Go Along With Pioneers:

shared bicycle experiences in the case of Arriva bike&go

Master Thesis **Society, Sustainability and Planning**

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Cover picture: Arriva bike&go in front of the lockers (Source: Internal Arriva promotion)

Abstract

Rural areas often struggle with car dependency and limited public transit. Arriva bike&go is an initiative that aims to improve mobility with sustainable transport options by providing electric foldable bikes at train stations for travelers. This research uses bike-along interviews to understand user experiences, applying Roger's innovation and diffusion model to emphasize the role of engagement and direct experience surrounding the factors of knowledge, trialability and (dis)approval. Pioneers generally have a positive initial view of Arriva bike&go, driven by curiosity and the perceived advantages of e-bikes. However, mixed opinions exist regarding its overall effectiveness for providing rural accessibility. Participants noted that trial experiences could improve overall engagement and adoption. Issues with the foldability, the app, lockers, and other transfer penalties were highlighted as main complexities. Recommendations include expanding bike availability, simplifying usage, and increasing observability through clear information, promotion and trial opportunities. Although it is still questioned, whether Arriva bike&go can specifically address the last mile problem, addressing a decrease in complexity and increase in observability could be central for the initiative's adoption to a wider travel group.

Keywords: Last Mile, Rural accessibility, Bike Sharing Systems, Innovation and Diffusion, Trialability, Go-along, Bike-along

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IDM: Innovation and Diffusion Model (by Rogers)

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Chapter 1: Introduction

1.1: Background and problem definition

Having grown up in a rural part of The Netherlands, I distinctly remember a time when some friends from the city wanted to visit my parents' farm. Which at first thought and in their eyes, sounded easy enough: Take a train then a bus, and maybe walk the last bit. Until they realized that they had to walk four kilometers. Renting a bike at the train station may have been a next option, but since there were none at this particular station this was also not possible. Even if there were some, 12 kilometers is not an easy cycle. A car could be an option, but at that time, no one had their own driver's license, and driving back and forth a few times, can also quickly become a hassle. Eventually, a tractor with a trailer was used, a creative solution to such a seemingly easy trip toward a get-together (Figure 1). This story illustrates that the rural countryside of the Netherlands may not always be as accessible as the urban areas that they surround. Rural areas are characterized by low populations and considerable distances between places, this mix leads to a low density of residents and facilities (Milbourne and Kitchen, 2014; Jorritsma, Jonkeren and Krabbenborg, 2023).

Figure 1) The tractor and trailer used to pick up people from a bus station. (Source: author)

Public transit in rural regions is, therefore, less economically viable and often underserved and uncertain (Porru *et al.*, 2020), not benefitting from scalability that more urban regions do (Jorritsma, Jonkeren and Krabbenborg, 2023). Moreover, rural areas often have to deal with a shrinking population (CBS, 2022a), enhancing this effect (Porru *et al.*, 2020). National policy aims to improve the accessibility of rural areas, where a focus on needs at different locations and scales stands central (De Lange and Ministerie I&W, 2021). A central concept within this focus is last mile solutions, which are often the missing link in robust and reliable public transport systems (European Environment Agency, 2019). The missing link from public transport to locations where people need to go is crucial to increase the accessibility of the rural area (Rongen *et al.*, 2022). When this link is missing, usage and availability of public transit in rural areas, is decreasing, often translating into a high dependency on the car as a form

of transportation to get around (NOS, 2022; RTV Noord, 2022; Jorritsma, Jonkeren and Krabbenborg, 2023).

The high usage of cars in rural areas, while it can provide accessibility, does have limitations when it comes to a dependency to get around (Rongen *et al.*, 2022). Many people may not perceive car dependency as a problem, but this dependency does provide risks in spatial accessibility for people who do not have access to a car, or when facilities in rural areas disappear even more (Pot, Koster and Tillema, 2023; RTV Noord, 2023). Consequently, individuals who do not have a driver's license or access to a car can lose their mobility as seen in rural Poland (Żukowska, Chmiel and Połom, 2023). Similarly, in Wales, rural residents consider the car ever more essential to life in the area, mainly because local services have been deteriorating (Milbourne and Kitchen, 2014). Moreover, there are not only social effects related to car use, but environmental effects and emissions are also central motivators to reduce car usage in policy documents (De Lange and Ministerie I&W, 2021; De Vos, 2024). Habits of car usage in rural areas have been shown to be challenged by a trial of new modalities (Bösehans *et al.*, 2024), challenging these habits could thus be beneficial for understanding. Because these environmental goals often align with the social goals of the Dutch government a reduction in the number of cars is often aimed for (Hoen *et al.*, 2019; De Lange and Ministerie I&W, 2021). In addition, in rural areas because of the benefit of density in economic processes, public transit and other forms other than car use can be hard to achieve (Milbourne and Kitchen, 2014; Plazier, Weitkamp and van den Berg, 2023a). That is why in this diverse context, we can look for new solutions to look for rural accessibility, which may be better suited than a tractor with a trailer.

Shared bicycles can be an opportunity to fill the gap in the last mile that public transit alone is not always able to solve. The bicycle infrastructure in the Netherlands is often well and thoroughly designed (Cabral Dias and Gomes Ribeiro, 2021; Jorritsma *et al.*, 2021), which can likewise be used for commuting, recreating, or other bicycle uses including last mile trips (Kask *et al.*, 2021). With the increase in the diversity and number of users of e-bikes, shared bicycle initiatives are added to the transport mix that might compete with the car (Weitkamp, Plazier and Mossel, 2018; Plazier, Weitkamp and van den Berg, 2023a). Already in the Netherlands, there is a considerable amount of travelers who cycle to a train station and continue their journey from there (Jonkeren *et al.*, 2021), showing that bicycles are being used as a part of multimodal transportation (Jonkeren *et al.*, 2021; Plazier, Weitkamp and van den Berg, 2023a). The sharing of bikes especially, is intuitively a last mile solution, but not sure whether initiatives will be used for this purpose (Campbell, 2019). New bike sharing initiatives are maturing at their own pace (Ma *et al.*, 2020), and careful consideration in the implementation is central to achieve the goals of reducing CO2 emissions and more robust accessibility in rural areas (Hoen *et al.*, 2019; Bergantino, Intini and Tangari, 2021).

One of the routes to introduce new mobility initiatives to an area is through pilots. One of these pilots is Arriva bike&go, a shared foldable bicycle initiative at the train stations of Groningen and Leeuwarden. One of the intentions behind the pilot is that users can take these foldable bikes with them on the train free of charge. This way users can use this bicycle to finish the last mile of their trip, even at stations where there would not be sufficient public transit or other options (Arriva Nederland, 2024; Leasefiets, 2024). This research creates a case study, where a specific solution: the Bike&Go initiative, can be assessed and be translated as a solution for the last mile problem in areas outside of just the urban.

1.2: Research aim and questions

In this complex context, Arriva bike&go is used as a case study to evaluate the user experience of this new pilot initiative. Drawing on the concepts of knowledge (relative advantage & compatibility), approval factors (observability), and trialability (complexity), adopted from Rogers' (1983) model of innovation and diffusion, the experiences of pioneers are identified. While the focus lies on the experiences of users in a wide plurality of ways, the research is done in light of rural accessibility and what these various experiences might say about Arriva bike&go as part of rural accessibility regarding the last mile problem. Consequently, for this research, the following research question and sub-research questions is answered.

How do pioneers experience the Arriva bike&go initiative as a way of contributing to rural accessibility regarding the last mile problem?

1) How do knowledge factors contribute to views of Arriva bike&go as a first-time user?
2) How can trialability add to the ease of adoption of Arriva bike&go?
3) What improvements could be made to Arriva bike&go to increase approval in the user experience?

From a societal perspective, numerous arguments can be made to look at rural accessibility, whether it is critically looking at the perceived accessibility of the car (Pot, Koster and Tillema, 2023), the underservice of public transport (Milbourne and Kitchen, 2014), or environmental concerns (Hoen *et al.*, 2019). Looking at local government, the province of Fryslân recognizes that they are a province where car usage is relatively high (Provincie Fryslan, 2021). However, they want to integrate and foster other forms of mobility in the transport network, forms that are more sustainable and healthy (Provincie Fryslan, 2021). Similarly, the province of Groningen promotes a well-integrated mobility strategy, where there is a focus on mobility hubs and equality of opportunity stand central (Provincie Groningen, 2022). Trying to tackle this last mile problem, can consequently be beneficial in these regions to tackle policy goals regarding accessibility of the rural. For this research, the so-called last mile problem is used as a perspective to look at rural accessibility.

From an academic point of view, this study could add to various debates that are being researched. Firstly, the last mile is often discussed in relation to underserved communities, mainly centering on urban areas (Lu, Prato and Corcoran, 2021; Alfaris and Jalayer, 2023). Also in the Dutch context research in bike-sharing initiatives often focuses on urban areas or initiatives centered in big population centers (Arendsen, 2019; Ma *et al.*, 2020; Jorritsma *et al.*, 2021), overlooking the accessibility of rural regions. Secondly, motives, experiences, and identification of different demographics in bicycle sharing have been researched (Jones, Harms and Heinen, 2016; Peine, van Cooten and Neven, 2017; Bergantino, Intini and Tangari, 2021). However, they are used on a bigger scale allowing for quantitative analysis (Arendsen, 2019), or are in other ways limiting for small-scale novel initiatives and overlook the direct experiences during use. Last and most centrally, experiences can be interviewed, but an understanding of the barriers to adoption are missing or outside the scope of most researches in this field (Popovich *et al.*, 2014; Jones, Harms and Heinen, 2016; Plazier, Weitkamp and van den Berg, 2017; Rongen *et al.*, 2022). That is why for this research the perspective of the innovation and diffusion model (IDM) by Rogers is taken. Some studies already use this perspective of Rogers (Munkácsy and Monzón, 2018; Bösehans *et al.*, 2024), however, these often look at a longer time scale and focus on the rate of adoption. So, this research takes a step back and with a novel method of bike-along interviews, to look in-depth look at the experiences of pioneer users.

1.3: Reading Guide

Chapter 1 has just described the social and academic relevance of researching the experience of the new bicycle initiative of Arriva bike&go. After which the motivation and consequent research questions where provided. Chapter 2 will look at the theoretical framework, where first the concept of last mile problems and transfer penalties is given, followed by information on Arriva bike&go as a bike sharing scheme, and finally end with our conceptual model and the explanations of Roger's theory on innovation. Chapter 3 will provide the methodology and introduce go-along methods as a method to capture direct experiences. Chapter 4 will provide the results of the research and interviews done, along with the structure of the conceptual model. Chapter 5 will discuss these results in relation to the literature and provide a discussion of these results and the methods used. Chapter 6 will finally conclude the research question and provide recommendations for the planning practice and future research.

Chapter 2: Theoretical Framework

2.1 Last mile problem in rural areas

It is important to understand the complexities of multimodal trips, since the first and last mile transport is essential for public transport, but is often experienced as the weakest link (Stam *et al.*, 2021). In general, a multi-modal trip can be unpacked in three different stages: the first mile, the main stage, and the last mile. The main stage is often the part that covers the largest distance and the first and last mile, the ways to get to and from this mode to the start and end point of a journey (Stam *et al.*, 2021). Because of this direction, a distinction is often made, where the first mile refers to the home end and the last mile refers to the activity end of the journey (Arendsen, 2019). When integrated well, multimodal trips are suggested to compete with car travel (Jonkeren *et al.*, 2021; Stam *et al.*, 2021; Kosmidis and Müller-Eie, 2024).

Cars do not only constitute a central role in the accessibility of rural areas (Pot, Koster and Tillema, 2023) but are also often the most preferred mode for first and last mile in multimodal trips, including public transport (Stam *et al.*, 2021). However, especially in the context of the Netherlands, regular bicycles are often used to get to and from the train station especially in the first mile (Jonkeren *et al.*, 2021). Walking and cycling are in most contexts the most used mode in both the first as well as the last mile (Jonkeren *et al.*, 2021; Jara-Diaz *et al.*, 2022). So while cars might be preferred, usage is often not translated, because of lacking parking facilities and sufficient choice of alternative modal options (Jonkeren *et al.*, 2021). Furthermore, car usage does lead to more congestion at central spots at peak hours (European Environment Agency, 2019), which is why it is often not preferred by planners (Stam *et al.*, 2021; Alfaris and Jalayer, 2023). In urban areas, the car is consequently strongly suppressed in multimodal transit, and in rural areas increasingly so (Jonkeren *et al.*, 2021; Stam *et al.*, 2021).

Electric bicycles are suggested to, however, provide an opportunity to tackle first and last mile problems in rural areas (Plazier, Weitkamp and van den Berg, 2023a). The multimodal transit with bicycles and trains is a complex context specific collaboration that is influenced by numerous factors, like the quality of infrastructure, the surrounding built environment, and attractiveness of alternative modes (Kosmidis and Müller-Eie, 2024). Still, different modes in multimodal trips have been suggested to strengthen one another if well integrated (Ma *et al.*, 2020). In the last mile, shared bicycles claim an increasing share and can provide an opportunity to strengthen this collaboration (Jonkeren *et al.*, 2021). Still, because of the low population in rural areas, positive financial returns can be limited in less dense areas (Rongen *et al.*, 2022), where subsidies can be vital to the existence of new mobility initiatives (Jorritsma, Jonkeren and Krabbenborg, 2023). Moreover, the complexity and diversity of municipalities and other levels of government could cause long implementation procedures (Jorritsma, Jonkeren and Krabbenborg, 2023). So, not only multimodal journey itself can become complex also the institutions surrounding it can create hurdles to overcome. This shows that in order to tackle the last mile, a clear understanding of complexities and steps towards integration are needed (Garcia-Martinez *et al.*, 2018; Kosmidis and Müller-Eie, 2024).

2.2 Transfer penalties

To understand the context specific complexities in multimodal transit the concept of transfer penalties can be used. A transfer penalty is the disutility that a traveler experiences during their transfer in a journey (Garcia-Martinez *et al.*, 2018). One of the central aspects of this is the pure transfer penalty, which is the additional travel time a user is willing to stand to avoid breaking the trip (Jara-Diaz *et al.*, 2022) or the inconvenience of the transfer itself (Garcia-Martinez *et al.*, 2018). Other considerations can include time factors, personal characteristics, and factors in the built environment (Cascajo *et al.*,

2019). Bicycles often being central in multimodal trips (Jonkeren *et al.*, 2021), deserve special attention, when considering various transfer penalties.

Firstly, looking more closely at time, most research agrees that having a pure transfer penalty is negatively experienced, regardless of time (Cascajo *et al.*, 2019; Jara-Diaz *et al.*, 2022). Moreover, both waiting and walking time in between transfers can be seen as the most relevant factors in all transfer penalties (Cascajo *et al.*, 2019). Having bike-parking facilities close by could consequently decrease the penalty experienced (Zhong *et al.*, 2021). However, what the exact disutility of time is and what people would prefer can be highly context-specific. An unclear provision of information on the time penalty (Cascajo *et al.*, 2019) or limiting options with a mandatory transfer (Gschwender, Jara-Díaz and Bravo, 2016) could both add to the disutility experienced. Moreover, a clear provision of communication is important for the traveler (Cascajo *et al.*, 2019), so coordination among operators of the various modes is central to achieving this (Monzon, Alonso and Lopez-Lambas, 2017). At transportation hubs especially, collaboration between public and private parties is essential for organizing an integrated travel journey for users (Rongen *et al.*, 2022).

Secondly, considering the built environment, a stated preference survey has shown that crowded transfers on their own also caused increased disutility (Cascajo, Garcia-Martinez and Monzon, 2017). Bicycle parking facilities could likewise be very crowded adding a specific penalty in this part of the journey (Heinen and Buehler, 2019). Moreover, protection from climate can stand central in the disutility experienced (Cascajo, Garcia-Martinez and Monzon, 2017). As weather is already an influential factor in using bicycles themselves (Jones, Harms and Heinen, 2016), At transfers, potential penalties as protection from rain likewise exist (Cascajo, Garcia-Martinez and Monzon, 2017). This may suggest that there are also some more personal characteristics at play.

Lastly, with a high diversity of users, it can be hard to accommodate all personal preferences (Rongen *et al.*, 2022), but an effort towards understanding should be made nevertheless (Cascajo *et al.*, 2019). The mental effort refers to the fact that travelers need to stay alert during their trips, which can limit one from concentrating on onboard activities (Cascajo *et al.*, 2019). Moreover, diverse individuals also have diverse, physical abilities, so to consider a plethora of health statuses can be beneficial the approach a wide audience (Garcia-Martinez *et al.*, 2018). Similarly, transport modes can be used for different purposes. Shopping trips, for example, are suggested to be good for electric bikes in rural areas (Bösehans *et al.*, 2024), but other trips might require people to deal with transfer penalties differently (Cascajo *et al.*, 2019). E.g. taking groceries with you can create other hurdles than when one has to go to school.

Overall, considering transfer penalties, identification and awareness are central to understanding the shortcomings of a system. Rongen et al. illustrate that for mobility hubs specifically in the context of a culture like the Netherlands it may be hard to add shared micromobility at transportation hubs, because of a fear of replacing regular bike trips (2022). It is not clear whether e-bike share may be used as a first- and last mile solution, it may well be competing with busses or other active modes of transport (Campbell, 2019). The less accustomed users that are new to modes are more likely to dislike them (Arendsen, 2019). So, taking into account how potential transfer penalties and complexities influence multimodal tris, we can look at bike sharing schemes in more detail, to identify how these translate.

2.3: Bike sharing schemes

Bike sharing serves as a mode of public transportation where a fleet of bicycles is provided for public use (Gao, Li and Guo, 2019). Bike sharing schemes come in numerous shapes and sizes, each serving a specific purpose in transportation, often multimodal (Lazarus *et al.*, 2020). They provide a flexible (Jain *et al.*, 2018), relatively cheap (Chen *et al.*, 2020) alternative to many other transport modes. For this research bike-sharing is considered to be a service where bicycles can be shared by numerous individuals for a relatively low cost. This excludes bicycle-lease systems, such as Swapfiets, where individual bicycles are leased on a longer-term subscription basis (Ma *et al.*, 2020). In The Netherlands, 10 percent of all kilometers traveled are done by bicycles in general (CBS, 2022b). Private bicycle use has been studied widely in the Dutch context and bike sharing initiatives are one of the more recent additions to this mix, which in some cases is maturing at its own pace (Ma *et al.*, 2020). The NS OV-fiets is this year for 15 years in existence and is a bicycle renting system that is present at most major stations in the Netherlands (NS, 2024b). In 2023 over 5.9 million trips were made with these bikes, which is a still growing number, compared with previous years (van der Vis, 2024). The NS OV-fiets may be one of the more well-known bicycle sharing systems. In addition to the NS OV-fiets, there are other types of bicycle sharing systems that are categorized in different ways. Arriva bike&go is a new scheme, that is used to explain various aspects of bike sharing schemes.

2.3.1: Arriva bike&go

In 2021 Arriva, a multinational transport company, piloted: Arriva bike&go, as a new shared bicycle scheme. 16 electric foldable bikes were placed in lockers at the train stations of Groningen and Leeuwarden. Users can use the “Arriva Deelfiets”-app and from here rent these bikes for 7.50 euros a day (24 hours) to finish their last mile trip (Arriva Nederland, 2024). The pilot started in 2021 but has been repiloted in 2024, with new integration between the app and lockers. As can be seen in figure 2, only the biggest and most central train stations in each province (Leeuwarden and Groningen) provide these bikes. The bike has two main advantages, that it advertises with, they are electric and foldable. The electric part can provide ease of travelling and the foldability serves as a flexibility to take the bike with you on the train, free of charge (NS, 2024a). These two key characteristics are not fully novel but do provide key differences with most other bike-sharing systems that are present. Categorization of different bike sharing systems can be made on five distinctions of the system (Rijkswaterstaat, 2017).

Figure 2) Map of train stations in the provinces of Groningen and Fryslân (Source: Author)

Accessibility

The first categorization is defined by the people who use the bike and the function that it serves. The target users have an impact on the number of bikes that would be needed and how often a bike would be used at certain intervals (Rijkswaterstaat, 2017). Public transit related systems are open for public transport users and are often targeted at commuters (Rijkswaterstaat, 2017). Arriva bike&go is a system that follows this definition. On the other hand, commercial location systems are often a closed system instead of an open one. This means that only certain groups of people in a commercial space have access to them (Rijkswaterstaat, 2017). These often included internal bicycles that companies have. Arriva is such a company that has internal 'office bikes' that employees can use to make trips during the working day, but this is a different scheme than Arriva bike&go.

Even more subcategories could be made, depending on the target audience and users that a system aims for. Tourists and recreational users usually take short trips between longer stops to visit activities and landmarks, for which most bike-sharing schemes are well intended (Munkácsy, 2017). More specifically electric bicycles might aim at a more specific user, where inclusivity for people with lesser mobility could be targeted (Jones, Harms and Heinen, 2016). In general, many bicycle share programs target and have a predominantly younger user base. Still, personal preferences and characteristics, while seemingly small can still have impacts on the accessibility and the users a system attracts (Munkácsy, 2017; Arendsen, 2019; Ma *et al.*, 2020), where the perceived use and perceived accessibility can also play a role (Lättman, Olsson and Friman, 2016; van der Vlugt, Curl and Wittowsky, 2019).

Registration

Most bike-sharing systems make prior registration a requirement before usage. This has the benefit that it prevents thefts, vandalism, and makes the registration of usage fees easier (Munkácsy, 2017). Still, the type of registration can take various forms. Users can be charged from their debit card, have

a yearly subscription, pay a deposit, or use another way of subscription (Munkácsy, 2017; Jain *et al.*, 2018). The type of registration could attract a certain demographic to use bike sharing systems. Most micro-mobility systems are used by younger, well-educated demographics (Reck and Axhausen, 2021), which may in part be because this demographic generally has an easier time adopting new technologies (Morris and Venkatesh, 2000; Reck and Axhausen, 2021). Arriva bike&go requires registration through the app, where users link their bank account before registration.

Return options

While the system of many different bike sharing initiatives is unique, their basic return options are often categorized into three categories. (Rijkswaterstaat, 2017; Liu, Szeto and Ho, 2018; Du, Deng and Liao, 2019; Chen *et al.*, 2020; Reck and Axhausen, 2021). The first category, the one that Arriva bike&go belongs to, is a station based category the so-called back-to-one. Here bicycles are picked up from a specific location, where they also have to be returned. These, sometimes called docked bicycles, are often the largest and biggest group, because of the convenience of being in the same place (Reck and Axhausen, 2021). Likewise, these docked bicycles are often found near transport stations and hubs to target a big potential user base (Rijkswaterstaat, 2017). The second category is also a station based system referred to as back-to-many. This system is similar to the back-to-one system, the only difference being that a bike does not have to be returned to the initial location, but can be returned at more locations (Rijkswaterstaat, 2017). The last category is the free-floating category. In this case, bicycles are not bound to a station and are dockless, which means they can be started and ended anywhere (Chen *et al.*, 2020; Reck *et al.*, 2021). This gives users more freedom in their trips but can create environmental nuisance as well (Rijkswaterstaat, 2017). Some cities in the Netherlands often cope with the nuisance from free-floating shared bicycles and scooters (Hovinga, 2023; Suijkerbuijk, 2023).

Number and type of locations

The number of locations refers to the coverage of the bike sharing system. Where in a back-to-one system the number of locations can be limited in coverage since they often are centered at transport hubs (Rijkswaterstaat, 2017). Free-floating systems are less bound to the number of locations since they can be found at many different places. Consequently, free-floating bicycles offer more freedom in usage and are often used for longer distances and duration compared to station based ones (Lazarus *et al.*, 2020). However, being stationed in or near green areas and population centers can be beneficial for the usage of station based systems (Du, Deng and Liao, 2019), whereas dockless can often be seen in less crowded places (Lazarus *et al.*, 2020). Additionally, many bike sharing systems, especially station based ones, are present at or near transportation hubs (Rijkswaterstaat, 2017; Kask *et al.*, 2021; Bösehans *et al.*, 2024). Here they often experience a greater number of travelers that pass by. Additionally, maintenance can also be done at a central location which can be beneficial for operators, who do not need travel costs as operators experience with free floating systems. Arriva bike&go, although it is station-based and limited in numbers, could have more freedom than other back-to-one systems. The freedom to take it with you on the train, allows for a wider range of use that is more similar to free-floating systems.

In local policy, there is also interest in the use of bike sharing as part of the mobility views in local regions (De Lange and Ministerie I&W, 2021). Both in the province of Groningen and Fryslan shared mobility is seen as a crucial aspect of providing mobility as a whole (Provincie Fryslan, 2021; Provincie Groningen, 2022). In the province of Fryslan, there is shared mobility can help assist in promoting the

inclusiveness and accessibility of smaller population centers (Provincie Fryslan, 2021). Many policy documents suggest that shared mobility can be provided at transportation hubs (De Lange and Ministerie I&W, 2021; OV Bureau Groningen Drenthe, 2022). Since many rural areas are dependent on car mobility (De Lange and Ministerie I&W, 2021; Pot, Koster and Tillema, 2023), the provision of mobility hubs in rural areas offers a cost-efficient way to provide frequent and fast public transport in areas with dispersed travel demand (Rongen *et al.*, 2022). As shared mobility can increase flexibility and enhance the appeal of multimodal transport (Rongen *et al.*, 2022), The presence of the hubs in the region can provide opportunities for and encourage shared mobility. Since hubs where cycling and public transportation can be combined in travel mobility, the infrastructure surrounding the hubs should be of a good quality, to allow for especially good cycling infrastructure. Both provinces see the potential for the usage of e-bikes to promote the accessibility of rural areas. Still, it is important to note that the e-bike is described as a safety concern in more urban places. However, other research does provide insights into the rise of e-bikes and the potential it may have for accessibility in rural areas. Especially for Arriva bike&go, which distincts itself as an electric shared bicycle system, these considerations can be important.

2.3.2: E-bikes

The adoption and utilization of e-bikes are influenced by various factors including safety, sustainability, health, demographic profiles, and mobility needs. Sustainability and health are two key drivers for individuals to purchase private e-bikes in the Dutch context (Plazier, Weitkamp and van den Berg, 2017). Safety concerns are also often considered (Popovich *et al.*, 2014; Campbell, 2019), but may be less stressed in the Dutch context, where infrastructural safety barriers have largely been overcome, due to an overall high cycle culture and infrastructure (Fishman and Cherry, 2016; Plazier, Weitkamp and van den Berg, 2017). Still, policy pays special attention to the speed differences on cycling paths, so the safety of this cycle infrastructure can be guaranteed (Provincie Groningen, 2022), since speed differences with normal bikes can lead to unsafe situations (Rich *et al.*, 2021). Similarly, there may be a mismatch between policy and people's views towards sustainability. While policy puts sustainability central in their future transit options (De Lange and Ministerie I&W, 2021; Provincie Fryslan, 2021; Provincie Groningen, 2022), for users sustainability is often not an important factor in choosing different transport options (Weitkamp, Plazier, and Mossel, 2018).

While it cannot be concluded that there is a specific type of e-bike user, research shows that different regions exhibit different patterns of e-bike usage (Plazier, Weitkamp and van den Berg, 2023). Generally, however, e-bike usage tends to be higher among women, older age groups, and individuals with lower income and education levels (Lee *et al.*, 2015; Plazier, Weitkamp and van den Berg, 2017). However, there is a growing positive attitude toward e-bikes among younger audiences, including students (Plazier, Weitkamp and van den Berg, 2017). Still, the demographic of e-bike users is gradually becoming more diverse, especially with the rise of e-bikes as a form of shared mobility targeting a wider demographic (Reck *et al.*, 2021; Plazier, Weitkamp and van den Berg, 2023b; Bösehans *et al.*, 2024).

More specifically in rural areas, the potential for e-bikes is particularly notable among rural residents with low socio-economic status, suggesting that making e-bikes more affordable or otherwise accessible could significantly increase their usage (Plazier, Weitkamp and van den Berg, 2023b). Shared e-bike systems could effectively serve mobility demands outside the urban core, especially in systems that allow for free-floating bikes (Lazarus *et al.*, 2020). This capability further underscores the versatility of e-bikes in enhancing mobility across various contexts. Trips made with shared e-bikes tend to be longer than those made with normal bicycles (Reck *et al.*, 2021), highlighting their capacity to facilitate more extended or complex journeys (Jones, Harms and Heinen, 2016). Despite not being as robust as

cars, e-bikes are less influenced by weather conditions and distance, making them a viable alternative for certain modes (Campbell, 2019). Still, while shared e-bikes can be utilized for commuting, it is unlikely that they replace cars as the main mode of transit (Bösehans *et al.*, 2024). This can be because cars are often deeply embedded in the culture and perceived as essential for accessibility (Pot, Koster and Tillema, 2023). However, they have the potential to substitute for a second car or be used for occasional trips (Bösehans *et al.*, 2024). The mobility context of e-bikes is complex, as they can potentially replace various forms of transportation, including regular cycling, car trips, and public transit, or serve as a complement to them (Plazier, Weitkamp and van den Berg, 2023b).

As Plazier et al. (2023) point out, there is limited research on e-bikes in rural areas, as a mobility option, as most studies focus on urban and semi-urban regions. Health and enjoyment can significantly contribute to promoting sustainable travel behavior (Plazier, Weitkamp and van den Berg, 2017). Awareness and trialability of new mobility options can benefit the perception of new mobility initiatives (Plazier, Weitkamp and van den Berg, 2017; Bösehans *et al.*, 2024). This promotion of well-being being important in cycling in more rural areas has been seen in previous research, where this approach focusing on the benefits can provide opportunities for usage (Jones, Harms and Heinen, 2016; Shaker, Hermans and Zahoor, 2021; Meijering and Weitkamp, 2024). Looking more closely at the trialability and adoption of new mobility options, we can have a look at Rogers' theory of innovation and diffusion.

2.4: Innovation and diffusion:

New innovations are often seen as solutions to complex problems, however, the diffusion of new innovations is critical for the adoption and spread of the innovations (Vargo, Akaka and Wieland, 2020). Likewise, bike sharing initiatives should first be adopted, before they can have a real impact on the accessibility of places, like rural (Bösehans *et al.*, 2023). Rogers' IDM is one of the most popular models to describe the process of the adoption of innovations. "An innovation is an idea, practice, or project that is perceived as new by an individual or other unit of adoption" (Rogers, 1983, p. 11). This implies that the innovation does not necessarily have to be completely new, but merely seen as new by the adopters. Various variables go into the theory of Rogers. On the one hand, adoption takes place in a social system and the structure of the social system can influence people's innovativeness which respectively influences the rate of adoption (Sahin, 2006). Communication channels describe the process of mutual understanding and information sharing of the new innovation (Sahin, 2006). According to Rogers, interpersonal communication between individuals can be more effective for the adoption of the innovation than more formal established channels like mass media channels (Rogers, 1983). On the other hand, more personal factors are considered, where objective information and personal experience stand central (Sahin, 2006). Time is a central element in adaptation that is often overlooked (Sahin, 2006). This aspect of time is be made more clear in chapter 2.4.3 below with the distinction of different adopter categories. Firstly, we dive into the conceptual model of this research which is highly inspired by Rogers' model of five stages in the innovation-decision process (appendix 4). However, parts of this model have been omitted or adapted to better line up with this study.

2.4.1: Conceptual model:

Figure 3 shows the conceptual model that is central throughout this research. In this simple model, an overview is given of 2 stages (engagement & decision), and 3 factors (knowledge, trialability, and (dis)approval) towards two possible outcomes (adoption & rejection). In Roger's model, persuasion stands central, where an individual forms an attitude towards the innovation. Similarly, in our model at the **engagement** stage, individuals take in all the different factors that they experience. From this, an

attitude is formed after learning about the innovation, where three factors have an influence on the engagement: knowledge, trialability, and (dis)approval. **Knowledge** refers to the more objective parameters, like the relative advantage that can be evaluated, or how compatible an innovation is with an individual's needs. **Trialability** concerns the physical trial, where an individual can personally assess an innovation to check to experiment in for their use. This factor can show the complexities of using the innovation. This aspect is often experienced on one's own, whereas in the personal domain an individual trials the innovation. **(Dis)approval** shows how in the social domain others view the innovation, whether this is people specifically recommending the innovation or more subtle where individuals can observe others using it. After these three factors are put together in the engagement stage, an individual personally comes to a personal conclusion a the **decision** stage. Here an individual can either choose to **adopt** or **reject** the innovation. Where adoption is the "full use of an innovation as the best course of action available," and rejection is "not to adopt an innovation" (Rogers, 2003, p. 177). Following this. Which they in their terms can use to (dis)approve to others. Following this logic, for pioneers in the earlier stage of adoption, trialability in the personal domain is more important, whether for later adopters the social domain and the approval by others becomes more dominant. The knowledge factors stay dominant throughout and are less influenced by time.

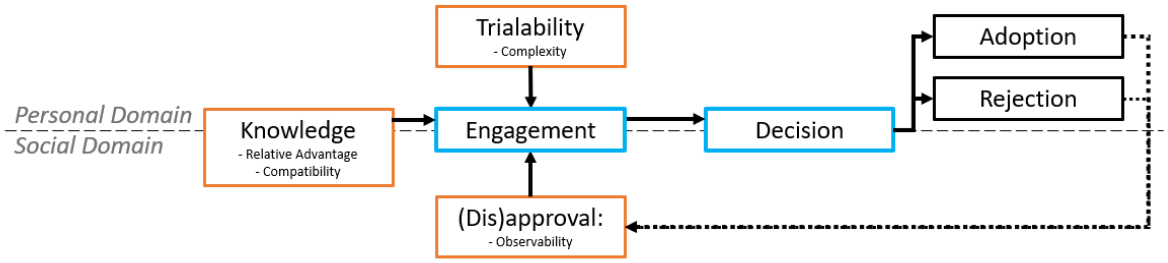

Figure 3: The conceptual model (Author, 2024)

2.4.2: 5 Attributes of IDM

The rate of adoption of an innovation is a central characteristic of IDM. Rogers identifies five Attributes of Innovation in the rate of adoption: relative advantage, compatibility, complexity, trialability, and observability (Rogers, 1983). These attributes may contribute to 49-87% of the variance found in adoption rates (Sahin, 2006). As seen in our conceptual model these are categorized under our three factors: knowledge (relative advantage, compatibility], trialability (trialability and complexity), and dis(approval) (Observability). The relevance of these 5 aspects has also been found to be useful in describing the overall adoption rate of bicycle sharing systems (Munkácsy, 2017).

Relative advantage

"The degree to which an innovation is perceived as being better than the idea it supersedes"
(Rogers, 2003, p. 213).

Relative advantage may be the strongest predictor of the rate of adoption (Sahin, 2006). In the case of new bicycle initiatives, this can be interpreted in various ways. One can look at economic benefits, social prestige, or just overall why a new idea is better than an existing or lack of an existing

practice (Munkácsy, 2017). Relative advantage is thus highly relevant in comparing the innovation to the existing innovations and the social norms that surround these norms.

Compatibility

"The degree to which an innovation is perceived as consistent with the existing values, past experiences, and needs of potential adopters"

(Rogers, 1983, p. 15)

More specifically, compatibility refers to the values of social norms and personal values. What the innovation entails should be meaningful to the adopter (Sahin, 2006). Not merely be cheaper than the alternative that relative advantage prescribes, but be of genuine interest to the adopter. In terms of bike-sharing this could entail that the initiative resonates with lifestyle cyclists or can easily fit into people's mobility patterns (Munkácsy, 2017).

Complexity

"The degree to which an innovation is perceived as difficult to understand and use"

(Rogers, 1983, p. 15)

Focusing more on the usage itself, complexity is the only attribute that is negatively correlated to adoption rate. When complexity is high, it can create an obstacle to adoption, making the innovation not user-friendly and limiting adoption (Sahin, 2006). In bike-sharing, this could be related to the methods of renting the bike, as well as the ease of adjustment of the saddle for example (Munkácsy, 2017). In general, one could say that complexity relates to the ease of use of innovations.

Trialability

"The degree to which an innovation may be experimented with on a limited basis"

(Rogers, 1983, p. 15)

The more an innovation is tried, the faster the adoption of that innovation generally is (Sahin, 2006). Additionally, trying the innovation and experiencing it firsthand, is not only positively related to adoption, but can also lead to re-invention (Sahin, 2006). In this way adopters can identify particular shortcomings or strengths of the innovation. These can consequently be modified and could increase the rate of adoption (Sahin, 2006). Consequently, trialability is more important for earlier adopters (Munkácsy and Monzón, 2018). Where later adopters generally put less importance on their own experiences, but so-called vicarious trials by their peers are seen as an important trialability for them (Rogers, 1983). For this research, more emphasis will be laid on this aspect of IDM, which is elaborated on in the methods.

Observability:

"The degree to which the results of an innovation are visible to others"

(Rogers, 1983, p. 16)

The last attribute is observability, where the observation of the innovation can be positively related to the adoption rate (Sahin, 2006). Especially for later adopters, these can become more important (Rogers, 1983). For bike-sharing initiatives, seeing the innovation advertised in public space, or being used by others can contribute to the observability (Munkácsy, 2017).

2.4.3: Pioneer adaptors:

Another, arguably one of the more well-known aspects of IDM by Rogers is the adopters categories that he established based on innovativeness. The classification includes 5 categories: innovators, early adaptors, early majority, late majority, and laggards (Rogers, 1983). Innovativeness is based on the degree of relative earliness in the adoption of innovations (Sahin, 2006), which is distributed among a normal distribution seen in figure 4.

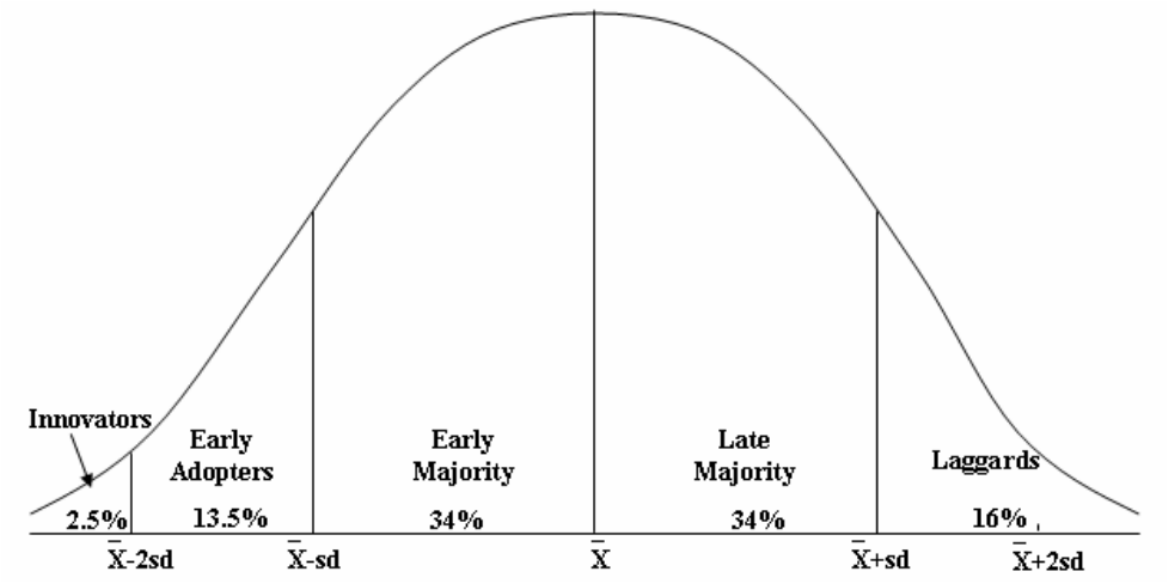

Figure 4: Normal Distribution of adopter categories according to Rogers' IDM (Rogers, 2003)

All categorizations have different characteristics, they are not only different in stage of adaptation but could also be summarized in a few key characteristics. Innovators are the most willing to experience new ideas and can be characterized by their preparedness for uncertainties, and unsuccessfulness, and shortly could be seen as venturesome and curious about new innovations (Sahin, 2006). Early adopters are similar in their venturesomeness, but bring innovation in the social system with their leadership roles (Sahin, 2006). Or as Rogers (1983, p. 283) puts it: "Early adopters put their stamp of approval on a new idea by adopting it". Early majority could be categorized as individuals, well woven into the social system and taking the early adopters' stamp of approval to then adopt the innovation itself (Sahin, 2006). The late majority are similar to the early majority but need to feel more safe to adopt, where economic necessity and peer pressure are key factors in their adoption decision (Sahin, 2006). Lastly, the laggards' adaptation period is the longest, because they want to make sure all uncertainties are gone and see their peers have mostly successfully adopted the innovation (Sahin, 2006). Innovators and early adopters, while different could be grouped similarly because of their degrees in venturesomeness; their risk-taking attitude and opinion leadership are strong characteristics that both radiate (Rogers, 1983; Munkácsy, 2017). Identifying the preferences of these two groups could be key to the acceleration of the adoption rate and the promotion of a diverse range of innovations (Wu *et al.*, 2023). For this research these are combined as well under pioneers.

This distinction has similarly been made by Munkáscy (2018) in their research on the adoption of bike-sharing, where over a longer period of time the adoption process of shared bicycles in Madrid has been identified. The leadership role of innovators and early adopters could be seen, where only a small amount (11%) of pioneers relied on peers, whereas for the early majority (38%) and late majority (44%) were more influenced by their peers (Munkácsy and Monzón, 2018). Furthermore, pioneers tend to

have a driving license and access to both a car and a bike, which suggests that pioneers are mainly looking to add new elements to their lifestyle and not out of necessity (Munkácsy and Monzón, 2018), in the Netherlands being a cycling country and having many lifestyle cyclists can suggest that adoption of shared bicycle initiatives can be even stronger. Familiarity whether that comes from peers, or especially through personal trialability has been seen as one of the key factors to adoption (Munkácsy and Monzón, 2018; Arendsen, 2019), which links to the importance of trialability identified in e-bike adoption (Plazier, Weitkamp and van den Berg, 2017; Bösehans *et al.*, 2024). Overall this can lead to positive experiences, and these positive experiences may be the key factors that sum up the adoption rate (Wu *et al.*, 2023).

Chapter 3: Methods

3.1: Research Design

In order to study how pioneers experience bicycle sharing initiatives, a qualitative case study research design is opted for. A case study research design is well suited when one wants to understand phenomena in depth in a real-life context (Yin, 2009). As seen in our conceptual model, various aspects specific to the case of Arriva bike&go stand central. Knowledge, trialability, and approval factors all play their role in the specific engagement with Arriva bike&go. While this model may be applied, in a broader context, for this research the focus lies on the experiences of Arriva bike&go. Furthermore, case study research can be beneficial when boundaries between the case and context are not clearly evident (Yin, 2009). The research focuses on Arriva bike&go in the light of the last mile problem. However, the specific use of the innovation does not have to be limited to last mile solutions, but could also be used more widely as a form of mobility. For this reason, the case of Arriva bike&go is focused on in light of, but not limited to the last mile problem.

Case study research is often accompanied by qualitative research design (Clifford *et al.*, 2016). Previous research on bike-sharing concluded that trialability and direct experience of adopters can be beneficial for understanding adopters' motivations and increase the rate of adoption of future users (Wu *et al.*, 2023). Furthermore, positive experiences in bicycle commuting can help with the adaptation of initiatives (Plazier, Weitkamp and van den Berg, 2023b), suggesting that identifying why experiences are positive or negative can be insightful. The context of this particular bike-sharing initiative, the pilot is relatively new and limited in its outreach, and in a context where numbers are limited it may be more beneficial to deeply analyze motivations instead of quantitative numbers (Clifford *et al.*, 2016). Lastly, IDM by Rogers suggests that adoption, especially for pioneers, can be a social activity (Sahin, 2006). So, a deeper understanding of the experiences of pioneers may help to elaborate on these different aspects. Overall, a more qualitative approach with a deeper understanding in particular this case study research may be best suited.

To do this more specifically so called bike-along interviews have been held. It provides the researcher with a natural way to acclimate to the locality, raise questions in an inductive manner, and observe phenomena that may escape in other settings (Carpiano, 2009). Additionally, go-along methods immerse themselves in the social architecture of the setting (Carpiano, 2009), which can benefit the understanding of the social environment of pioneers that they provide a crucial leadership role in (Sahin, 2006). Bike-along in particular has previously been used to identify perceived safety among children cycling for transport (Ghekiere *et al.*, 2014) and identify environmental factors among the elderly during cycling for transport (Van Cauwenberg *et al.*, 2018). It has been shown to help identify safety and direct experiences on a route (Van Cauwenberg *et al.*, 2018). Moreover, being able to spot emotions like facial expressions and tone during the ride can be beneficial (Jones, Harms and Heinen, 2016). Contrarily, however, focusing on one trip could also imply some bias, e.g. bad weather would affect go-along experiences (Carpiano, 2009), which is important to consider these one-sided experiences. So, comparing the ideas that trialability is beneficial for adaptation and go-along interviews can provide direct insights in experiences, using bike-along interviews as a method to test Rogers' IDM could be insightful in pioneer research. This means to not only go along during the cycling like previous research has done, but also in the rental process of Arriva bike&go, to add to the overall context of using Arriva bike&go.

3.2: Data collection

During the bike-along method, semi-structure interviews have been conducted. The semi-structured nature of the interviews allows participants to explore topics they personally consider important (Clifford *et al.*, 2016) and is in line with the inductive nature of go-along methodology in general. Current public transport users have shown an interest in using shared e-bikes for a multi-modal commute trip (Bösehans *et al.*, 2024). Due to this observation and to fit with the intent of Arriva bike&go, participants have been approached through the social media channels of Arriva-Noord. From these sources and by snowballing, where respondents recommended others, participants who wanted to try Arriva bike&go were found to participate in the bike-along interviews. The participants have been provided with a 25 euro gift card, provided by Arriva, to compensate for expenses made during the interview and as a thank you for their effort..

During the data-gathering process, a total of eight interviews were conducted in May and June of 2024. The interviews themselves lasted between 30 minutes and 90 minutes, but the overall interview process often took longer than that, because the rental process had to be started, bikes were taken into the train, breaks were taken, or other factors, that influenced the time to conduct the interviews. In table 1 below some characteristics about the interviews and the participants are given that can be relevant for understanding the results in the next chapter.

Participants	Age	Student	Have a personal car	Bike-use	Station of rental	Used before	Take bike in train?
P-1	18-25	Yes	No	Daily	Groningen	No	Yes
P-2	18-25	Yes	No	Daily	Groningen	No	No
P-3	18-25	Yes	No	Daily	Groningen	No	No
P-4	18-25	Yes	No	Daily	Groningen	No	No
P-5	18-25	Yes	No	Daily	Groningen	No	Yes
P-6	26-35	No	Yes	Daily	Groningen	Yes	No
P-7	26-35	No	Yes	Daily	Leeuwarden	Yes	Yes
P-8	26-35	No	Yes	Daily	Groningen	No	No

Table 1) Participants of the bike-along interviews

3.3: Data Analysis

The primary component of the data analysis involves utilizing code trees within Atlas.ti to code the interview transcriptions. Atlas.ti is used to organize interview data and provides the advantage of identifying structure and commonalities among interviewees (Burgos-Watkinson, 2020; Chandra Sekaran *et al.*, 2020). The analysis employs a combination of inductive and deductive coding. Deductive codes are used to structure the interview questions (appendix 2) and inductive approaches involve finalizing codes after the interviews are completed to identify previously unrecognized themes and factors (Dunn, 2000; Clifford *et al.*, 2016). The code tree (appendix 3), had been mainly structured using the conceptual model, and inductive codes have been added along the way.

3.4: Ethics

Considering that this research discusses individuals' personal preferences, mobility patterns, and in general personal data, ethical considerations are needed. Positionality, confidentiality, and

anonymity are important considerations in semi-structured interviews (Clifford *et al.*, 2016). While the research focuses mostly on direct experiences, personal details may not be spoken about much, but are never less important to keep confident about (American University, 2017). Gathered data has been completely anonymized and is solely kept on the researcher's personal computer and not shared with third parties. These considerations have been signed by all participants in a confidentiality agreement, of which full details can be found in the appendix. Here it is also clarified, that participants can always withdraw from the research as well as other considerations.

Regarding my positionality as a researcher, other than always considering personal bias and background. It is important to note that this research was combined with an internship at Arriva Nederland and a more insight look was gathered into the project. While this provided mainly positive opportunities gaining a better understanding of the project, which allows for more concrete recommendations. However, though the understanding is there, representing the institution that facilitates the innovation may have led to some overlooked ethical considerations.

Chapter 4: Results

In the following section, the results gathered from the interviews are presented. The structure follows the sub-questions and the structure from the conceptual model. First, in chapter 4.1 the knowledge factors are discussed in relation to the first sub-question: *How do knowledge factors contribute to views of Arriva bike&go as a first-time user?* The attributes of compatibility and relative advantage will each be considered with their respective facets and components. Second, in chapter 4.2, the trialability is addressed in light of the second sub-question: *How can trialability add to the ease of adoption of Arriva bike&go?* Here the various components of Arriva bike&go are considered stressing the attribute of complexity and the trial itself. Third, in chapter 4.3, the approval factors and decision stage is examined in consideration of the third sub-question: *What improvements could be made to Arriva bike&go to increase approval in the user experience?* In 4.3.1 the current experienced approval factors are considered around observability. Where in 4.3.2 the decision stage of the conceptual model is taken to look at experiences surrounding the last mile and future recommendations.

4.1: Knowledge factors

Before participants trialed Arriva bike&go, certain factors about the bicycles could be known by the participants or could easily be found online or through the researcher. Throughout the interviews, these knowledge factors have been identified. These factors may have influenced the participants‘ motivation to participate, compatibility, or various relative advantage factors. Furthermore, participants' existing knowledge and observation of electric and foldable bicycles can be identified.

4.1.1: Compatibility

Initial motivation

Starting the interviews, many participants have various motivations for participation. Most participants stated that they valued trialability as a main factor. Stating it is “nice to try an electric bicycle” (R-3, 2024), or “seeing whether this bike is something for me” (R-6, 2024). While the overall experience of trialability is discussed after, it can be observed that participants intrinsically viewed trialability as a nice thing. Interestingly enough, some participants noted that there is an intrinsic motivation to try something new:

> *“When I saw these bikes I thought why not try them once”. I'm always just curious to try something out.”* (P-2, 2024)

This curiosity, which some other participants also hinted at, could be seen as one of the key characteristics of pioneers (Sahin, 2006). Seeing that this is present with at least some participants may suggest that other findings to come are in line with previous research provided by Rogers (1983). Contrarily, it should also be noted that some participants did not see themselves as pioneers, or intrinsically curious. Participant 3 stated that they would not always go out and try everything, but new mobility options are an interest of them (2024). Participant 4, more strongly, stated that just saw this bike-along as an opportunity to compare the bike to other modes, but would not consider themselves a pioneer in terms of mobility (2024). So, while curiosity is observed, it does not necessarily come from being a true pioneer, although they do share a connection on wanting to try thee initiative.

Another key initial motivation lies consists of being able to test thee usage of Arriva bike&go, hinting at the key factor of trialability. Where some respondents specifically stated that they want to

see whether bike&go fits in their last mile solution (R-1, R-3, R,5, R-8, 2024), others specifically stated that they want to see whether Arriva bike&go may be better than other last mile modes such as the NS ov-fiets (R-2, R-3, R-4, 2024).

"Yes, then one time I had a competition in a small village. So then I went by train to Buitenpost and from there by bike to the competition. And that was because the village was not very accessible, especially on weekends." (P-7, 2024)

Participant 7 was the only one that used Arriva bike&go before this research, where he used it for the last mile of their trip. Overall, this experience was seen as pleasant, which is why he used it a handful of times afterwards. This This may suggest that the trialability that participants seek beforehand could be helpful, but later on this is discussed more.

Personal values:

While compatibility on the one hand considers social norms, and thus the possible future (dis)approval of an initiative, existing personal values also come into play on why pioneers themselves may be(dis-)interested. Most participants have no existing strong notions on either electric or foldable bikes. The individuals that have used an electric bicycle before, however, did experience it as pleasant and have positive expectations of the electric aspect (P-2, P-5, P-6, 2024). Even so, this is not always the case.

"Yes, but that's also due to the fact that electric bikes are stupid. This is really just some kind of moped with pedals that I sit on. I always made this comment in my high school days." (P-1, 2024)

It is interesting to see how a negative stereotype can be influential in adoption. It is important to keep these in mind in the future adoption, and how Participant 1 changed his mind with the trialability.

4.1.2: Relative advantage

Time:

As a motivation to trial Arriva bike&go is to compare it towards other mobility modes, various relative advantage positions are considered by the pioneers. One of the first considerations here is the relative advantage of time, which is mainly considered in terms of travel time.

"Timewise I think it should pay off to rent such a thing for your daily commute than to have an public transit subscription" (P-4, 2024)

As P-4 illustrates, time is a central consideration for most the usage of mobility. Where the travel speed and thus travel time are central consideration for most participants (P-1, P-3, P-4, P-6, P-7, P-8, 2024). The speed that is associated with the electric aspect of the bike is for all participants the main contributor to this and viewed this factor as the main competitive advantage (P-3, P-4, P-5, 2024). Still, the speed is not only positive as others also identified that the speed could be scary and take some time to get used to, both for themselves and for others. (P-6, P-8, 2024).

Furthermore, speed is not the only relative advantage and is weighed with other aspects as well.

"… but even then, when it is very dirty weather and this is available and it takes as much time or maybe even faster to travel somewhere, then I would do it too." (P-6, 2024)

Considerations of bad weather have been seen to limit shared bike usage (Campbell, 2019), and in line with what respondents stated (P-1, P-3, P-5, P-6, 2024). Weather could not only deter users, but good weather might also strengthen the advantages, and show extra appreciation of the surroundings:

"Well if I would take a little more time to travel on a nice day, […] then a beautiful scenery is nice too. (P-1, 2024)

This relative advantage may also have its linkages with personal compatibility. Statements like "I haven't been here in a while" (P-1, 2024) and "Yes, this route is also a piece of nostalgia" show that the routes also show a different aspect that participants have not done before. These unexpected advantages, may therefore also strengthen future use, and weather may strengthen this notion (Carpiano, 2009). Moreover, the comparative negative aspects of public transit can on the flip side strengthen the positive weather experiences. Rather being in the open air (P-7, 2024) and not wanting to feel crammed in a bus with hot weather (P-6, 2024) are relative advantages that users identified. Still, with rain and other bad weather many stated that they would rather take a bus (P-3, P-4, P-5, P-6, P-8, 2024), confirming that for bike&go previous observed weather effects also play a role to at least some extent (Campbell, 2019).

Price:

A second main relative advantage identified in literature is that of monetary costs (Munkácsy and Monzón, 2018; Ma *et al.*, 2020), Overall, the price of 7,50 euros for 24 hours is seen as reasonable (P-1, P-2, P-3, P-4, P-6, P-8), although it could also be seen as a bit too expensive (P-5, 2024) or even quite cheap (P-8, 2024). A notion that was identified is that the electric aspect of the bike is a premium that you can reasonably pay a bit more for (R-2, R-4, 2024). However, the determinant of appropriate monetary costs is not a clear cut one, where for short trips, to only conclude the last mile, it may be seen as expensive:

"and every time I go to my parents or something, because there I have to walk half an hour. Then it's that 7.50 euro each time and I do lose a lot of money." (R-3, 2024)

Comparatively, using the bike for a longer day-trip was seen by some as a bargain (P-1, P-2, P-4, P-6, 2024). Determinants here are also, are often based on the market prices set by similar initiatives or the alternatives. An often mentioned alternative by participants was the NS OV-fiets. This station-based bicycle can be rented for 4,55 euros a day. Especially in comparison to this, the premium paid for the electric aspect can be valued more strongly (R-2, R-4, R-8, 2024). Another comparison was that a person could take their own bicycle with them in the train as an option, which is 7,50 euros (NS, 2024a). This being just as expensive as renting an Arriva bike&go, can make this a better option (R-4, 2024), although it is unclear, how much of an advantage this is, as no participant does this and likely not as many other train travelers.

Similarly, quite a view participants where students, who often have free public transit in the Netherlands. P-5 stated: "… but maybe I'm too much used to my free student public transit." (2024), which could imply that the price advantages that are identified above, or that initiatives may have, be limited in their effect. Also other findings that became more clear during the trial itself, where often compared to the ov-fiets, which is important to keep in mind. So, having knowledge of the market price and competitors in general can be a central factor in determining the relative advantage from an initiative, although other more complicated consideration should not be forgotten.

4.2: Trialability

As identified, trialability is as a central motivation factor for most respondents. During the bike-along interviews a clear overview of the whole process was viewed, from which more specific motivations, reasonings and limitations considering Arriva bike&go were trialed. Below, the different aspects of the process itself are closer assessed, starting with the app, then the lockers, the foldability, other aspects of the bike, and ending with overall views on the process, that all are considered in their linkage to the adoption of Arriva bike&go, where a focus lies on the complexities, transfer penalties and other striking or less striking observations that were observed.

4.2.1: App-complexities

When using Arriva bike&go one uses the app to start the process of renting. First, it should be said that during the interview process, the app did have some technical malfunction that did not allow all participants to correctly walk through the process in the app. Manually the bikes were taken out of the lockers, from which the bike-along continued, but this gave five of the eight participants an incomplete overview of the trial. For most participants these problems did not cause much trouble, and were seen as "teething problems" (P-2, 2024), or otherwise understandable in pilot situations (P-1, P-3, P-4, P-6, P-7, 2024).

Nevertheless, using an app in general was by some seen as a positive aspect. One does not need an OV-chipcard (P-5, 2024) and there is less risk of losing it and your keys (P-2, 2024). However, some saw also a dependency that if your phone runs out of battery (P-3, 2024) or has bad connection (P-7, 2024), the app is not always ideal. Moreover, the use of an app creates less social contact, which some view as positive (P-4, 2024), and others see as a negative aspect because the lack of human contact creates a barrier to asking questions:

> *"What might still help is that, for example, the public transport service point becomes a little more involved in this. That the service point really gets a role in cycling as well. So, that they can support you a little bit."* (P-7, 2024)

Still, no one specifically did not like that is was through an app, so using an app is likely not a considerable transfer penalty.

The steps that the apps take you through could be a limiting factor, however. Participants stated as long as the steps to go through are clear and the app is sufficient in the information given (P-3, P-4, P-5). Still, one participant who used the app stated that the information in the app was not fully clear to easily unfold the app (P-1, 2024), but participant 8, did get enough information from the app. So, it might be better to provide a more clear information in the app, so at least all respondents can have the information they need to start their journey.

4.2.2: Locker-complexities

The foldability of the e-bikes allows Arriva bike&go to be stored in lockers. This overall storage in lockers was by some identified as neutral, while others mainly saw negative aspects. Many respondents did not have any opinions on the fact that the bikes are in lockers, as compared to having them locked in bicycle stands, no negative, but also no positive (P-1, P-3, P-5). Some respondents did identify that the top row of lockers can be hard to reach, especially when you are elderly or not as strong (P-6, P-8 2024), which may be a drawback. Some participants would prefer that when in the rental process,

individuals can only use the bottom ones, or at least have the choice to do so when available (P-3, P-6, P-8, 2024).

Having lockers operate as a back-to one system, also means that users have to bring them back to the same place where they rented them. Where most participants, understood this and did not seem to mind (P-1, P-2, P-3, P-4, P-7), others would want to see a back to many or free floating system, which allows for more freedom in the rental process (P-5, P-6, P-8). A rental bike in particular does too some extend take away the total freedom to go wherever you want, as P-6 identified:

"That if you can put these bikes in more places that would be even more interesting. And of course that's when you have your own folding bike, then you can just take it with you and also you don't have to bring it back to one specific point." (P-6, 2024)

4.2.3: Train-complexities

The foldability allows for the bike to go into the train, which was identified differently by the three participants who trialed so. One participant viewed the overall experience as quite pleasant:

"On the train, the bike was pretty easy to carry, especially since it wasn't that crowded. Of course, there could be other people standing around who also had their bikes, but since it is not that big when folded up, this was not a problem and the other people on the train were able to pass us just fine." (P-1, 2024)

This experience in the train was seen as quite pleasant. Similairly, participant 7 experienced no problems in taking the bike in the train. He did say however: "I could imagine there being more people who can struggle a bit more" (P-7, 2024), because he already used it a few times before he did not experience much trouble. Still, the part of taking the bike to the train is a bit of a different problem:

"Furthermore, it is not the most practical thing, to carry around in folded form. That you it doesn't really have a nice handle to carry with you" (P-1, 2024)

So, while the overall experience of taking a foldable bike with you in the train is not seen as a hastle, there are aspects that could be improved.

Moreover, Partiicpant 5 did have a less overall experience on taking the bike with you in the train:

"Even though you can fold it, it still takes up a lot of space. And also the train to Zuidhorn, which is always really packed, and then you really don't have room for a folding bike. That was also my first reaction when I saw that Arriva was doing this: 'Guys, there are already so many folding bikes and it's already so crowded, you shouldn't add more'." (P-5, 2024)

From this is could be seen that when the trains are busy, the transfer penalty of taking the bike with you in the train might increase. It could be said that taking the a foldable bike with you in the train, while arguably bringing positives in creating mobility at the station, the aspect of the train journey is not seen as positive and may be neutral at best, but increase the transfer penalty and complexity of the trip at worst.

Interestingly other participants did not take the bike with them in the train. This could be because of it did not occur to them: "It does not occur to me to take a bike with me in the train" (P-6, 2024). However, participant 7 stated that: "I don't mind taking it with me on the train" (2024). Suggesting that they may do want to take it with them. Still, the penalties present might hinder the thought of doing this, as some participant suggested that they see taking a bike on the train is a hastle in general (P-3,

P-4, P-5, P-8, 2024). This reason, compared with most people don't have to travel to places, where it may be usefull (P-3, P-4, P-6, 2024). Could limit the use of Arriva bike&go in train travel, which is elaborated on in the discussion.

4.2.4: Bike-complexities

During the trialability, certain inconveniences other than the struggles with foldability are identified. Overall, the bike is experienced quite well, especially the electric aspect which was a main motivator, was seen as quite nice. In the first few meters of cycling almost all participants, especially liked the electric aspect of the bike, which became especially present up a hill (p-3, P-6, 2024) or in headwind (P-1, 2024).

The comfort of the bike, was for most satisfactory (P-2, P-3, P-4, 2024), although improvements could be made, especially for longer distances than just the last mile:

> *"But yes, I don't think I would be happy riding this for more than half an hour, back to back"*
> (P-5, 2024)

These unpleasantness was for some people due to the steering wheel that was relatively low, for taller people (P-1, P-5, P-6, 2024), or the seat was not too comfortable for longer distances (P-2, P-7, 2024). Still, similar initiatives like the ov-fiets are also not necessarily seen as comfortable, but still useful (P-3, P-4, 2024). Also, simplicity and robustness of the bikes can be values (P-7, 2024), so this research cannot identify what the specific tradeoff is in comfort and robustness.

There are also some small more personal complexities, that some participants introduced. A first is the stand that the bike uses, this goes from back to front, which was seen as impractical (P-1, P-2, P-3, P-4, P-7, 2024) and some even struggled more with to even access fully (P-5, P-8, 2024). This could just add a minor complexity to the bike, but could never the less be negative for the overall experience and future recommendations. Second, some participants could not find the on button for the electricity. Where some forgot that this should have a button (P-3, 2024), others wondered how it turned on and could not find the button (P-8, 2024). But the information on this was not very clear, which can add to the complexity of the bike. Third, folding in the bicycle can be seen as hard, and especially the pedals can be of a struggle. and the generally it is inconvenient, where most struggled to some degree, and other could not figure it out on their own even (P-3, P-8, 2024), even after multiple tries it can get easier but it stays complex (P-7, 2024). Lastly, being able to change the angle of the seat (P-2, P-8, 2024), and the addition of more gears (P-8, 2024) was also a stated preference on the bikes.

Overall, there were some other small complexities identified and more nuance in the specific example. But it could be said that the foldability aspect and the lockers through the app added some complexity to the system, which can negatively affect the experience of bike&go. Where simplicity is valued highly in the literature as well (Munkácsy and Monzón, 2018). The trial was also seen as a way to make the bike more approachable (P-1, P-3, P-6, 2024), where it was viewed as a nice addition to know how it works and may reduce future complexities (P-3, P-5, P-8, 2024).

4.3: Approval Factors

4.3.1 Observability

As many participants identified that before they take note of this research, they did not know of Arriva bike&go (P-1, P-3, P-4, P-8, 2024), the observability of the initiative could do with some

improvements, especially since the conceptual model suggests that later in the adoption process observability becomes more important. Participant 4 stated that they did not know that this was an mobility option and could well imagine others to experience the same (2024). Likewise, participant 4 stated:

"Also, if Arriva just gets a little more famous with those bikes, people will take their bikes faster too." (P-4, 2024)

One aspect this lack of publicity may have do with the anonymity of the lockers. Some participants stated before the interviews, that they never, saw these lockers (P-1, P-4, P-6, P-8, 2024), or never thought that there would be rentable bikes inside (P-2, P-5, 2024). It could then be suggested that, the lockers could be placed on a more central location, where people would see them in their journey, or at least with signs, showing that this is present (P-2, 2024). Currently in this process, the anonymity might create a barrier in the built environment, arguably providing a transfer penalty before the journey is even started:

"But before I would take the step to open that safe, see what's in it and how it works, yes then I would have to be a little further along. Then someone before me would have tested that once and said I have to get that, then I would. But one of those ns bikes that is clear and already assembled, I just go faster on that." (P-6, 2024)

It could thus be that when the bike is more in the open, people may be more inclined to try or adopt them. During three of the eight interviews, individuals came up inquiring about what these bicycles or lockers were. Participant 7 commented on this:

"Actually, you should do this a lot more often too. Bring that bike along, so that people start to see it a bit. [...] because you saw the people sitting across from us looking at us." (P-7, 2024)

Likewise, participant 1 suggested, that when these bikes are present on different stations, more people may observe them and be inclined to try them (2024). To put it shortly, the bikes might benefit by giving them "more attention in the public space" (P-7, 2024).

4.3.2 Decision

Overall, many participants hold a positive attitude towards Arriva bike&go, where all could see themselves use it in particular situations. Some would specifically call themselves a fan (P-8, 2024) or strongly believes they will become a regular user (P-2, 2024), but with many it comes more nuanced.

"But it's just a very specific thing you should use it for and how often does that happen. Because there are just quite a lot of alternatives." (P-5, 2024)

This view by participant 5 might summarize what a lot of other participants where hinting towards, they could not see themselves use it very often in their current situation (P-1, P-3, P-8, 2024) or at all (P-4, 2024). The usage for the bike is for most participants clear, but personally getting in that situation can be hard:

"But yes, if I get into that situation then I do consider the chances to use it high, but I have to get into that situation first." (P-3, 2024)

Approval could thus be present among some of the participants, but can be hard to translate to adoption itself. In order to understand this better, we can look at the specific situations that participants can suggest. One usage that some participants see, is for day trips (P-1, P-3, P-4, 2024). Or one

participant stated that they could see their parents use it on their day of, that they go to a nature area by train and cycle around there (P-4, 2024). Moreover, participant 2 stated that they could use the bike for relaxation purposes, to cycle to get your head empty which in combination with the train you can explore many more new places (P-2, 2024). However, these uses do not particularly add to the last mile problem.

Last mile

Considering the last mile, users see the future use of Arriva bike&go as an alternative to the bus (P-1, P-3, P-4, P-5). So in places where the bus is not frequent or does not have a good connection it safes either time (P-3, P-4, 2024). Or participants might make the trade off when the weather is nice enough to take the bike instead of the bus (P-1, P-6, P-8, 2024). Participants can imagine this being in the rural area (P-1, P-3, P-5, 2024), or even in the urban (P-4, P-6, 2024), where for example sports facilities that are often further away from the urban center, can be accessed (P-5, 2024).

> *"Look today this is a nice day to experiment in going by bicycle. Suppose now I would go to my parents and I don't need the bike, they would also be fine to pick me up. I think a lot of people do it this way and get picked up from the station by car if it's too far anyway."* (P-1, 2024)

This statement by particpant one shows that for many last mile, perceived accessibility might not as low, and the car provides a good alternative, like the literature suggests (Pot, Koster and Tillema, 2023). This particularly holds strong in the first mile where participants don't see it useful, because people would have a car or bike (P-1, P-3, P-5, 2024). Still, participant 1 states that he does not neccisarily prefer being picked up by the car (2024) and it can be nice that you don't have to depend on someone else to pick you up (P-3, 2024). Participant 3 and 6 stated that this a bicycle at a station would allow for some more personal freedom to travel instead of being picked up at the station (2024). Here it might also add an extra dimension to the system, if one fails, you can take the other (P-3, 2024). Especially the electric aspect makes this a viable alternative as it does not take much effort or time (P-1, P-3, P-6, P-7, P-8, 2024). So, this might suggest, that Arriva bike&go can be an addition to the transport mix in certain situations, but whether this can be wildly adopted, is still dependent on numerous factors.

To give a short overview of some smaller more specific recommendations given by particiapnts themselves, which can help observability and nudge the decision of Arriva bike&go towards adoption. A first recommendation is to add the bike to more stations, because that can limit the hassle of taking it with you on the train (P-2, P-5, 2024), allows for more freedom in returning the bike (P-6, 2024) and could increase the observability of the bikes (P-1, P-7, 2024). And allows for more freedom in day trips, to nature areas (P-4, 2024), the islands (P-7, 2024) or other places in the country side (P-4, P-5, 2024). A second recommendation is central to Arriva bike&go's distinctness, namely its foldability. The foldability, which allows you to, but on the flip side also forces you to, take the bike with you on trains (P-5, 2024). This is similar to the recommendation above, that it may be easier to just have the bike on your end station, from where you can take it. This could be preferred, since people would either do not have a preference, on whether they need to carry it on the train (P-1, P-7, 2024), or would see it as reducing another penalty in the trip (P-2, P-3, P-4, P-6, P-8, 2024). A third recommendation is that when lockers are kept, make it so that people can only use the bottom ones, or at least have the choice, since some elderly might struggle with putting the bikes in the top lockers (P-3, P-6, P-8, 2024).

And other changes to the bike may be personal, but could also be considered. These include but are not limited to; being able to change the height of the steering wheel (P-1, P-5, P-6, 2024), add a

handle to easier take it with you when walking (P-1, 2024), being able to change the angle of the seat (P-2, P-8, 2024), and lastly add more gears (P-8, 2024).

Chapter 5: Discussion

5.1: Interpretation of results

To interpret the above found results we can compare and contrast them against the literature and the conceptual model. Knowledge, trialability and approval factors are all play their own role in the engagement with and decision towards adoption of Arriva bike&go. Below the findings on these factors are compared and contrast towards the existing academic and social debate. To centrally discuss, pioneers are venturesome (Sahin, 2006), as our participants likewise either recognized themselves (P-2, 2024), or became clear from their initial motivations that they have a strong curiosity (P-1, P-3, P-4, P-8, 2024). Similarly they we prepared for uncertainties, like the teething problems with the app (P-2, 2024), so it could be said, that participants at least show some characteristics of pioneers. According to Roger's pioneers, put their stamp of approval on an innovation (1983). While it may be too bold to state that the participants and their views and decision on the bikes will be the main narrative in the future adoption of Arriva bike&go, their views on the potential decisions to adopt or not can be central in changes to make and the potential for the last mile.

Knowledge

Considering compatibility, we found that stereotypes, in this case holding negative views of electric bicycle users might be changed or at least lessened with trial (P-1, 2024). This could strengthen Plazier et al.'s conclusion that awareness and trial can help adoption and reduce negative views held on e-bikes (2017). Jones et al., and Meijering and Weitkamp, suggested that focusing on the benefits in light of wellbeing can influence usage (2016; 2024). However, this was not identified in this research, where wellbeing was not mentioned as a motivational factor for trial. However, positive experiences with nostalgia (P-5, 2024), nature (P-1, 2024) and recreational use (P-2, 2024), could suggest that in later adoption stages beyond pioneers, these factors can become more important, as they were identified as positive aspects, only not a motivator yet.

Looking at the relative advantages, we identified that speed could be seen as one of the central factors for trialing Arriva bike&go. During transfers, but arguably also in during the trip itself, time is one of the most important factors as a transfer penalty (Cascajo, Garcia-Martinez and Monzon, 2017) So, likely due to an increase in speed, reduces time spent on the trips, compared to regular bikes. To little surprise participants in terms of comfort mostly preferred the electrical aspects of the bike, as suggested by Jones et al. (2016). Similarly, Plazier suggested that the electric aspect of bikes may be an opportunity in rural areas (2023), which participants in this study likewise hinted towards. Kosmidis and Müller-Eie also suggested that infrastructure and the built environment are important aspects of this opportunity (2024). However, participants rarely mentioned the infrastructure, which might be due to the already well-existing infrastructure present (Jorritsma, Jonkeren and Krabbenborg, 2023) which may be taken for granted and less attention is paid to. The relative advantage of price, while also not being a central aspect of this study, is a less clearer cut advantage. While the interviews may suggest that price may at least be not too much of a limiting factor, the limits for people with lower income, who are suggested to use e-bikes (Plazier, Weitkamp and van den Berg, 2023b), are not within the scope. Moreover, some participants are students, who often have free transportation, possibly further distorting results on the perception of price. Lastly, since participants were financially compensated, this may have also distorted views and why no strong preferences came to be.

Trialability

Overall, the trialability aspect is viewed as a positive part by participants, which is in line with views by Plazier et al (2023) and Bösehans (2024). Consequently, using trialability certain complexity and transfer penalties were identified, like research by Cascajo et al. (2019) suggested. The fact that Arriva bike&go is located in lockers, is a new feature of bike sharing systems in the literature. It was suggested that having lockers might add freedom towards normally limiting station-based options (Bösehans *et al.*, 2023). While most participants experienced the freedom to take a bike with them in the train, the real benefit is not fully clear. Some participants might prefer to have the station-based bike parking present at the train station where they get off, to limit the complexities in the journey. This can be in line with Zhong who suggested that travelers would prefer parking to be close to the transfer locations (2021). This tendency, however, could not as easily be achieved when Arriva as a provider benefits from central locations in maintenance and having access to more users when bikes are placed at central locations (Bösehans *et al.*, 2023). This is also the central struggle that Rongen et al (2022) identified in providing public transport in rural areas. Other participants did not mind taking the bike with them on the train as much, but limiting the complexities and transfer penalties is preferred, and rightly so the guiding principle in many research (Cascajo, Garcia-Martinez and Monzon, 2017; Jara-Diaz *et al.*, 2022). So, the impact of these principles and whether there is a market to be gained cannot be concluded by the limited qualitative nature of this research.

Considering the results of the app during the trialability, it was mostly perceived as a relatively easy to use an app for rental. It may be that the younger age of participants plays gives a one-sided view, as younger people usually get more easily used to these new initiatives (Reck *et al.*, 2021). However, it could also be that the app was a hurdle for people outside of these already established user group, which tends to be younger (Munkácsy, 2017), to give Arriva bike&go a try. This might then be a potential bias, that can be further researched in later stages of adoption. As a last note, various other small transfer penalties, or complexities were identified, that were either in accordance with literature or not specifically mentioned. The influence of weather was identified to also play a role in the usage of Arriva bike&go, like bicycles often do (Cascajo, Garcia-Martinez and Monzon, 2017). Most other complexities were identified on the bikes themselves, like foldability, comfort, or the usage of lockers, but these aspects are specific to Arriva bike&go, so a linkage to other bike sharing systems is outside the scope of this discussion. Overall, during trialability it became clear that complexities, where they were present, should be limited, like Rogers put central in IDM (1983).

Approval

In literature there are various suggestions on how electric bicycles or e-bikes can be used in the accessibility of the rural. For this looking at the point identified by the approval factors and future recommendations it could be that Arriva bike&go is suited for the last mile. Reck et al. (2021) and Plazier et al. (2017) suggested that electric bicycle users can become more diverse, and Arriva bike&go being a new initiative may add to that diversity. Additionally, having various participants stating that they would suggest bike&go for various purposes (recreational, visiting family or commuting) could strengthen this idea of future diversity, and the correct use of e-bike usage being higher among women, and older age groups (Plazier et al., 2017, Lee et al., 2015), can become less important, or might already be redundant, as participants would at least for Arriva bike&go not recommend it for this demographic specifically.

While previous research often concluded that e-bikes and shared e-bikes might compete with car travel (Jonkeren *et al.*, 2021; Stam *et al.*, 2021; Kosmidis and Müller-Eie, 2024). It is not clear whether

Arriva bike&go may do the same. Although participants stated that it may occasionally replace a car trip (P-1, P-5, P-6, P-7, 2024). Interestingly, P-1 (2024) did not see car dependency as a problem, and likewise, others did not see that Arriva bike&go might add much to their mobility, which is in line with conclusions by Pot et al. (2023) that accessibility problems in the rural might not be perceived as such. Many respondents were more considering the replacement of bus trips or even regular bicycle usage, more similar to conclusions of Campbell et al. (2019). E-bike competition with regular bike trips (Rongen et al., 2022), as mentioned by P-3 (2024) has a clear advantage when taking a regular bike on the train, as it costs just as much and might be more convenient. However, the added benefit may not be too great, as a great amount of people might not travel this way. It may put shortly then be that while Arriva bike&go might compete to some extent with other transport mode, it does not specifically outcompete one. Arriva bike&go can be just an addition to the choices of mobility as P-5 clearly quoted (2024), and may be used for occasional trips in line with Bösehans et al.'s conclusions (2023).

The feasibility of future usage may then be limited from just limited usage. As Rongen et al. stated feasibility in rural areas can be hard to achieve (2022), subsidies may then also for Arriva bike&go will be required when the pilot is continued. Governments have shown interest, so there may be some opportunities there. Observability is the last factor that goes into future approval. As Rogers outlines, observability is central to adoption of new initiative (1983), Arriva bike&go might have some steps to take here. Whether it is additional promotion (P-2, 2024), clearer description of the lockers (P-3, P-8, 2024) or the provision of potential uses for it, like visiting the islands (P-7, 2024) could all add to the observability from participants perspective. Munkácsy found that advertisement in public space and seeing bikes used by others could add to shared e-bike adoption, so promoting observability like participants described can be an addition to this. Pioneers stand central in this promotion according to Rogers (1983), so listening to these tips could be central.

Overall, during the experience of Arriva bike&go, some findings do correspond with the literature, while others do not. While the qualitative nature of this study, may be limited to drawing specific conclusions on how the found engagement with Arriva bike&go leads to adoption, some basic suggestions might be made. Generally speaking, Arriva bike&go might benefit from decreased complexities and an increase in observability. An integration of modes into multimodal transport, as suggested by Ma et al. (2020), could imply that this can be a focus point to achievement. Good integration with train travel with clear signage (P-2, 2024), providing possible trips showing this integration (P-7, 2024), and an increase in locations present (P-6, 2024) are all suggestions that could be added to put this integration central while paying attention to complexities and observability. As the trials showed that positive experiences might lead to positive views towards adoption and approval, focusing on providing these positive experiences can be central to increasing adoption, as Wu et al. (2023) concluded.

5.2: Methodological review

5.2.1 Bike along and IDM

The methodology used of combining bike-along interviews with Roger's IDM, has overall been experienced as satisfactory to gather experiences on Arriva bike&go. While it does have some limitations, there are various aspects that went into this satisfaction. Trialability is the central concept throughout the methodology, where being present in the trial stage allows the researcher to understand on sight what the participant observes. Especially the complexities encountered during these trials can show both positive and negative aspects of the innovation. An example during this

research is that almost all participants struggled to clip open the pedals. Because I used the bikes already a few times, I did not notice these complexities and I merely thought of them as an extra step, at most slightly increasing the time as a transfer penalty. However, being there at the trial allowed me as the researcher to go more into detail about this. Moreover, participants also may have forgotten these slight inconveniences themselves, as the usage of the bikes and may with other research methods when interviews are conducted afterward. Still, more research might be required to see whether these findings are really transfer penalties keeping users from using the initiative, or if they are just slight inconveniences and have no influence on the adoption rate.

The methodology may have some shortcomings, however. Firstly, individuals might be out of their flow as the following quote exemplifies:

> *"...then that saves me a half-hour bus ride I think and then I can be home in about 20 minutes. Euh, here we go left I think, I have no idea where we cycle to. Oh, this is Groningen Europapark"* (P-5, 2024)

Here the participant firstly talks about a possible future ride, to later be distracted by the route and noticing different surroundings. While this was also beneficial in identifying concepts related to nature and nostalgia. It often led to participants being lost for words, where answers did not always go as deep as one would like with semi-structured interviews. Secondly, because participants were on a moving vehicle, sometimes the audio, by the participants or interviewer may be inaudible, while this might be solved with a better quality microphone, it is something to consider that word-for-word quotations cannot always be present. Lastly, because this was their first trial for most participants, they often had their first impressions on which this research was based. However, as seen in the conceptual model, the decision stage is different from the trial. While participants during usage may be very positive or negative, this may change over time. The views could change after a second use or more time to consider. So, the first indications of bike-along with IDM give a good indication for initial strength and shortcomings, but can be too limited to say something about the future usage of initiatives.

5.2.2: Data gathering challenges

In the first stages of the research, a mixed methods approach was to be outlined, but eventually not chosen because of a lack of data. In the pilot stage where the initiative finds themselves in, users have not been widely observed, so a quantitative approach, where surveys could be distributed was not chosen. Although these findings might have been useful to do statistical data analysis and possibly draw sharper conclusions on the usage, because of a potential lack of participants this method was eventually tweaked to a full qualitative approach with bike-along interview.

5.2.3 Potential bias and positionality

Looking specifically at this research, while overall, interesting conclusions can be drawn, there are some shortcomings or biases to be considered. First and arguably most foremost, while trying to take an objective stance during the trials, my own bias in observations and trialability cannot be fully limited and may have influenced participants. I personally had my own opinion about the initiative which could have steered the interviews. Especially some personal frustration with malfunction in the app, may have shown a bias, but on the other hand, a personal positive attitude towards the initiative as a whole, could have steered in a positive way.

A second bias could be in the characteristics of participants. Several participants have been priorly known by the interviewer. Potentially harming the objectivity of this research. However, because participants were gathered out of inherent curiosity towards these bicycles they have been accepted as participants. Moreover, by the seven out of the eight participants reside in Groningen and 5 are students, which could form a bias that is not representative of actual users. Similarly three participants used took the bicycles with them in the train, which could be a potential bias or just an indication that Arriva bike&go has multiple non-intended purposes.

A third limitation could be considered to my own positionality as a researcher. Representing the University of Groningen on the one hand, but also gathering data that Arriva might use to improve the bikes on the other hand, could have seemed to participants as a non-independent researcher, since there is an inherent promotion of a commercial product.

Lastly, some smaller, limitations in the data process should be considered as well. Five out of eight participants did not have a fully functioning app, which did not allow them to fully go through the trial. Sound for some parts of the trial were inaudible, where valuable information might have been lost. For one participant the electric part of the bicycle was broken, causing the interviewer to switch, bikes which also caused extra complexity.

Chapter 6: Conclusion

6.1: Main research question

To conclude on the research we tried to answer the research question: *'How do pioneers experience the Arriva bike&go initiative as a way of contributing to rural accessibility regarding the last mile problem?*'. The research question explores how pioneers experience the Arriva bike&go initiative as a way to contribute to rural accessibility regarding the last mile problem. The study reveals that pioneers, characterized by their venturesome nature and curiosity, generally have a positive experience with the Arriva bike&go initiative, although there are mixed opinions on its overall effectiveness in addressing last-mile connectivity in rural areas. The participants, while limited in their numbers, could be identified as pioneers, and their views might be leading for the future narrative of Arriva bike&go. So, their engagement on knowledge, trialability, and approval factors provide some more insight into the experiences.

To firstly consider the knowledge factors that pioneers can consider before trial, most pioneers are pulled towards the initiative because of a curiosity towards an innovation, and a curiosity to trial plays a part in this. Furthermore, existing pleasant experiences with electric bicycles or foldable bicycles can play a role. Other than inherent motivation, the relative advantage of Arriva bike&go can be a considering factor. While an understanding of market prices and competitor activities might be a key factor in assessing the potential benefits of an initiative, it is unclear how the price directly translates to usage. Speed that is associated with the electric aspect of the bikes is suggested to have a more positive impact, where knowing that it might reduce time penalties could be a motivating factor. Infrastructure concerns were minimal, possibly due to existing adequate infrastructure, which might have been taken for granted.

Secondly, participants recognized that trial experiences could reduce negative stereotypes about e-bike users, supporting Plazier et al.'s findings that awareness and trial can aid adoption (2023). The locker system can add a unique flexibility to the bike sharing system, although some complexities are still present. While some participants, view the foldability to take the bike with them in the train as flexibility, others mainly focused on the transfer penalties associated with it. Problems with the unfolding, unclear information, and dealing with crowdedness are all negative experiences for first-time users. The app can be seen as a positive way to start renting, although some complexities and consideration towards a broader demographic might also need working.

Lastly, approval and future recommendations from participants suggested that Arriva bike&go could diversify its user base, similar to broader trends in e-bike adoption. While some participants saw the potential for replacing car trips, most viewed it as an addition to existing transport options rather than a direct competitor. With only specific journeys suggested by pioneers to benefit from Arriva bike&go, together with a low observability could cause the initiative to not catch on and be of any addition to increase rural accessibility. When observability can be increased, however, by using additional promotion, increasing visibility, or suggesting specific trips to users, the early majority may be reached by providing new opportunities. For users that want to use it for the last mile in rural areas or other more recreational trips.

In short, while the pioneers of the Arriva bike&go initiative experience opportunities to enhance rural accessibility for the last mile, its success hinges on addressing the complexities of use, increasing observability, and ensuring seamless integration with existing transport systems.

6.2: Recommendations for planning practice and Arriva

While conclusions of this research can focus on the experiences of pioneers, some more specific lessons can be learned to guide recommendations towards the planning practice and Arriva in particular. While these recommendations could be too specific and not fully feasible, they do focus on limiting the complexities, improving observability, and allowing for seamless integration. Some smaller recommendations by participants are found in Chapter 4.3.2.

To reduce complexities associated with the Arriva bike&go initiative, expanding the availability of bikes to more stations can be suggested. This would alleviate the hassle of carrying the bikes on trains (P-2, P-5, 2024), provide users with more freedom in returning the bikes (P-6, 2024), and allow greater flexibility for day trips to various rural locations such as nature areas (P-4, 2024) and islands (P-7, 2024). While it does take away a central spot, and arguably the unique factor of taking it with you on the train. It still being an option for users could be in line with future users, who might see Arriva bike&go in general as another mobility option and could still take the bikes with them on the train. Simplifying the use of the bikes can be further achieved by offering clear, proper information in the app, based on experiences discussed in this paper. Other factors mentioned in this paper on features of the bike can also be considered but might be personal preferences. A focus on reducing complexity could streamline the user experience and make the system more user-friendly.

Improving observability is another key area for enhancing the Arriva bike&go initiative. Promoting possible journeys and increasing overall visibility through various promotional activities might boost the initiative's adoption. Enhancing trialability by offering more opportunities for potential users to try the service without commitment could increase this initial rate of adoption. Providing options to try the initiative for a discount, could get the ball rolling. Furthermore, making the bikes as visible as possible in the space they are in, with clear signage and visibility can help this, although regulations at stations might limit the extent of to which this can be achieved. Keeping observability in mind when making changes, could enhance adoption rate and attract a broader user base.

6.3: Future research

Based on the outcomes of this study, some recommendations for future research can be made. The first topic to benefit from further investigation is looking at a longitudinal study of bike&go itself. This research provided some experiences by the initial pioneers. New pioneers could be followed for a longer period of time and potential future users that fit into the early and late majority could be identified. In this way, these adapters could be contrasted to this research and see whether recommendations and experiences change over time. Furthermore, on Arriva bike&go, results found in this study can be the basis for a more quantitative analysis of users of Arriva bike&go. Using panel groups, surveys with questions on preferences on a Likert scale, or other forms of analysis where identified problems in complexity or opportunities on observability can be ranked and quantified could significantly impact what. These might provide which find out which factors hold up for a broader audience, and which ones are personal preferences.

Moreover, future research could also see whether bike-along interviews can be used for more established users in the early or late majority, compared to pioneers. Trialability is suggested to be more important for early adopters (Sahin, 2006), so seeing whether bike-along interviews can be significant to identify experiences at later stages can be interesting. Furthermore, this method could also be translated to other initiatives in mobility. Where go-along interviews can be used for other mobility initiatives, to contrast what can be learned in another case.

Last, future research can look more at the possibility of electric and foldable bikes outside of bike sharing systems. Shared and personal electric bicycles have been seen to have an advantage for users, also in this research. However, the impact of foldable bikes in general has not been researched in great detail. So, for future research, the potential of electric foldable bikes can be analyzed more clearly as an opportunity for accessibility in rural areas.

Chapter 7: Bibliography

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Chapter 8: Appendices

8.1: Interview guide

The below outline was used as a guide throughout the interviews. However, as they were semi-structured the questions merely provided structure, and are no representation of the specific questions asked.

Questions before trial

- Why trial?

- How often do you use your own bike?

- What are you first impressions of Arriva bike&go?

- Have you seen other people use Arriva bike&go? (and foldable bikes? And electric bike?)

During trial

Relative advantage: Price, speed (time), other public transit

Compatibility: Personal mobility patterns, values (why trial?)

Complexity: electricity, app, lockers

Trialability: Overall experience of trial?

Observability: Seen before? How get to know? Other alternatives?

After trial

- Use more often? What purpose? (last mile?)

- Transfer penalties: waiting, walking, lockers, crowdedness

- Recommend to others?

- Comparative advantage to bus, car, bike

    Especially in last-mile

8.2: Consent form

Original (Dutch)

Overeenkomst van Deelname (Consent Form)
Onderzoeker: Rens Rolink
Onderzoeksproject: Master Scriptie Society Sustainability and Planning
Onderzoeksonderwerp: Nieuwe gebruikerservaringen deelfiets mobiliteit (Bike&Go)

rijksuniversiteit groningen

Geachte Meneer/Mevrouw,

Hartelijk dank dat u mee wilt werken aan een onderzoek naar deelfiets ervaringen van Bike&Go. Voor mijn masterscriptie in Society Sustainability and Planning aan de Rijksuniversiteit Groningen houdt dit onderzoek zich bezig met hoe deelfiets initiatieven en hun rol binnen de bereikbaarheid van het landelijke gebied, in de zogenoemde 'last-mile' mobiliteit. Hierbij is de focus op de ervaringen van nieuwe gebruikers van Bike&Go. Hierbij zou ik graag een interview afnemen tijdens het gebruik van de fiets, om hier tijdens het gebruik zelf uw inzage te krijgen. De duur van dit interview is afhankelijk van de reis die u voor zich ziet aangezien ik graag een reis die u wilt doen mee wil fietsen en hierbij te interviewen tijdens uw gebruik (zogenaamde 'bike-along interviews').

Het interview wordt via een geluidsrecorder opgenomen, waarna het wordt getranscribeerd. Als u dit transcript zou willen inzien kunt u altijd contact met mij opnemen hierover. Ook als u het uiteindelijke onderzoek zou willen lezen, kunt u contact opnemen. De informatie zal worden gebruikt om de onderzoeksvraag te beantwoorden, wanneer het onderzoek is afgerond zal de opname dan ook worden verwijderd. Tot die tijd zullen de gegevens vertrouwelijk en anoniem worden behandeld. De gegevens zullen alleen door mijzelf en mijn supervisor: Felix Pot worden ingezien. In de openbare resultaten van de onderzoeks-scriptie zal de informatie geanonimiseerd worden en niet aan u persoonlijk te linken zijn. Dit onderzoek is in samenwerking met Arriva. De gegevens zullen echter niet met Arriva gedeeld worden en alleen openbare resultaten zullen voor Arriva te zien zijn.

Met het ondertekenen van deze overeenkomst geeft u aan dat:

- Het duidelijk is voor u waar het onderzoek over gaat.
- Dat het duidelijk is dat de deelname vrijwillig is en dat u het recht heeft vragen niet te beantwoorden en zich altijd terug kunt trekken uit het onderzoek.
- Uw deelname vertrouwelijk is en dat informatie uit het interview gebruikt kan worden voor de onderzoeks-scriptie of in de vorm van quotes, en dat deze informatie geanonimiseerd zal zijn.
- Dat het duidelijk is dat uw interview met geluidsopname alle informatie die daaruit voortkomt vertrouwelijk wordt bewaard op een pc beveiligd met een wachtwoord en alleen toegankelijk is voor de onderzoeker en supervisor.

Voor verder vragen aanmerkingen kunt u mij of mijn supervisor contacteren:

Onderzoeker: Rens Rolink
Tel: --------
Email: r.h.j.rolink@student.rug.nl

Supervisor: dr. F.J. (Felix) Pot
Tel: ----------
Email: f.j.pot@rug.nl

Toestemmingsverklaring

- Ik heb de overeenkomst van deelname gelezen en begrepen. Ik had genoeg tijd om te beslissen of ik meedoe aan het onderzoek. Ook kon ik vragen stellen. Mijn vragen zijn voldoende beantwoord.
- Ik weet dat meedoen aan dit onderzoek vrijwillig is. Ook weet ik dat ik op ieder moment kan beslissen om toch niet mee te doen of te stoppen met het onderzoek. Daarvoor hoef ik geen reden te geven. Ik begrijp ook dat het onderzoekstem, in overleg met mij, kan beslissen om mijn deelname te stoppen.
- Ik begrijp dat er gegevens verzameld worden die te herleiden zijn tot mij als persoon.
- Ik begrijp dat deze persoonlijke gegevens apart worden opgeslagen van de andere gegevens die ik verstrek, vanwege veiligheidsredenen. Ook weet ik dat mijn gegevens zoveel mogelijk zullen worden gepseudonimiseerd en dat mijn gegevens veilig worden opgeslagen op de beveiligde servers van de Rijksuniversiteit Groningen.
- Ik geef toestemming voor het verzamelen en gebruiken van mijn gegevens voor het doel van dit onderzoek.
- Ik wil meedoen aan dit onderzoek.

Naam deelnemer: _____

Handtekening: _____ Datum: ___ / ___ / ___

Ik zou graag de onderzoeksresultaten ontvangen: Ja / Nee

Zo ja, in welke vorm? Geschreven / Mondeling

- Ik verklaar dat ik de deelnemer volledig heb geïnformeerd over het genoemde onderzoek.
- Als er tijdens het onderzoek informatie bekend wordt die de toestemming van de deelnemer zou kunnen beïnvloeden, dan breng ik de deelnemer daarvan tijdig op de hoogte.

Naam onderzoeker: _____

Handtekening: _____ Datum: ___ / ___ / ___

English translation:

Agreement of Participation (Consent Form)

Researcher: Rens Rolink
Research project: Master thesis Society Sustainability and Planning
Research topic: New user experiences of bicycle sharing mobility (Bike&Go)

Dear Sir/Madam,
Thank you very much for participating in a research project about Bike&Go's bicycle sharing experiences. For my master's thesis in Society Sustainability and Planning at the University of Groningen, this research deals with how bicycle sharing initiatives and their role within rural accessibility, in so-called 'last-mile' mobility. The focus here is on the experiences of new users of Bike&Go. I would like to conduct an interview during the use of the bicycle, in order to gain your insight into this. The duration of this interview depends on the journey you have in mind as I would like to cycle along on a journey you want to do and interview you during your use (so-called 'bike-along interviews').
The interview will be recorded via audio recorder and then transcribed. If you would like to see this transcript you can always contact me about it. Also, if you would like to read the final study, please contact me. The information will be used to answer the research question, therefore when the research is completed the recording will be deleted. Until then, the data will be kept confidential and anonymous. The data will be viewed only by myself and my supervisor: Felix Pot. In the public results of the research thesis, the information will be anonymized and will not be linked to you personally. This research is in collaboration with Arriva. However, the data will not be shared with Arriva and only public results will be viewable to Arriva.
By signing this agreement, you indicate that:
- It is clear to you what the study is about.
- That it is clear that participation is voluntary and that you have the right not to answer questions and can withdraw from the study at any time.
- Your participation is confidential and that information from the interview may be used for the research thesis or in the form of quotes, and that this information will be anonymized.
- That it is understood that your interview with audio recording all information resulting from it will be kept confidentially on a password protected personal computer and accessible only to the researcher and supervisor.

For further questions and comments please contact me or my supervisor:
Researcher: Rens Rolink
Email: r.h.j.rolink@student.rug.nl

Supervisor: Dr. F.J. (Felix) Pot
Email: f.j.pot@rug.nl

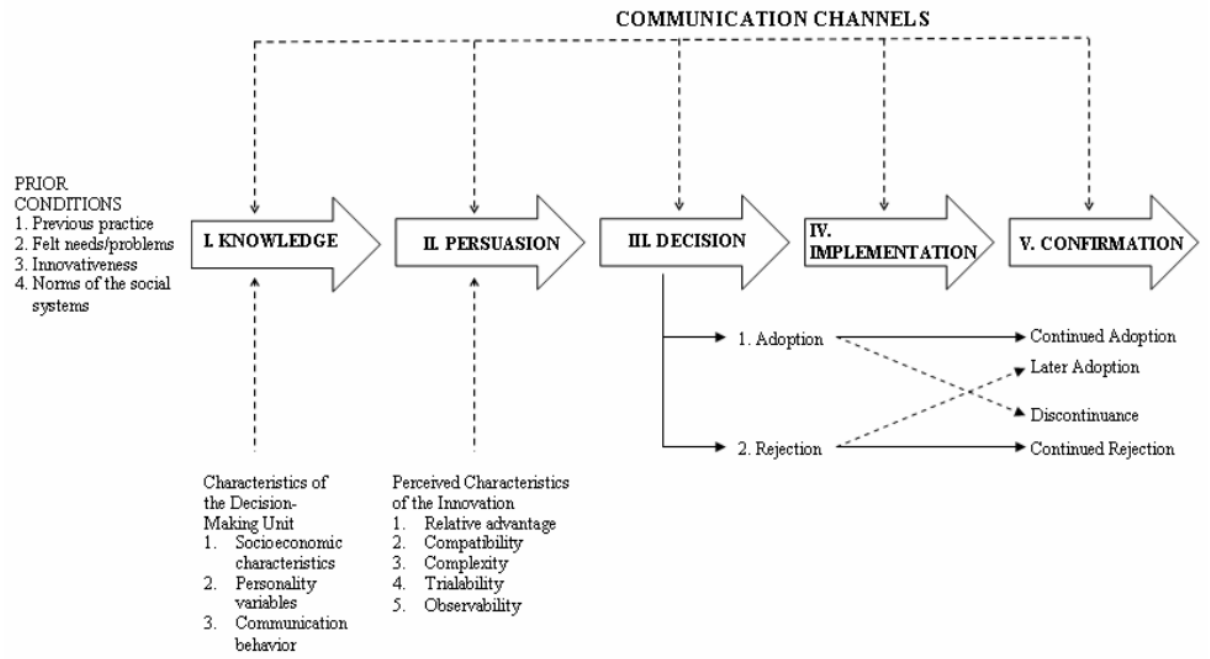
Consent Statement

- I have read and understood the agreement of participation. I had enough time to decide whether to participate in the study. I was also able to ask questions. My questions were adequately answered.
- I know that participating in this study is voluntary. I also know that I can decide at any time not to participate anyway or to stop the study. I do not have to give a reason for doing so. I also understand that the research voice, in consultation with me, may decide to stop my participation.
- I understand that data will be collected that can be traced back to me as an individual.
- I understand that this personal data will be stored separately from the other data I provide, for security reasons. I also know that my data will be pseudonymized as much as possible and that my data will be safely stored on the secure servers of the University of Groningen.
- I consent to the collection and use of my data for the purpose of this study.
- I wish to participate in this study.

8.3: Code tree

	Themes	Code	Sub-Code
Bike-along interviews: Experience on Arriva bike&go			
	Approval / Future Factors	Future	Future Changes
			Future Usage
			Recommend to others
		Last Mile Solution	
		Perceived Accessibility	
	Trialability	Bike-along method	
		App	
		Bike	
		Familiarity / Nostalgia	
		Lockers	
		Transfer penalties	Built Environment
			Personal Character
			Pure
			Time
		Real Pioneer	
	Knowledge	Initial Motivation	
		Market Position	
		Observability	Arriva bike&go
			Electric bikes
			Foldable bikes
		Previous Usage	
		Relative Advantage	Nature
			Public transit
			Price
			Speed
	Other		
		Deductive Code	
		Inductive Code	

8.4: Model of Five Stages in the Innovation-Decision Process by Rogers



Source: Rogers, E.M. (2003) Diffusion of Innovations, 5th Edition. 5th edn. English Free Press.