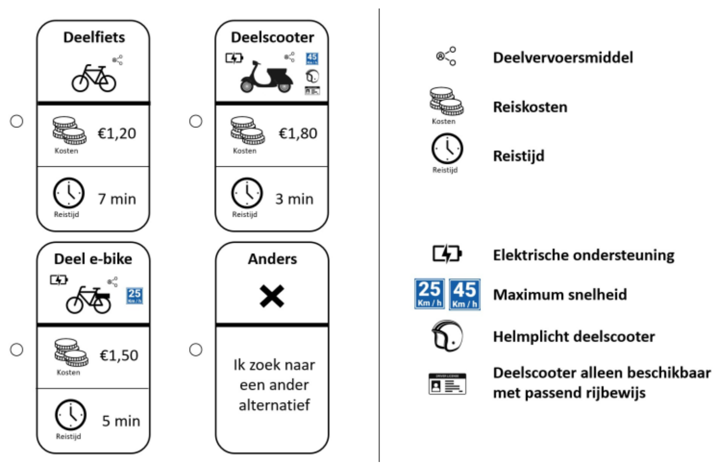


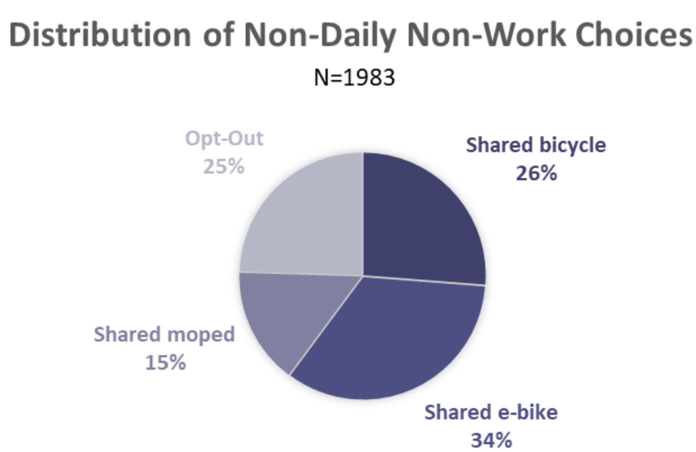
Non-Daily Non-Work **Stated preference experiment**

In this part of the study, you will be presented with 8 choices to make a trip, where the distance, price, and travel time change. Assume the following situation:

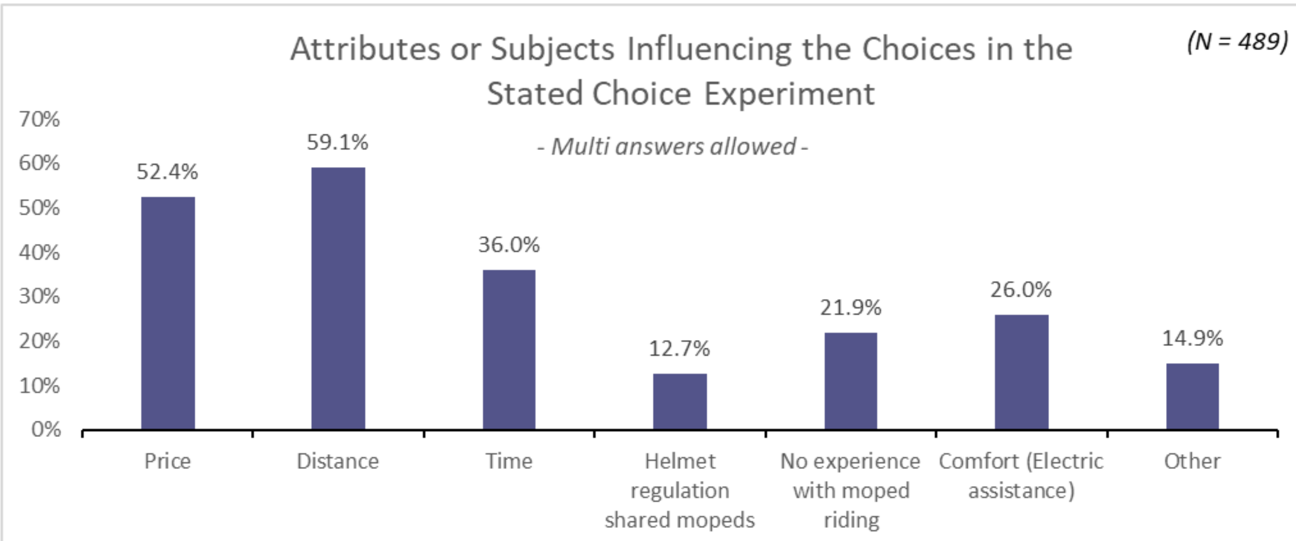
- You are going on a day trip. You are either taking your car or being driven.
- Parking at the destination is not possible, so after the car ride, you need to cover some distance. This distance varies from 2 km to 8 km.
- You must choose between 3 modes of transportation: shared bicycle, electric shared bicycle, or shared scooter.
- Additionally, you have the choice not to use any of these 3 options and cover the distance in another way.
- The weather is dry and not cold.

Below, you will find an example with additional explanation (Dutch):

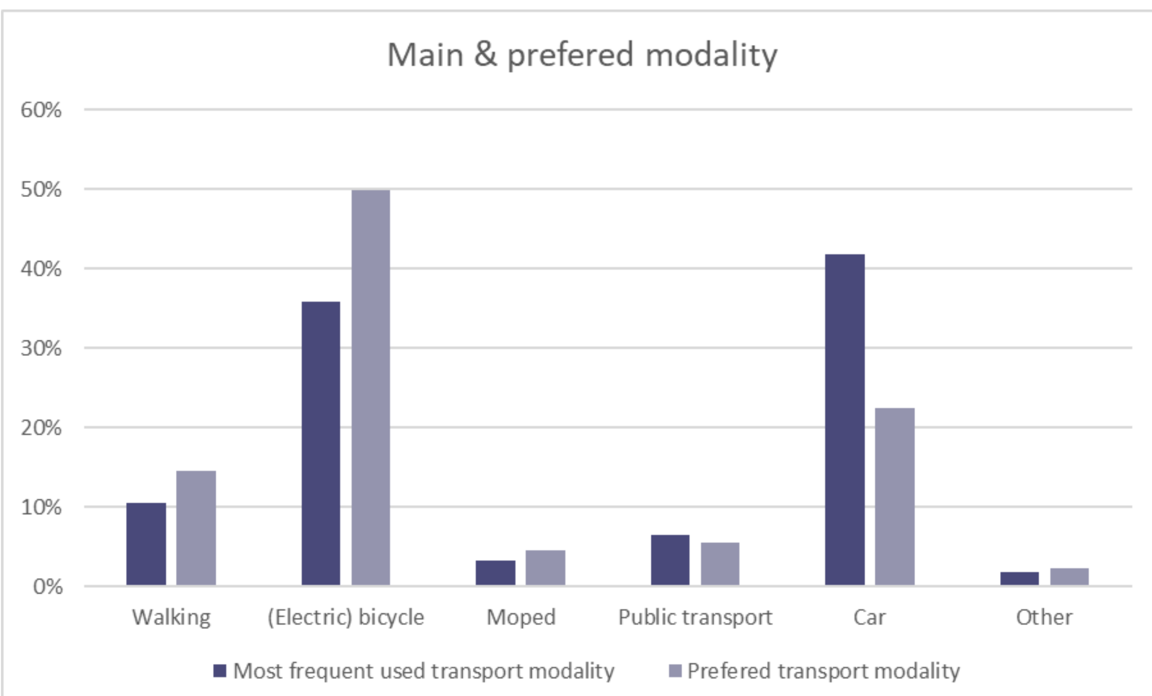




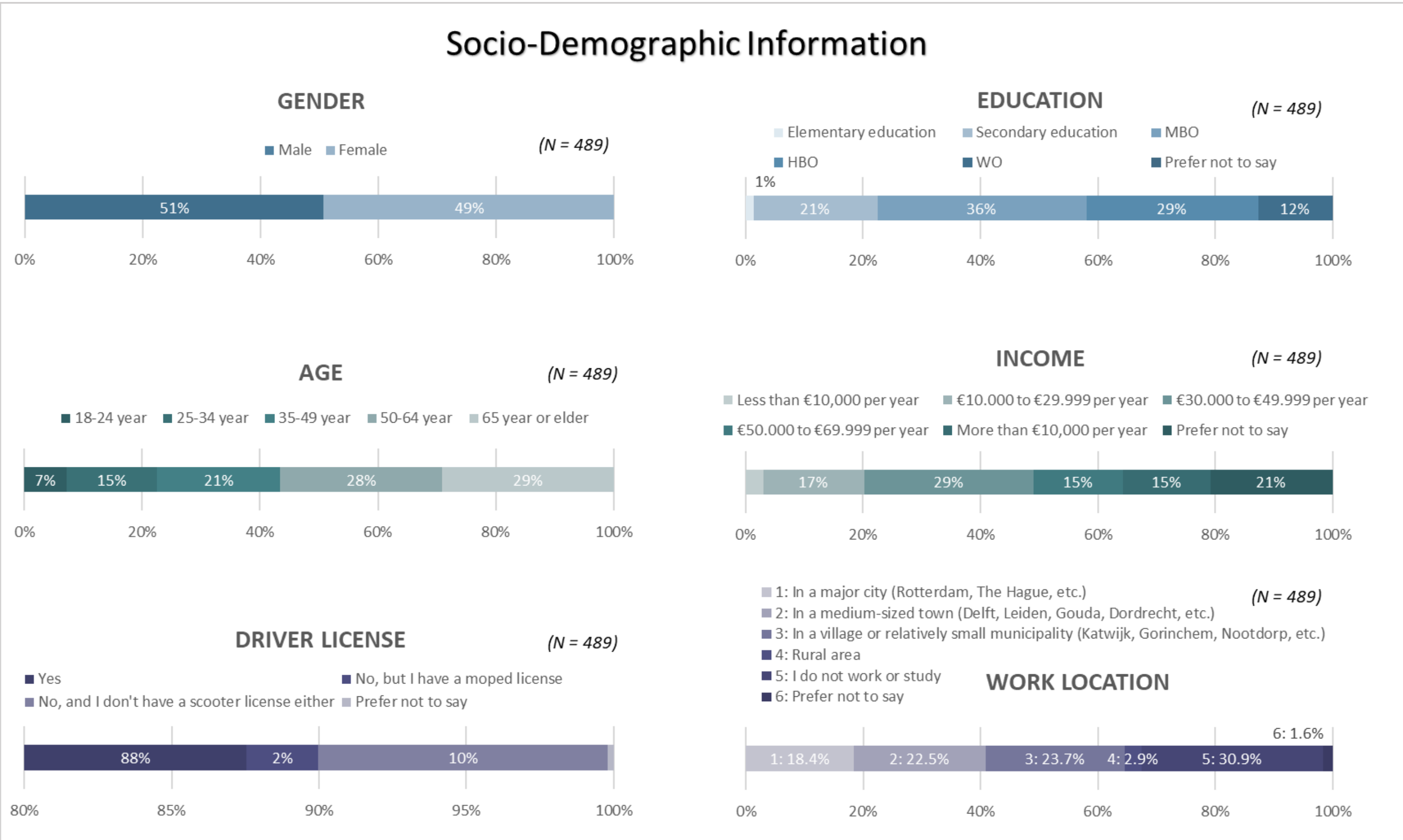
11
What has influenced your choices in the previous 8 questions?
[Multiple answers possible]



12.1 & 12.2
How do you most frequently commute?
How would you prefer to commute?

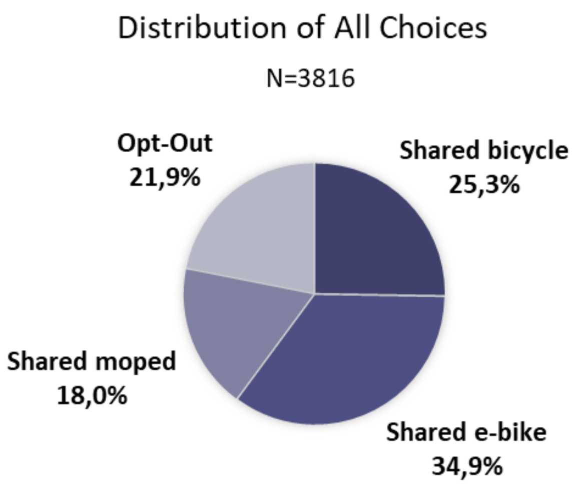


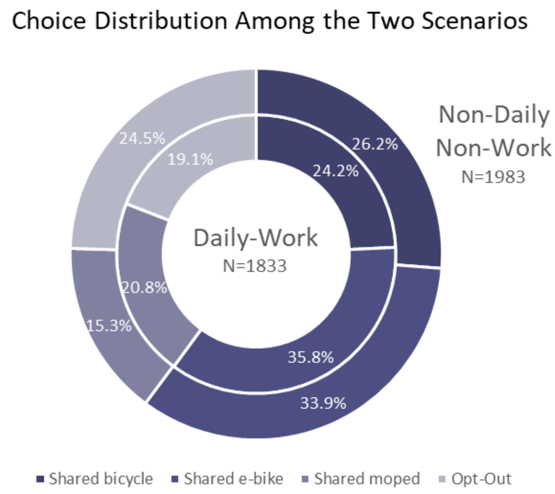
12.3 Gender: "What is your gender?"
12.4 Age: "What is your age?"
12.5 Education: "What is the highest level of education you have completed?"
12.6 Income: "What was your total gross household income per year in euros?"
10 Driver license: “Do you possess a driver's license for a car?”
6.3 Work Location: “Where do you work or study?”



F. Choice statistics

Distribution of all choices





Distance context

	2km	4km	6km	8km	Total
Shared bicycle	318	300	190	156	964
Shared e-bike	244	341	400	345	1330
Shared moped	81	134	207	264	686
Opt-Out	335	151	161	189	836
Total	**978**	**926**	**958**	**954**	**3816**

	2km	4km	6km	8km
Shared bicycle	32,5%	32,4%	19,8%	16,4%
Shared e-bike	24,9%	36,8%	41,8%	36,2%
Shared moped	8,3%	14,5%	21,6%	27,7%
Opt-Out	34,3%	16,3%	16,8%	19,8%

Age of participants

	18-24	25-34	35-49	50-64	65+
Shared bicycle	94	133	220	234	283
Shared e-bike	69	213	299	348	401
Shared moped	87	181	128	206	84
Opt-Out	27	66	149	260	334
Total	**277**	**593**	**796**	**1048**	**1102**

	18-24	25-34	35-49	50-64	65+
Shared bicycle	33,9%	22,4%	27,6%	22,3%	25,7%
Shared e-bike	24,9%	35,9%	37,6%	33,2%	36,4%
Shared moped	31,4%	30,5%	16,1%	19,7%	7,6%
Opt-Out	9,7%	11,1%	18,7%	24,8%	30,3%

Age related to distance

2km

	18-24	25-34	35-49	50-64	65+
Shared bicycle	32	55	72	85	74
Shared e-bike	10	39	57	62	76
Shared moped	10	28	10	28	5
Opt-Out	18	28	65	95	129
	70	**150**	**204**	**270**	**284**

Percentages

	18-24	25-34	35-49	50-64	65+
Shared bicycle	45,7%	36,7%	35,3%	31,5%	26,1%
Shared e-bike	14,3%	26,0%	27,9%	23,0%	26,8%
Shared moped	14,3%	18,7%	4,9%	10,4%	1,8%
Opt-Out	25,7%	18,7%	31,9%	35,2%	45,4%

4km

	18-24	25-34	35-49	50-64	65+
Shared bicycle	33	47	67	70	83
Shared e-bike	17	58	81	88	97
Shared moped	17	32	18	46	21
Opt-Out	1	10	27	50	63
	68	**147**	**193**	**254**	**264**

Percentages

	18-24	25-34	35-49	50-64	65+
Shared bicycle	48,5%	32,0%	34,7%	27,6%	31,4%
Shared e-bike	25,0%	39,5%	42,0%	34,6%	36,7%
Shared moped	25,0%	21,8%	9,3%	18,1%	8,0%
Opt-Out	1,5%	6,8%	14,0%	19,7%	23,9%

6km

	18-24	25-34	35-49	50-64	65+
Shared bicycle	19	18	42	42	69
Shared e-bike	21	64	88	110	117
Shared moped	27	54	48	54	24
Opt-Out	3	12	23	56	67
	70	**148**	**201**	**262**	**277**

Percentages

	18-24	25-34	35-49	50-64	65+
Shared bicycle	27,1%	12,2%	20,9%	16,0%	24,9%
Shared e-bike	30,0%	43,2%	43,8%	42,0%	42,2%
Shared moped	38,6%	36,5%	23,9%	20,6%	8,7%
Opt-Out	4,3%	8,1%	11,4%	21,4%	24,2%

8km

	18-24	25-34	35-49	50-64	65+
Shared bicycle	10	13	39	37	57
Shared e-bike	21	52	73	88	111
Shared moped	33	67	52	78	34
Opt-Out	5	16	34	59	75
	69	**148**	**198**	**262**	**277**

Percentages

	18-24	25-34	35-49	50-64	65+
Shared bicycle	14,5%	8,8%	19,7%	14,1%	20,6%
Shared e-bike	30,4%	35,1%	36,9%	33,6%	40,1%
Shared moped	47,8%	45,3%	26,3%	29,8%	12,3%
Opt-Out	7,2%	10,8%	17,2%	22,5%	27,1%

Level of education of participants

	Primary education	Secondary education	MBO	HBO	WO	Prefer not to answer
Shared bicycle	8	180	273	305	198	0
Shared e-bike	15	271	509	376	157	2
Shared moped	7	137	260	211	67	4
Opt-Out	25	215	314	218	62	2
Total	**55**	**803**	**1356**	**1110**	**484**	**8**

	Primary education	Secondary education	MBO	HBO	WO	Prefer not to answer
Shared bicycle	14,5%	22,4%	20,1%	27,5%	40,9%	0,0%
Shared e-bike	27,3%	33,7%	37,5%	33,9%	32,4%	25,0%
Shared moped	12,7%	17,1%	19,2%	19,0%	13,8%	50,0%
Opt-Out	45,5%	26,8%	23,2%	19,6%	12,8%	25,0%

Education related to distance

2km

	Primary	Secondary	MBO	HBO	WO	Prefer not to answer
Shared bicycle	2	58	102	100	56	0
Shared e-bike	4	48	94	75	23	0
Shared moped	0	20	35	19	7	2
Opt-Out	8	80	117	92	36	0
	14	**206**	**348**	**286**	**122**	**2**

Percentages

	Primary	Secondary	MBO	HBO	WO	Prefer not to answer
Shared bicycle	14,3%	28,2%	29,3%	35,0%	45,9%	0,0%
Shared e-bike	28,6%	23,3%	27,0%	26,2%	18,9%	0,0%
Shared moped	0,0%	9,7%	10,1%	6,6%	5,7%	25,0%
Opt-Out	57,1%	38,8%	33,6%	32,2%	29,5%	0,0%

4km

	Primary	Secondary	MBO	HBO	WO	Prefer not to answer
Shared bicycle	2	54	75	100	69	0
Shared e-bike	4	68	144	89	34	0
Shared moped	2	30	46	44	12	2
Opt-Out	5	41	62	38	5	0
	13	**193**	**327**	**271**	**120**	**2**

Percentages

	Primary	Secondary	MBO	HBO	WO	Prefer not to answer
Shared bicycle	15,4%	28,0%	22,9%	36,9%	57,5%	0,0%
Shared e-bike	30,8%	35,2%	44,0%	32,8%	28,3%	0,0%
Shared moped	15,4%	15,5%	14,1%	16,2%	10,0%	25,0%
Opt-Out	38,5%	21,2%	19,0%	14,0%	4,2%	0,0%

6km

	Primary	Secondary	MBO	HBO	WO	Prefer not to answer
Shared bicycle	2	38	52	55	43	0
Shared e-bike	4	82	142	120	52	0
Shared moped	2	38	80	64	21	2
Opt-Out	6	43	66	41	5	0
	14	**201**	**340**	**280**	**121**	**2**

Percentages

	Primary	Secondary	MBO	HBO	WO	Prefer not to answer
Shared bicycle	14,3%	18,9%	15,3%	19,6%	35,5%	0,0%
Shared e-bike	28,6%	40,8%	41,8%	42,9%	43,0%	0,0%
Shared moped	14,3%	18,9%	23,5%	22,9%	17,4%	25,0%
Opt-Out	42,9%	21,4%	19,4%	14,6%	4,1%	0,0%

8km

	Primary	Secondary	MBO	HBO	WO	Prefer not to answer
Shared bicycle	2	30	44	50	30	0
Shared e-bike	3	73	129	92	48	0
Shared moped	3	49	99	84	27	2
Opt-Out	6	51	69	47	16	0
	14	**203**	**341**	**273**	**121**	**2**

Percentages

	Primary	Secondary	MBO	HBO	WO	Prefer not to answer
Shared bicycle	14,3%	14,8%	12,9%	18,3%	24,8%	0,0%
Shared e-bike	21,4%	36,0%	37,8%	33,7%	39,7%	0,0%
Shared moped	21,4%	24,1%	29,0%	30,8%	22,3%	25,0%
Opt-Out	42,9%	25,1%	20,2%	17,2%	13,2%	0,0%

Income level of participants

	< €10.000 per year	€10.000 – €29.999 per year	€30.000 – €49.999 per year	€50.000 – €69.999 per year	> €70.000 per year	Prefer not to say
Shared bicycle	54	174	270	154	149	163
Shared e-bike	38	247	399	191	194	261
Shared moped	14	92	216	93	139	132
Opt-Out	12	147	224	133	91	229
Total	**118**	**660**	**1109**	**571**	**573**	**785**

	< €10.000 per year	€10.000 – €29.999 per year	€30.000 – €49.999 per year	€50.000 – €69.999 per year	> €70.000 per year	Prefer not to say
Shared bicycle	45,8%	26,4%	24,3%	27,0%	26,0%	20,8%
Shared e-bike	32,2%	37,4%	36,0%	33,5%	33,9%	33,2%
Shared moped	11,9%	13,9%	19,5%	16,3%	24,3%	16,8%
Opt-Out	10,2%	22,3%	20,2%	23,3%	15,9%	29,2%

Income related to distance

2km

	< €10.000 per year	€10.000 – €29.999 per year	€30.000 – €49.999 per year	€50.000 – €69.999 per year	> €70.000 per year	Prefer not to say
Shared bicycle	13	56	96	48	45	60
Shared e-bike	9	58	66	30	41	40
Shared moped	1	7	28	12	17	16
Opt-Out	7	47	92	58	43	88
	30	**168**	**282**	**148**	**146**	**204**

Percentages

	< €10.000 per year	€10.000 – €29.999 per year	€30.000 – €49.999 per year	€50.000 – €69.999 per year	> €70.000 per year	Prefer not to say
Shared bicycle	43,3%	33,3%	34,0%	32,4%	30,8%	29,4%
Shared e-bike	30,0%	34,5%	23,4%	20,3%	28,1%	19,6%
Shared moped	3,3%	4,2%	9,9%	8,1%	11,6%	7,8%
Opt-Out	23,3%	28,0%	32,6%	39,2%	29,5%	43,1%

4km

	< €10.000 per year	€10.000 – €29.999 per year	€30.000 – €49.999 per year	€50.000 – €69.999 per year	> €70.000 per year	Prefer not to say
Shared bicycle	16	51	81	50	53	49
Shared e-bike	6	64	112	49	44	66
Shared moped	5	18	41	13	30	27
Opt-Out	2	29	34	22	15	49
	29	**162**	**268**	**134**	**142**	**191**

Percentages

	< €10.000 per year	€10.000 – €29.999 per year	€30.000 – €49.999 per year	€50.000 – €69.999 per year	> €70.000 per year	Prefer not to say
Shared bicycle	55,2%	31,5%	30,2%	37,3%	37,3%	25,7%
Shared e-bike	20,7%	39,5%	41,8%	36,6%	31,0%	34,6%
Shared moped	17,2%	11,1%	15,3%	9,7%	21,1%	14,1%
Opt-Out	6,9%	17,9%	12,7%	16,4%	10,6%	25,7%

6km

	< €10.000 per year	€10.000 – €29.999 per year	€30.000 – €49.999 per year	€50.000 – €69.999 per year	> €70.000 per year	Prefer not to say
Shared bicycle	13	38	52	30	29	28
Shared e-bike	13	60	122	62	59	84
Shared moped	4	33	62	31	38	39
Opt-Out	0	35	43	23	17	43
	30	**166**	**279**	**146**	**143**	**194**

Percentages

	< €10.000 per year	€10.000 – €29.999 per year	€30.000 – €49.999 per year	€50.000 – €69.999 per year	> €70.000 per year	Prefer not to say
Shared bicycle	43,3%	22,9%	18,6%	20,5%	20,3%	14,4%
Shared e-bike	43,3%	36,1%	43,7%	42,5%	41,3%	43,3%
Shared moped	13,3%	19,9%	22,2%	21,2%	26,6%	20,1%
Opt-Out	0,0%	21,1%	15,4%	15,8%	11,9%	22,2%

8km

	< €10.000 per year	€10.000 – €29.999 per year	€30.000 – €49.999 per year	€50.000 – €69.999 per year	> €70.000 per year	Prefer not to say
Shared bicycle	12	29	41	26	22	26
Shared e-bike	10	65	99	50	50	71
Shared moped	4	34	85	37	54	50
Opt-Out	3	36	55	30	16	49
	29	**164**	**280**	**143**	**142**	**196**

Percentages

	< €10.000 per year	€10.000 – €29.999 per year	€30.000 – €49.999 per year	€50.000 – €69.999 per year	> €70.000 per year	Prefer not to say
Shared bicycle	41,4%	17,7%	14,6%	18,2%	15,5%	13,3%
Shared e-bike	34,5%	39,6%	35,4%	35,0%	35,2%	36,2%
Shared moped	13,8%	20,7%	30,4%	25,9%	38,0%	25,5%
Opt-Out	10,3%	22,0%	19,6%	21,0%	11,3%	25,0%

Gender of participants

	Male	Female
Shared bicycle	505	459
Shared e-bike	615	715
Shared moped	335	351
Opt-Out	475	361
Total	**1930**	**1886**

	Male	Female
Shared bicycle	26,2%	24,3%
Shared e-bike	31,9%	37,9%
Shared moped	17,4%	18,6%
Opt-Out	24,6%	19,1%

Gender related to distance

2km

	Male	Female
Shared bicycle	157	161
Shared e-bike	122	122
Shared moped	29	52
Opt-Out	188	147
	496	**482**

Percentages

	Male	Female
Shared bicycle	31,7%	33,4%
Shared e-bike	24,6%	25,3%
Shared moped	5,8%	10,8%
Opt-Out	37,9%	30,5%

4km

	Male	Female
Shared bicycle	158	142
Shared e-bike	153	188
Shared moped	67	67
Opt-Out	85	66
	463	**463**

Percentages

	Male	Female
Shared bicycle	34,1%	30,7%
Shared e-bike	33,0%	40,6%
Shared moped	14,5%	14,5%
Opt-Out	18,4%	14,3%

6km

	Male	Female
Shared bicycle	100	90
Shared e-bike	181	219
Shared moped	107	100
Opt-Out	97	64
	485	**473**

Percentages

	Male	Female
Shared bicycle	20,6%	19,0%
Shared e-bike	37,3%	46,3%
Shared moped	22,1%	21,1%
Opt-Out	20,0%	13,5%

8km

	Male	Female
Shared bicycle	90	66
Shared e-bike	159	186
Shared moped	132	132
Opt-Out	105	84
	486	**468**

Percentages

	Male	Female
Shared bicycle	18,5%	14,1%
Shared e-bike	32,7%	39,7%
Shared moped	27,2%	28,2%
Opt-Out	21,6%	17,9%

Main transport modality

	Walking	(Electric) bike	Moped	PT	Car	Other	Prefer not to say
Shared bicycle	132	398	19	75	324	10	6
Shared e-bike	109	579	23	103	494	22	0
Shared moped	38	181	58	42	359	8	0
Opt-Out	115	216	24	34	408	30	9
Total	**394**	**1374**	**124**	**254**	**1585**	**70**	**15**

	Walking	(Electric) bike	Moped	PT	Car	Other	Prefer not to say
Shared bicycle	33,5%	29,0%	15,3%	29,5%	20,4%	14,3%	40,0%
Shared e-bike	27,7%	42,1%	18,5%	40,6%	31,2%	31,4%	0,0%
Shared moped	9,6%	13,2%	46,8%	16,5%	22,6%	11,4%	0,0%
Opt-Out	29,2%	15,7%	19,4%	13,4%	25,7%	42,9%	60,0%

Preferred transport modality

	Walking	(Electric) bike	Moped	PT	Car	Other	Prefer not to say
Shared bicycle	173	567	9	62	140	7	6
Shared e-bike	140	827	20	76	247	12	8
Shared moped	64	273	121	20	178	30	0
Opt-Out	168	255	22	52	288	34	17
Total	**545**	**1922**	**172**	**210**	**853**	**83**	**31**

	Walking	(Electric) bike	Moped	PT	Car	Other	Prefer not to say
Shared bicycle	31,7%	29,5%	5,2%	29,5%	16,4%	8,4%	19,4%
Shared e-bike	25,7%	43,0%	11,6%	36,2%	29,0%	14,5%	25,8%
Shared moped	11,7%	14,2%	70,3%	9,5%	20,9%	36,1%	0,0%
Opt-Out	30,8%	13,3%	12,8%	24,8%	33,8%	41,0%	54,8%

User or non-user of shared modes

	Inexperienced with sharing	Shared bicycle users	Shared e-bike users	Shared moped users
Shared bicycle	633	257	31	76
Shared e-bike	944	207	104	132
Shared moped	425	86	41	184
Opt-Out	722	70	27	44
Total	**2724**	**620**	**203**	**436**

	Inexperienced with sharing	Shared bicycle users	Shared e-bike users	Shared moped users
Shared bicycle	23,2%	41,5%	15,3%	17,4%
Shared e-bike	34,7%	33,4%	51,2%	30,3%
Shared moped	15,6%	13,9%	20,2%	42,2%
Opt-Out	26,5%	11,3%	13,3%	10,1%

Interest in the topic

	Yes	A little bit	No	I don't know
Shared bicycle	251	463	227	23
Shared e-bike	272	710	293	55
Shared moped	178	320	155	33
Opt-Out	31	291	460	54
Total	**732**	**1784**	**1135**	**165**

	Yes	A little bit	No	I don't know
Shared bicycle	34,3%	26,0%	20,0%	13,9%
Shared e-bike	37,2%	39,8%	25,8%	33,3%
Shared moped	24,3%	17,9%	13,7%	20,0%
Opt-Out	4,2%	16,3%	40,5%	32,7%

Place of residence

	City	Town	Village
Shared bicycle	286	516	162
Shared e-bike	288	809	233
Shared moped	151	415	120
Opt-Out	184	514	138
Total	**909**	**2254**	**653**

	City	Town	Village
Shared bicycle	31,5%	22,9%	24,8%
Shared e-bike	31,7%	35,9%	35,7%
Shared moped	16,6%	18,4%	18,4%
Opt-Out	20,2%	22,8%	21,1%

Bothered by shared micromobility (Experiencing nuisance)

	Often	Sometimes	Never	No opinion
Shared bicycle	169	494	261	40
Shared e-bike	173	659	446	52
Shared moped	105	330	224	27
Opt-Out	185	331	238	82
Total	**632**	**1814**	**1169**	**201**

	Often	Sometimes	Never	No opinion
Shared bicycle	26,7%	27,2%	22,3%	19,9%
Shared e-bike	27,4%	36,3%	38,2%	25,9%
Shared moped	16,6%	18,2%	19,2%	13,4%
Opt-Out	29,3%	18,2%	20,4%	40,8%

G.1. Stated preference experiment

Attributes	Attributes levels	
Travel cost shared bike	Normal price [0]	50% discount [1]
Travel cost shared e-bike	Normal price [0]	50% discount [1]
Travel cost shared e-moped	Normal price [0]	50% discount [1]

Normal price	**2km**	**4km**	**6km**	**8km**
Travel cost shared bike	€1,20	€1,60	€2,00	€2,40
Travel cost shared e-bike	€1,50	€2,00	€2,50	€3,00
Travel cost shared e-moped	€1,80	€2,40	€3,00	€3,60

Travel time	**2km**	**4km**	**6km**	**8km**
Travel time shared bike	7 min	14 min	21 min	28 min
Travel time shared e-bike	5 min	10 min	15 min	20 min
Travel time shared e-moped	3 min	6 min	9 min	12 min

Table with all context scenario's (Situations) for stated preference (choice) experiment

		Shared bicycle	**Shared e-bike**	**Shared moped**	**Scenario**
2km	Situation 1	[0]	[0]	[0]	**Daily work**
	Situation 2	[1]	[0]	[0]	Non-work
	Situation 3	[0]	[1]	[0]	**Daily work**
	Situation 4	[0]	[0]	[1]	Non-work
	Situation 5	[1]	[1]	[0]	**Daily work**
	Situation 6	[1]	[0]	[1]	Non-work
	Situation 7	[0]	[1]	[1]	**Daily work**
	Situation 8	[1]	[1]	[1]	Non-work
4km	Situation 1	[0]	[0]	[0]	Non-work
	Situation 2	[1]	[0]	[0]	**Daily work**
	Situation 3	[0]	[1]	[0]	Non-work
	Situation 4	[0]	[0]	[1]	**Daily work**
	Situation 5	[1]	[1]	[0]	Non-work
	Situation 6	[1]	[0]	[1]	**Daily work**
	Situation 7	[0]	[1]	[1]	Non-work
	Situation 8	[1]	[1]	[1]	**Daily work**
6km	Situation 1	[0]	[0]	[0]	**Daily work**
	Situation 2	[1]	[0]	[0]	Non-work
	Situation 3	[0]	[1]	[0]	**Daily work**
	Situation 4	[0]	[0]	[1]	Non-work
	Situation 5	[1]	[1]	[0]	**Daily work**
	Situation 6	[1]	[0]	[1]	Non-work
	Situation 7	[0]	[1]	[1]	**Daily work**
	Situation 8	[1]	[1]	[1]	Non-work
8km	Situation 1	[0]	[0]	[0]	Non-work
	Situation 2	[1]	[0]	[0]	**Daily work**
	Situation 3	[0]	[1]	[0]	Non-work
	Situation 4	[0]	[0]	[1]	**Daily work**
	Situation 5	[1]	[1]	[0]	Non-work
	Situation 6	[1]	[0]	[1]	**Daily work**
	Situation 7	[0]	[1]	[1]	Non-work
	Situation 8	[1]	[1]	[1]	**Daily work**

Table with dummy coded variables for MNL model

Gender	GENDER				
Male	0				
Female	1				
Age	AGE1	AGE2	AGE3	AGE4	
18-24	1	0	0	0	
25-34	0	1	0	0	
35-49	0	0	1	0	
50-64	0	0	0	1	
65+	0	0	0	0	
Income	INCOME1	INCOME2	INCOME3		
< €10.000 per year	0	0	0		
€10.000-€29.999 per year	0	0	0		
€30.000-€49.999 per year	1	0	0		
€50.000-€69.999 per year	0	1	0		
+€70.000 per year	0	1	0		
Prefer not to answer	0	0	1		
Education	EDU1	EDU2			
Primary education	0	0			
Secondary education	0	0			
MBO	1	0			
HBO	1	0			
WO	0	1			
Prefer not to say	1	0			
Main modality	MM1	MM2	MM3	MM4	MM5
Walking	0	0	0	0	0
(Electric) bike	1	0	0	0	0
Moped	0	1	0	0	0
Public transport	0	0	1	0	0
Car	0	0	0	1	0
Other	0	0	0	0	1
Prefer not to say	0	0	0	0	1
Preferred modality	PM1	PM2	PM3	PM4	PM5
Walking	0	0	0	0	0
(Electric) bike	1	0	0	0	0
Moped	0	1	0	0	0
Public transport	0	0	1	0	0
Car	0	0	0	1	0
Other	0	0	0	0	1
Prefer not to say	0	0	0	0	1
Usage	USAGE				
Non-user	0				
User	1				
Interest	INTEREST				
No	0				
Yes	1				
Scenario	SCENARIO				
Non-Daily Non-Work	0				
Daily-Work	1				
Town	TOWN1	TOWN2			
> 100.000 inhabitants	0	0			
15.000-100.000 inhabitants	1	0			
< 15.000 inhabitants	0	1			

G.2. MNL model

Base model Python Biogeme script

```
import pandas as pd
import biogeme.database as db
import biogeme.biogeme as bio
import biogeme.models as models
from biogeme.expressions import Beta
from biogeme.expressions import Variable

df = pd.read_csv('data.dat', sep='\t')

database = db.Database("data",df)

globals().update(database.variables)
```

Parameters to be estimated

```
ASC_SHARED_BICYCLE =
Beta('ASC_SHARED_BICYCLE', 0, None,
None, 0)
ASC_SHARED_E_BIKE =
Beta('ASC_SHARED_E_BIKE', 0, None,
None, 0)
ASC_SHARED_MOPED =
Beta('ASC_SHARED_MOPED', 0, None,
None, 0)
ASC_OPT_OUT = Beta('ASC_OPT_OUT', 0, None,
None, 1)

B_COST = Beta('B_COST', 0, None, None, 0)
B_ SCENARIO = Beta('B_ SCENARIO, 0, None, None, 0)

ASC_DISTANCE_B = Beta('ASC_DISTANCE_B', 0,
None, None, 0)
ASC_DISTANCE_E_B = Beta('ASC_DISTANCE_E_B',
0, None, None, 0)
ASC_DISTANCE_M = Beta('ASC_DISTANCE_M', 0,
None, None, 0)
```

Utility functions

```
V_SHARED_BICYCLE =
        (ASC_SHARED_BICYCLE +
        B_COST * C_BYCICLE +
        ASC_DISTANCE_B * DISTANCE +
        B_ SCENARIO * SCENARIO)

V_SHARED_E_BIKE =
        (ASC_SHARED_E_BIKE +
        B_COST * C_E_BIKE +
        ASC_DISTANCE_E_B * DISTANCE +
        B_ SCENARIO * SCENARIO)

V_SHARED_MOPED =
        (ASC_SHARED_MOPED +
        B_COST * C_MOPED +
        ASC_DISTANCE_M * DISTANCE +
        B_SCENARIO * SCENARIO)

V_OPT_OUT = (ASC_OPT_OUT)

V = {1: V_SHARED_BICYCLE,
  2: V_SHARED_E_BIKE,
  3: V_SHARED_MOPED,
  4: V_OPT_OUT}

av = {1: 1, 2: 1, 3: AVAIL_MOPED, 4: 1}

logprob = models.loglogit(V, av, CHOICE)

biogeme = bio.BIOGEME(database, logprob)
biogeme.modelName = 'MNL Base'

results = biogeme.estimate()
```

Base model results

Number of estimated parameters:	8
Sample size:	3816
Excluded observations:	0
Init log likelihood:	-5181.931
Final log likelihood:	-4854.731
Likelihood ratio test for the init. model:	654.4006
Rho-square for the init. model:	0.0631
Rho-square-bar for the init. model:	0.0616
Akaike Information Criterion:	9725.461
Bayesian Information Criterion:	9775.437

Estimated parameters

Name	Value	Rob. Std err	Rob. t-test	Rob. p-value
ASC_DISTANCE_B	0.0581	0.0233	2.49	0.0127
ASC_DISTANCE_E_B	0.264	0.0225	11.7	0
ASC_DISTANCE_M	0.429	0.0271	15.8	0
ASC_SHARED_BICYCLE	0.403	0.12	3.34	0.000826
ASC_SHARED_E_BIKE	-0.0876	0.119	-0.738	0.461
ASC_SHARED_MOPED	-1.36	0.152	-8.97	0
B_ SCENARIO	0.35	0.0801	4.37	1.22e-05
B_COST	-0.548	0.0392	-14	0

Final model Python Biogeme script

```
import pandas as pd
import biogeme.database as db
import biogeme.biogeme as bio
import biogeme.models as models
from biogeme.expressions import Beta
from biogeme.expressions import Variable

df = pd.read_csv('data.dat', sep='\t')

database = db.Database("data",df)

globals().update(database.variables)
```

Parameters to be estimated

```
ASC_SHARED_BICYCLE = Beta('ASC_SHARED_BICYCLE', 0, None,
None, 0)
ASC_SHARED_E_BIKE = Beta('ASC_SHARED_E_BIKE', 0, None,
None, 0)
ASC_SHARED_MOPED = Beta('ASC_SHARED_MOPED', 0, None,
None, 0)
ASC_OPT_OUT = Beta('ASC_OPT_OUT', 0, None, None, 1)

B_COST = Beta('B_COST', 0, None, None, 0)
B_TIME = Beta('B_TIME', 0, None, None, 0)

ASC_GENDER_B = Beta('ASC_GENDER_B', 0, None, None, 0)
ASC_AGE1_B = Beta('ASC_AGE1_B', 0, None, None, 0)
ASC_AGE2_B = Beta('ASC_AGE2_B', 0, None, None, 0)
ASC_AGE3_B = Beta('ASC_AGE3_B', 0, None, None, 0)
ASC_AGE4_B = Beta('ASC_AGE4_B', 0, None, None, 0)
ASC_DISTANCE_B = Beta('ASC_DISTANCE_B', 0, None, None, 0)
ASC_SCENARIO_B = Beta('B_SCENARIO_B', 0, None, None, 0)
ASC_INTEREST_B = Beta('B_INTEREST_B', 0, None, None, 0)
ASC_USAGE_B = Beta('B_USAGE_B', 0, None, None, 0)

ASC_GENDER_E_B = Beta('ASC_GENDER_E_B', 0, None, None, 0)
ASC_AGE1_E_B = Beta('ASC_AGE1_E_B', 0, None, None, 0)
ASC_AGE2_E_B = Beta('ASC_AGE2_E_B', 0, None, None, 0)
ASC_AGE3_E_B = Beta('ASC_AGE3_E_B', 0, None, None, 0)
ASC_AGE4_E_B = Beta('ASC_AGE4_E_B', 0, None, None, 0)
ASC_DISTANCE_E_B = Beta('ASC_DISTANCE_E_B', 0, None, None, 0)
ASC_SCENARIO_E_B = Beta('B_SCENARIO_E_B', 0, None, None, 0)
ASC_INTEREST_E_B = Beta('B_INTEREST_E_B', 0, None, None, 0)
ASC_USAGE_E_B = Beta('B_USAGE_E_B', 0, None, None, 0)

ASC_GENDER_M = Beta('ASC_GENDER_M', 0, None, None, 0)
ASC_AGE1_M = Beta('ASC_AGE1_M', 0, None, None, 0)
ASC_AGE2_M = Beta('ASC_AGE2_M', 0, None, None, 0)
ASC_AGE3_M = Beta('ASC_AGE3_M', 0, None, None, 0)
ASC_AGE4_M = Beta('ASC_AGE4_M', 0, None, None, 0)
ASC_DISTANCE_M = Beta('ASC_DISTANCE_M', 0, None, None, 0)
ASC_SCENARIO_M = Beta('B_SCENARIO_M', 0, None, None, 0)
ASC_INTEREST_M = Beta('B_INTEREST_M', 0, None, None, 0)
ASC_USAGE_M = Beta('B_USAGE_M', 0, None, None, 0)
```

Utility functions

```
V_SHARED_BICYCLE = (ASC_SHARED_BICYCLE +
            B_COST * C_BYCICLE +
            B_TIME * TIME +
            ASC_SCENARIO_B * SCENARIO +
            ASC_GENDER_B * GENDER +
            ASC_AGE1_B * AGE1 + ASC_AGE2_B * AGE2 +
ASC_AGE3_B * AGE3 + ASC_AGE4_B * AGE4 +
            ASC_DISTANCE_B * DISTANCE +
            ASC_INTEREST_B * INTEREST +
            ASC_USAGE_B * USAGE)

V_SHARED_E_BIKE = (ASC_SHARED_E_BIKE +
            B_COST * C_E_BIKE +
            B_TIME * TIME +
            ASC_SCENARIO_E_B * SCENARIO +
            ASC_GENDER_E_B * GENDER +
            ASC_AGE1_E_B * AGE1 + ASC_AGE2_E_B *
AGE2 + ASC_AGE3_E_B * AGE3 + ASC_AGE4_E_B * AGE4
            + ASC_DISTANCE_E_B * DISTANCE +
            ASC_INTEREST_E_B * INTEREST +
            ASC_USAGE_E_B * USAGE)

V_SHARED_MOPED = (ASC_SHARED_MOPED +
            B_COST * C_MOPED +
            B_TIME * TIME +
            ASC_SCENARIO_M * SCENARIO +
            ASC_GENDER_M * GENDER +
            ASC_AGE1_M * AGE1 + ASC_AGE2_M * AGE2 +
ASC_AGE3_M * AGE3 + ASC_AGE4_M * AGE4 +
            ASC_DISTANCE_M * DISTANCE +
            ASC_INTEREST_M * INTEREST +
            ASC_USAGE_M * USAGE)

V_OPT_OUT = (ASC_OPT_OUT)

V = {1: V_SHARED_BICYCLE,
   2: V_SHARED_E_BIKE,
   3: V_SHARED_MOPED,
   4: V_OPT_OUT}

av = {1: 1, 2: 1, 3: AVAIL_MOPED, 4: 1}

logprob = models.loglogit(V, av, CHOICE)

biogeme = bio.BIOGEME(database, logprob)
biogeme.modelName = 'MNL Final

results = biogeme.estimate()
```

Final model results

Number of estimated parameters: 30
Sample size: 3816
Excluded observations: 0
Init log likelihood: -5181.931
Final log likelihood: -4509.131
Likelihood ratio test for the init. model: 1345.6
Rho-square for the init. model: 0.13
Rho-square-bar for the init. model: 0.124
Akaike Information Criterion: 9078.262
Bayesian Information Criterion: 9265.671

Name	Value	Rob. Std err	Rob. t-test	Rob. p-value
ASC_AGE1_B	0.792	0.241	3.29	0.001
ASC_AGE1_E_B	0.21	0.247	0.847	0.397
ASC_AGE1_M	2.36	0.277	8.52	0
ASC_AGE2_B	0.381	0.184	2.07	0.0385
ASC_AGE2_E_B	0.516	0.178	2.9	0.00379
ASC_AGE2_M	2	0.207	9.66	0
ASC_AGE3_B	0.353	0.142	2.48	0.013
ASC_AGE3_E_B	0.3	0.137	2.2	0.028
ASC_AGE3_M	0.994	0.181	5.48	4.33e-08
ASC_AGE4_B	-0.12	0.128	-0.936	0.349
ASC_AGE4_E_B	-0.1	0.12	-0.835	0.404
ASC_AGE4_M	0.985	0.163	6.03	1.65e-09
ASC_DISTANCE_B	0.0812	0.0246	3.3	0.000955
ASC_DISTANCE_E_B	0.289	0.0242	12	0
ASC_DISTANCE_M	0.472	0.029	16.3	0
ASC_GENDER_B	0.203	0.102	1.99	0.0471
ASC_GENDER_E_B	0.457	0.0985	4.64	3.44e-06
ASC_GENDER_M	0.292	0.117	2.49	0.0129
ASC_SHARED_BICYCLE	-0.96	0.18	-5.35	8.86e-08
ASC_SHARED_E_BIKE	-1.7	0.188	-9.03	0
ASC_SHARED_MOPED	-3.88	0.242	-16	0
B_SCENARIO_B	0.379	0.101	3.75	0.000178
B_SCENARIO_E_B	0.596	0.0966	6.17	6.64e-10
B_SCENARIO_M	0.718	0.116	6.2	5.76e-10
B_COST	-0.564	0.0408	-13.8	0
B_INTEREST_B	1.37	0.109	12.6	0
B_INTEREST_E_B	1.49	0.105	14.3	0
B_INTEREST_M	1.24	0.126	9.82	0
B_TIME	0.000325	0.000141	2.3	0.0217
B_USAGE_B	0.5	0.138	3.63	0.000282
B_USAGE_E_B	0.321	0.137	2.35	0.0189
B_USAGE_M	0.566	0.151	3.75	0.000174

Results of various models

Many models are estimated in the process of finding the best model, the results of 2 models are presented below.

Extra model	**1**			**2**	
Parameters	51			57	
Sample size	3816			3816	
Excluded observations	0			0	
Init log likelihood	-5181.931			-5181.931	
Final log likelihood	-4470.986			-4336.257	
Likelihood ratio test	1421.89			1691.347	
Rho-square	0.137			0.163	
Rho-square-bar	0.127			0.152	
AIC	9043.971			8786.514	
BIC	9362.566			9142.591	
Name	**Value**	**Rob. p-value**	**Name**	**Value**	**Rob. p-value**
ASC_SHARED_BICYCLE	0.925	0.0183	**ASC_SHARED_BICYCLE**	0.997	0.0183
ASC_SHARED_E_BIKE	-0.62	0.106	**ASC_SHARED_E_BIKE**	-0.84	0.0408
ASC_SHARED_MOPED	-2.5	2.84e-06	**ASC_SHARED_MOPED**	-2.71	2.89e-07
B_AGE1_B	0.903	0.000193	**B_COST_B**	-0.566	1.89e-10
B_AGE1_E_B	0.377	0.122	**B_COST_E_B**	-0.6	0
B_AGE1_M	2.84	0	**B_COST_M**	-0.611	0
B_AGE2_B	0.328	0.085	**B_DISTANCE_B**	0.0719	0.00848
B_AGE2_E_B	0.551	0.00217	**B_DISTANCE_E_B**	0.288	0
B_AGE2_M	2.28	0	**B_DISTANCE_M**	0.493	0
B_AGE3_B	0.357	0.0191	**B_INCOME1_B**	-1.45	0.000182
B_AGE3_E_B	0.296	0.0445	**B_INCOME1_E_B**	-0.714	0.0588
B_AGE3_M	1.21	6.52e-10	**B_INCOME1_M**	-0.619	0.183
B_AGE4_B	-0.0641	0.636	**B_INCOME2_B**	-1.64	4.35e-05
B_AGE4_E_B	-0.0399	0.754	**B_INCOME2_E_B**	-1.06	0.0068
B_AGE4_M	1.12	1e-10	**B_INCOME2_M**	-1.08	0.0246
B_COST_B	-0.562	2.6e-10	**B_INCOME3_B**	-1.08	0.00823
B_COST_E_B	-0.563	0	**B_INCOME3_E_B**	-0.409	0.305
B_COST_M	-0.577	0	**B_INCOME3_M**	-0.105	0.828
B_DISTANCE_B	0.071	0.00812	**B_INCOME4_B**	-1.95	7.83e-07
B_DISTANCE_E_B	0.282	0	**B_INCOME4_E_B**	-1.14	0.00316
B_DISTANCE_M	0.477	0	**B_INCOME4_M**	-0.959	0.0444
B_EDU1_B	0.0905	0.467	**B_INTEREST_B**	1.36	0
B_EDU1_E_B	0.0152	0.895	**B_INTEREST_E_B**	1.41	0
B_EDU1_M	-0.401	0.00526	**B_INTEREST_M**	1.18	0
B_EDU2_B	0.76	0.000221	**B_MM1_B**	-0.18	0.374
B_EDU2_E_B	-0.0376	0.856	**B_MM1_E_B**	0.148	0.489
B_EDU2_M	-0.987	9.31e-05	**B_MM1_M**	0.0777	0.782

B_GENDER_B	0.22	0.042	**B_MM2_B**	0.0659	0.852
B_GENDER_E_B	0.459	6.82e-06	**B_MM2_E_B**	0.153	0.647
B_GENDER_M	0.289	0.0157	**B_MM2_M**	0.728	0.107
B_INCOME1_B	-1.18	0.00101	**B_MM3_B**	0.379	0.222
B_INCOME1_E_B	-0.489	0.158	**B_MM3_E_B**	0.892	0.00469
B_INCOME1_M	-0.414	0.385	**B_MM3_M**	0.975	0.0106
B_INCOME2_B	-1.4	0.000207	**B_MM4_B**	-0.35	0.0674
B_INCOME2_E_B	-0.79	0.031	**B_MM4_E_B**	-0.055	0.78
B_INCOME2_M	-0.953	0.054	**B_MM4_M**	0.438	0.085
B_INCOME3_B	-1.17	0.00276	**B_MM5_B**	0.347	0.341
B_INCOME3_E_B	-0.214	0.569	**B_MM5_E_B**	0.294	0.427
B_INCOME3_M	0.0227	0.964	**B_MM5_M**	-0.533	0.289
B_INCOME4_B	-1.69	3.47e-06	**B_PM1_B**	0.993	1.72e-08
B_INCOME4_E_B	-0.908	0.00994	**B_PM1_E_B**	1.47	6.66e-16
B_INCOME4_M	-0.953	0.0477	**B_PM1_M**	1.2	3.1e-07
B_INTEREST_B	1.4	0	**B_PM2_B**	-1.29	0.00461
B_INTEREST_E_B	1.52	0	**B_PM2_E_B**	-0.207	0.559
B_INTEREST_M	1.41	0	**B_PM2_M**	2.3	6.81e-11
B_TOWN1_B	-0.405	0.00085	**B_PM3_B**	-0.156	0.564
B_TOWN1_E_B	0.00669	0.956	**B_PM3_E_B**	-0.0246	0.927
B_TOWN1_M	-0.117	0.424	**B_PM3_M**	-0.577	0.108
B_TOWN2_B	-0.437	0.0071	**B_PM4_B**	-0.392	0.0379
B_TOWN2_E_B	-0.0606	0.691	**B_PM4_E_B**	0.282	0.121
B_TOWN2_M	-0.205	0.262	**B_PM4_M**	0.412	0.0689
			B_PM5_B	-0.699	0.0276
			B_PM5_E_B	-0.719	0.0456
			B_PM5_M	0.764	0.0457
			B_USAGE_B	0.65	2.25e-06
			B_USAGE_E_B	0.437	0.00128
			B_USAGE_M	0.877	7.93e-09

Results of various models

The results of two additional models can be found below. Model 4 includes one of the interaction variables estimated during the process. Most of the interaction variables were not significant and did not results in new insight, for that reason the interaction variables are not further used in the final model.

Extra model	**3**			**4**	
Parameters	47			17	
Sample size	2516			3816	
Excluded observations	1300			0	
Init log likelihood	-3419.736			-5181.931	
Final log likelihood	-2784.841			-4645.959	
Likelihood ratio test	1269.79			1071.944	
Rho-square	0.186			0.103	
Rho-square-bar	0.172			0.1	
AIC	5663.682			9325.918	
BIC	5937.712			9432.116	
Name	**Value**	**Rob. p-value**	**Name**	**Value**	**Rob. p-value**
ASC_SHARED_BICYCLE	0.831	0.00529	**ASC_SHARED_BICYCLE**	-0.403	0.00254
ASC_SHARED_E_BIKE	-0.476	0.114	**ASC_SHARED_E_BIKE**	-0.88	1.08e-10
ASC_SHARED_MOPED	-2.59	3.85e-12	**ASC_SHARED_MOPED**	-2.22	0
B_AGE1	0.744	0.0289	**B_COST**	-0.243	0.0558
B_AGE2	0.503	0.0426	**B_DISTANCE_B**	0.0733	0.00251
B_AGE3	-0.187	0.302	**B_DISTANCE_E_B**	0.277	0
B_AGE4	-0.511	0.00263	**B_DISTANCE_M**	0.448	0
B_SCENARIO	0.73	5.2e-08	**B_INCOME1_COST**	-0.302	0.0165
B_COST	-0.635	0	**B_INCOME2_COST**	-0.377	0.00538
B_DISTANCE_B	0.0756	0.0415	**B_INCOME3_COST**	-0.17	0.2
B_DISTANCE_E_B	0.32	0	**B_INCOME4_COST**	-0.437	0.00087
B_DISTANCE_M	0.532	0	**B_INTEREST_B**	1.33	0
B_GENDER	0.154	0.266	**B_INTEREST_E_B**	1.44	0
B_MM1_B	-0.236	0.444	**B_INTEREST_M**	1.21	0
B_MM1_E_B	0.201	0.519	**B_USAGE_B**	0.696	5.72e-08
B_MM1_M	0.209	0.576	**B_USAGE_E_B**	0.439	0.000453
B_MM2_B	-0.163	0.783	**B_USAGE_M**	1.05	7.66e-14
B_MM2_E_B	0.168	0.769			
B_MM2_M	0.177	0.769			
B_MM3_B	-0.633	0.163			
B_MM3_E_B	-0.213	0.637			
B_MM3_M	-0.0502	0.922			
B_MM4_B	-0.553	0.0535			
B_MM4_E_B	-0.231	0.421			
B_MM4_M	0.448	0.198			

B_MM5_B	0.449	0.404
B_MM5_E_B	0.0114	0.986
B_MM5_M	-1.78	0.0636
B_PM1_B	0.777	0.00204
B_PM1_E_B	1.25	6.92e-07
B_PM1_M	0.831	0.00533
B_PM2_B	-2.65	0.000208
B_PM2_E_B	-0.64	0.142
B_PM2_M	2.12	1.06e-06
B_PM3_B	0.57	0.179
B_PM3_E_B	0.814	0.0532
B_PM3_M	0.22	0.656
B_PM4_B	-0.345	0.207
B_PM4_E_B	0.421	0.107
B_PM4_M	0.533	0.0783
B_PM5_B	-1.55	0.00022
B_PM5_E_B	-0.486	0.319
B_PM5_M	0.673	0.183
B_TIME	0.000123	0.0136
B_USAGE_B	0.455	0.00446
B_USAGE_E_B	0.15	0.34
B_USAGE_M	0.646	0.000202

G.3. Model application

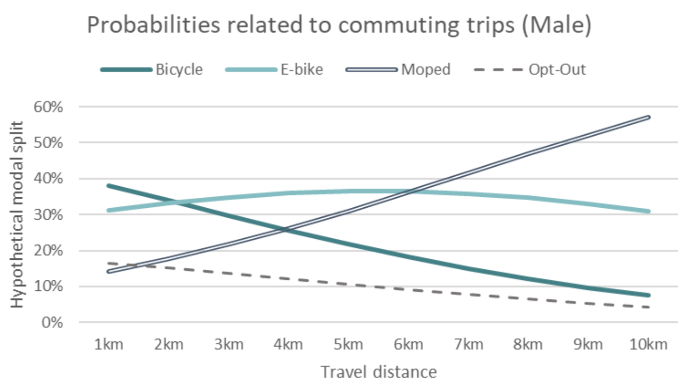
The first graph for each age group (25-34, 35-49 and 65 and older) is the base, in which each following graph includes one changed parameter compared to the base situation. The base situation includes commuting trips of males, that are interested in the subject, but do not have any experience with using shared modes. Additionally, the following costs table is applied:

Distance	1	2	3	4	5	6	7	8	9	10
Shared bicycle	1.00	1.20	1.40	1.60	1.80	2.00	2.20	2.40	2.60	2.80
Shared e-bike	1.25	1.50	1.75	2.00	2.25	2.50	2.75	3.00	3.25	3.50
Shared moped	1.50	1.80	2.10	2.40	2.70	3.00	3.30	3.60	3.90	4.20

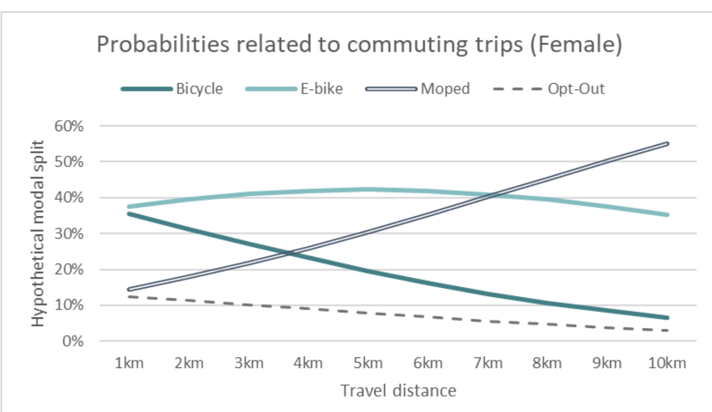
Price scheme in euros, based on real pricing in Dutch context

Probability estimations for age group 25-34 year

Base situation

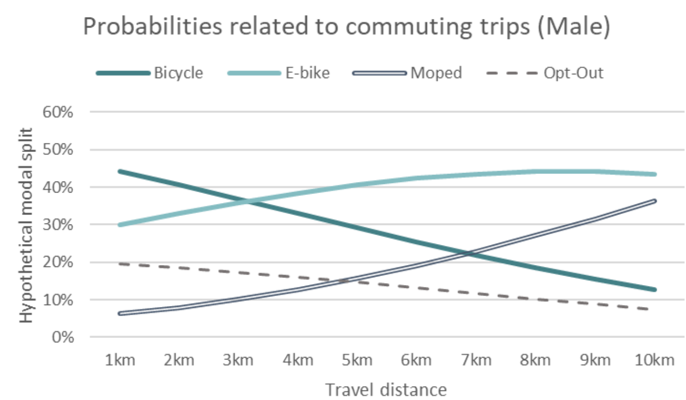


Adjustment: Gender to female

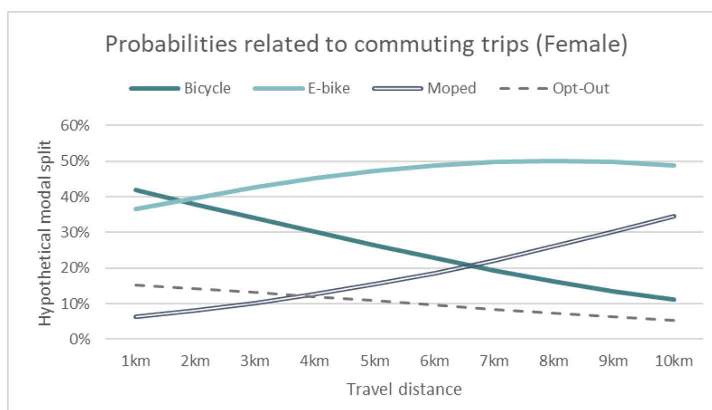


Probability estimations for age group 35-49 year

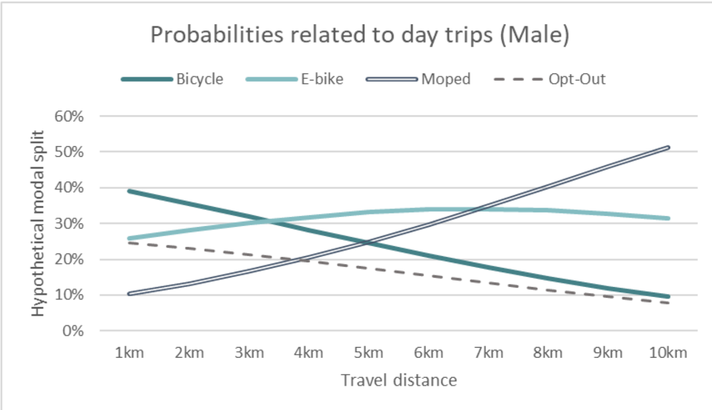
Base situation



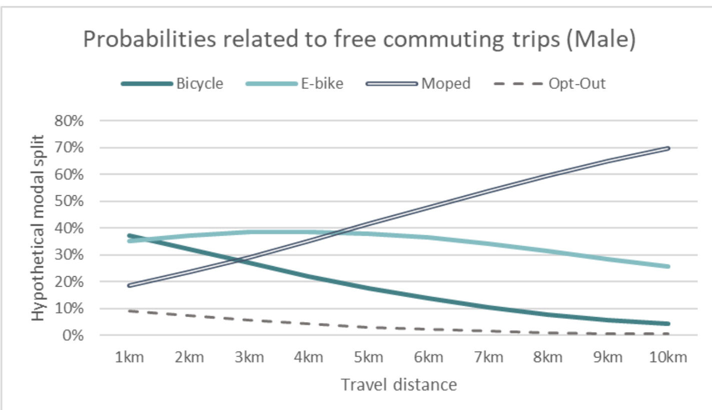
Adjustment: Gender to female



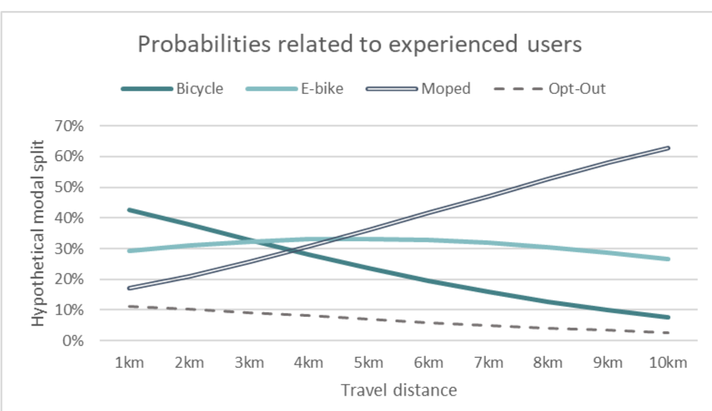
Adjustment: Scenario to day trip



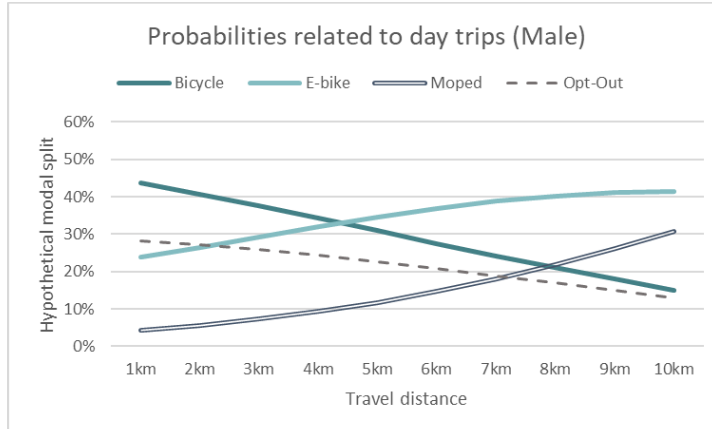
Adjustment: No pricing



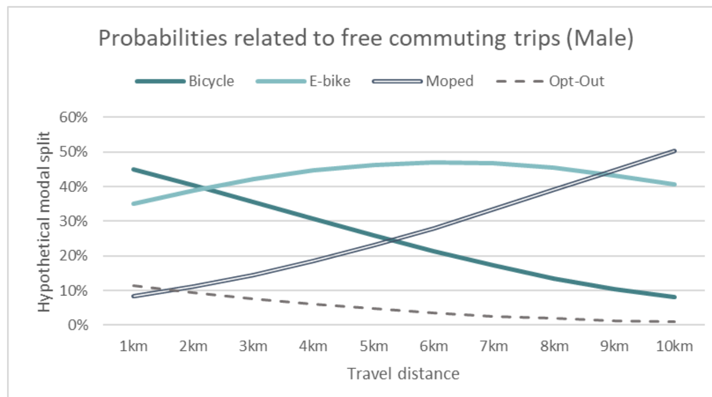
Adjustment: Only experienced users



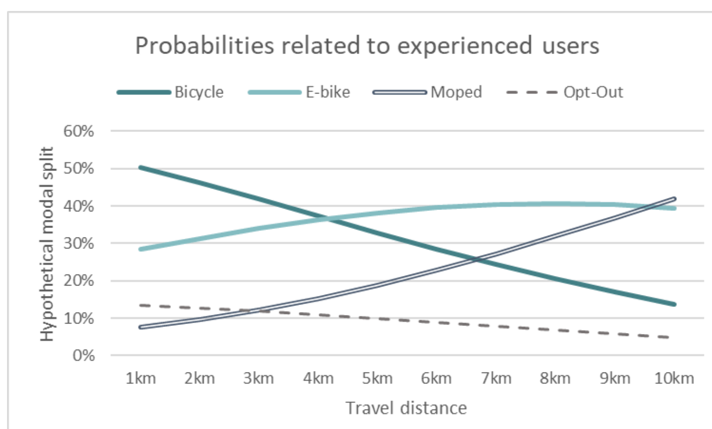
Adjustment: Scenario to day trip



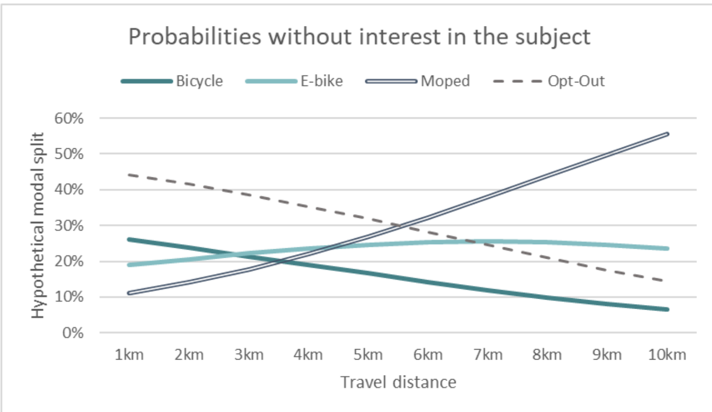
Adjustment: No pricing



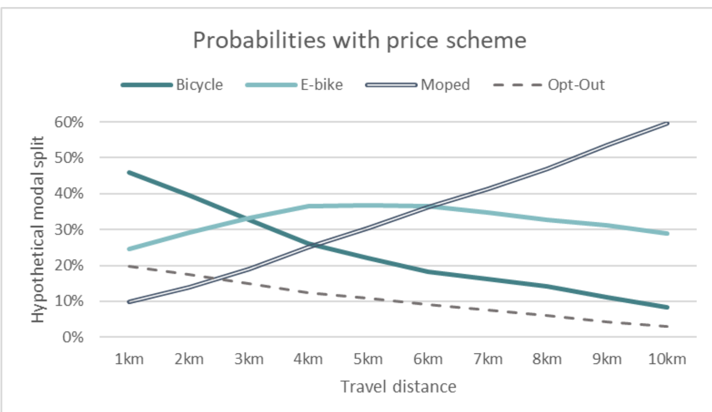
Adjustment: Only experienced users



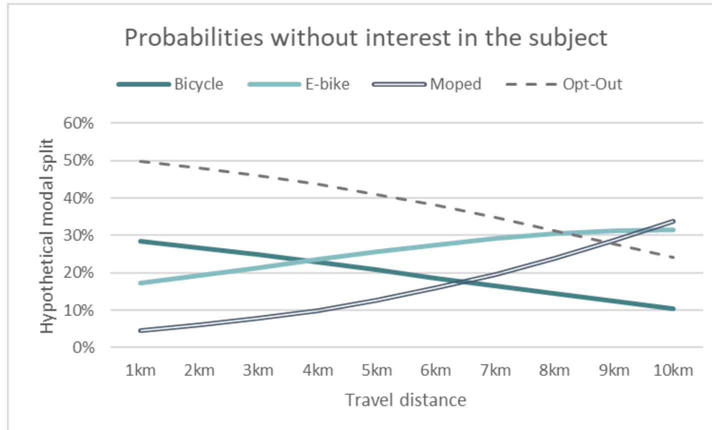
Adjustment: No interest in shared micromobility



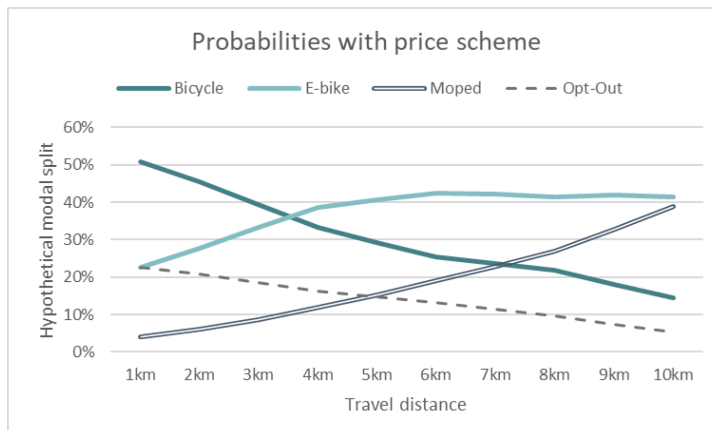
Adjustment: New price scheme



Adjustment: No interest in shared micromobility



Adjustment: New price scheme

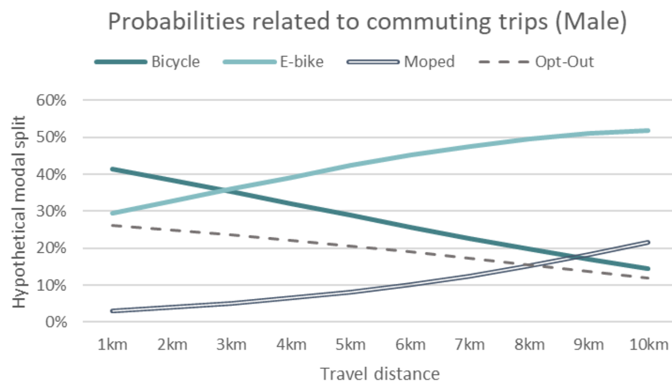


Distance	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Shared bicycle	1.00	1.20	1.40	1.60	1.80	2.00	2.00	2.00	2.00	2.00
Shared e-bike	2.00	2.00	2.00	2.00	2.25	2.50	2.75	3.00	3.00	3.00
Shared moped	2.50	2.50	2.50	2.50	2.75	3.00	3.25	3.50	3.50	3.50

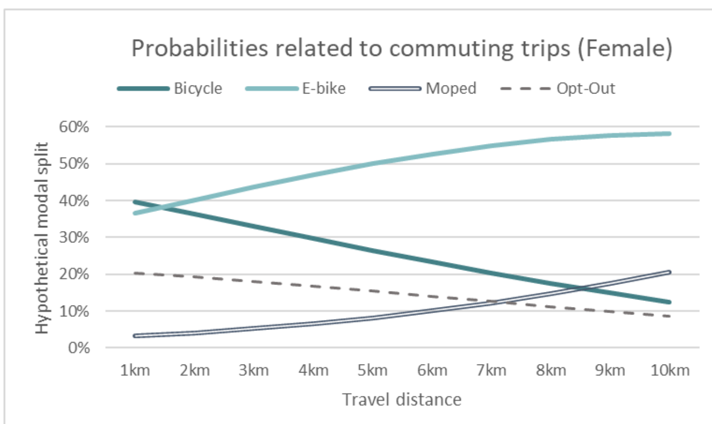
New price scheme in euros, encourage people to only use shared e-bikes & mopeds for longer distances

Probability estimations for age group above 65 year

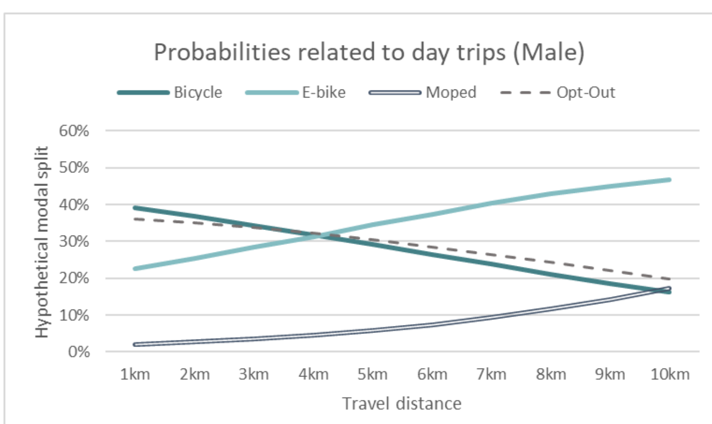
Base situation



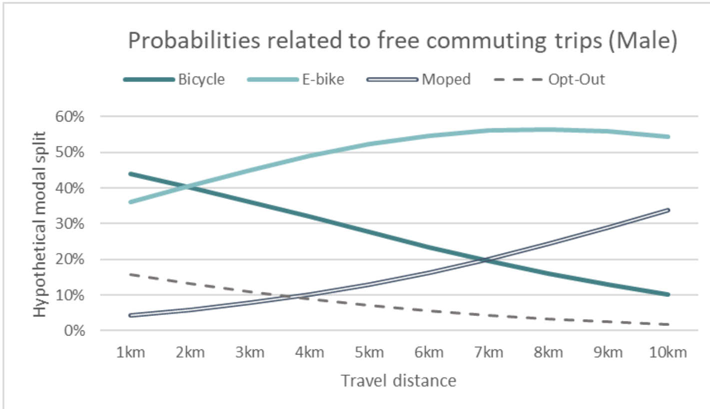
Adjustment: Gender to female



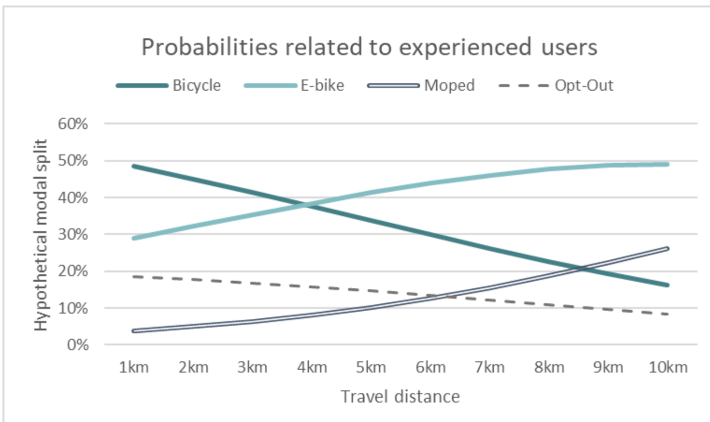
Adjustment: Scenario to day trip



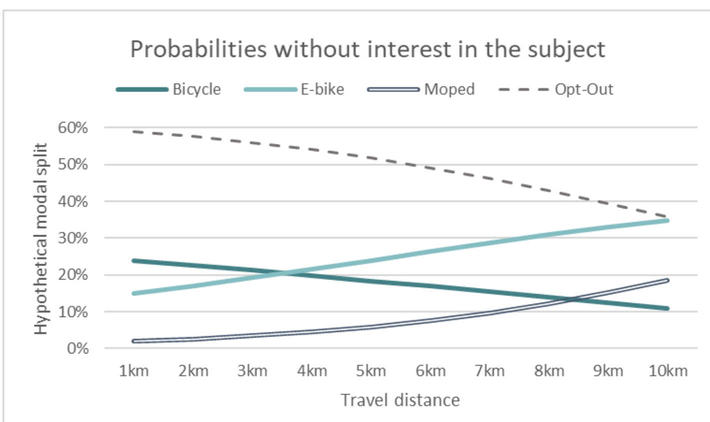
Adjustment: No pricing



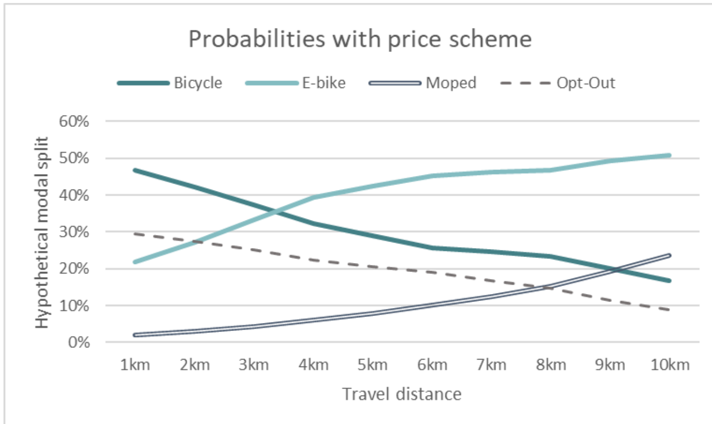
Adjustment: Only experienced users



Adjustment: No interest shared micromobility



Adjustment: New price scheme



H. Additional case study information (Dutch)

- Next page -

provincie Zuid-Holland

Leiden

Katwijk

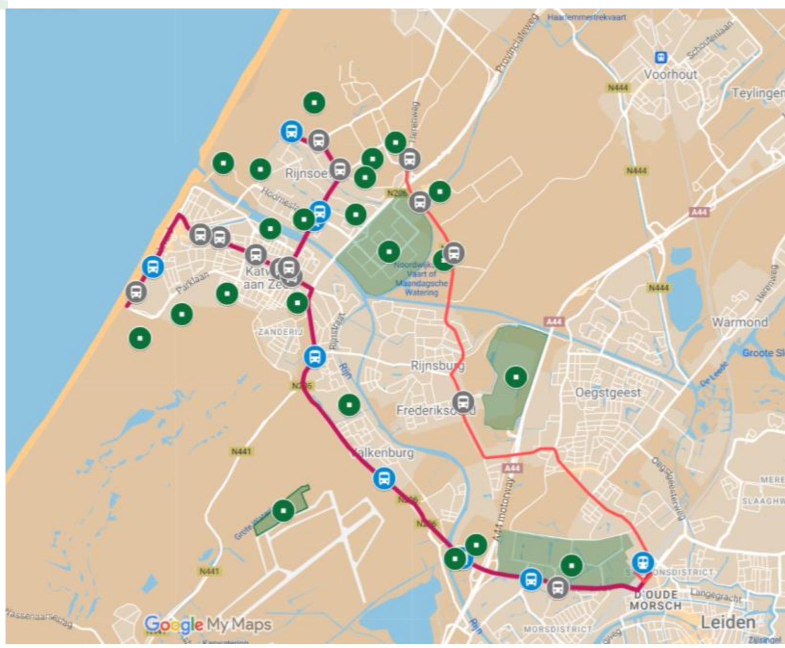
Deelmobiliteit Leiden-Katwijk-Noordwijk

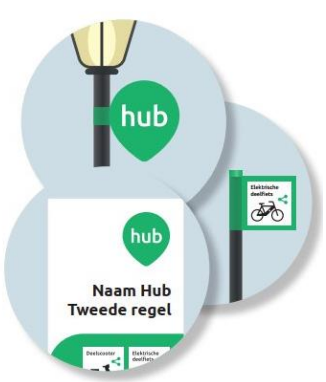
Bereikbaarheid verbeteren door toepassing van deelfietsen/-scooters in de regio

- Als verbetering van de bereikbaarheid en vervoerskeuze in de regio Leiden – Katwijk – Noordwijk
- Aanvulling op hoogwaardige R-Netlijnen 430 & 431 (Uitbreiding mogelijk voor buslijn 20 & 21)
- Aantrekkelijk en flexibel alternatief voor de auto, tevens vermindering van de druk op fietsenstallingen
- Station Leiden CS + belangrijkste bushaltes vormen de belangrijkste OV-hubs
- Bedrijventerreinen (O.a. ESA Estec en Unmanned Valley), sportverenigingen en andere bestemmingen fungeren als bestemming-hubs
- Op iedere hub kan een rit begonnen en/of beëindigd worden (Ofwel een 'back-to-many' deelsysteem)

- Gebruik van zones en aangeduide parkeerplekken voorkomt rommelige situaties op ongewenste plekken
- Voorkeur gaat uit naar standaard deelfietsen (Zelf trappen) met als aanvulling elektrische deelfietsen of deelscooters
- Voorkeur voor twee exploitanten
- MaaS (Mobility as a Service) kan onderdeel zijn van het systeem
- Eenduidig en gebruiksvriendelijk staat centraal binnen de toepassing van het deelvervoer

Link digitale kaart: ***Servicegebied (Concept)***





Interesse in het project?

Locaties kunnen op aanvraag worden toegevoegd aan het servicegebied

Stuur een mail aan:

R.Boting@pzh.nl of RA.Haverman@pzh.nl