Sustainable e-mobility services: a research on how to increase the uptake of eHUBS in Nijmegen

A research into the behavioural-intention to use eHUB modalities in Nijmegen in order to contribute to the sustainable mobility transition

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Master's Thesis for the Spatial Planning
Programme: Cities, Water and Climate Change

Nijmegen School of Management
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August, 2023

Abstract

The objective of this thesis was to investigate what the influence of behavioural-intention is to use the eHUB modalities in the city of Nijmegen. The combination of shared mobility services and electrical vehicles is new, yet promising. A key component is behavioural change, as the mobility sector has had a major focus on car-dependency and is embedded in the habitual nature of people. With growing attention to the effects of climate change, the influence of the mobility network on environmental pollution, and innovation on in information and communication technologies, there is a window of opportunity to institutionalize new mobility services. Because this transition effects people's everyday lives and in the general social world, insight in behavioural theories is important. Using the Theory of Planned Behaviour by Ajzen (1991) gives a deeper understanding in the characteristics of people why they use, or have the intention to use the eHUB modalities. The findings show that residents in Nijmegen are positively positions towards using the eHUBS, as long as they do not experience nuisance from them. The support for shared e-mobility options is present in the culture of Nijmegen - as the city has focused on sustainability for years - but it can still be embedded deeper. By investing in communication marketing as municipality, the confidence of (potential) users keeps expanding. Residents of Nijmegen are often unaware of the possible modalities they could be using for their travel-related journeys. So, although residents of Nijmegen have positive intentions to use eHUB modalities, there is still room for improvement to make fundamental changes in light of the sustainable mobility transition.

Keywords: Sustainable mobility, Shared mobility, Multimodal travel, Travel behaviour, Behavioural change.

Preface

I hereby present my thesis as the final part of my master Spatial Planning at the Radboud University. I am pleased with the outcome and ready for what the future will bring. I would like to thank my family and friends for encouraging and supporting me in this journey, which they know was necessary at times. I especially want to thank my supervisor, Sander Lenferink, for having the patience with me and for his guidance and support throughout my writing process.

This thesis is the result of my academic journey from the last few years where I have found my interest for the sustainable working field. I hope that this thesis will add to the existing body of knowledge in the sustainable mobility field, although I acknowledge its limitations. I hope to make a change for the better in the future and with that being said: I hope you enjoy reading my thesis.

Greetings,

Iris van Straaten

Nijmegen, August, 2023

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1. Introduction

Due to growing density in cities and the current climate change, there is a need for a change in urban planning in order to ensure sustainable cities. The mobility sector is one of the most polluting sectors that fail to reduce its CO_2 emissions, see **Fout! Verwijzingsbron niet gevonden.** (CBS, 2022). This is due to the fact that the road network have increased since 1990 and people rely more heavily on the existing infrastructure network. There is increasing attention to change the current mobility system in cities due to growing issues like increasing traffic congestion, noise and environmental pollution, and increasing demand of the mobility network. This has become problematic for the urban environment, citizen health and liveability in cities. Although some of these issues can be reduced, it is prominent that our current transportation system is not sustainable enough to solve these issues unless the system itself is changed (Verfaillie & Bidwell, 2000). So the issues regarding mobility are noticeable, but it is less clear how to achieve a transition to a sustainable mobility network and how to deal with uncertainties and complexity surrounding this change (NWO, 2022).

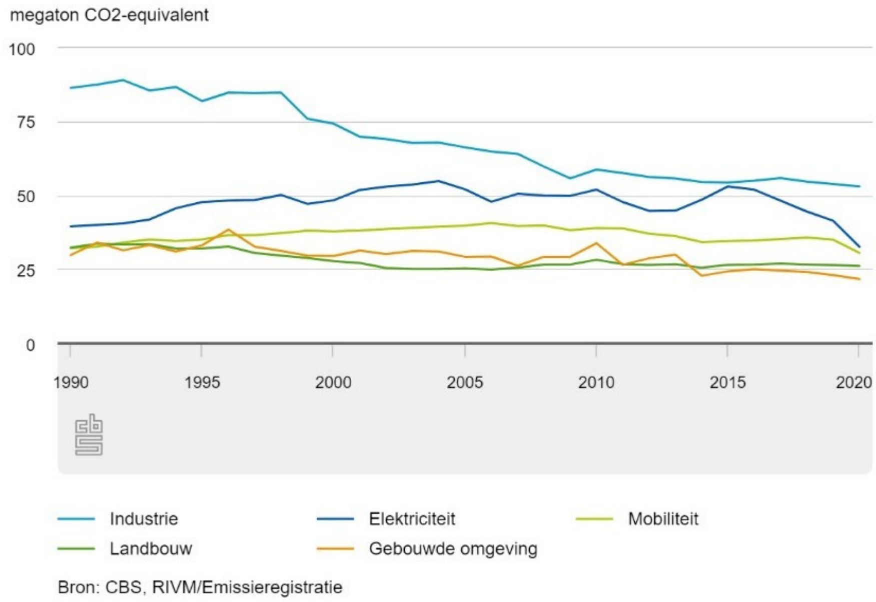


Figure 1. Greenhouse gas emissions by sector (CBS, 2022).

Mobility is an important aspect in the sustainable transition process in order to reduce the emission of greenhouse gases and important to consider regarding social inclusion in the city (Barreto, Amaral, & Baltazar, 2018). Nowadays, the mobility networks are embedded in people's everyday lives, but modern discourses mainly focus on individualised automobility (Doughty & Murray, 2016). In order to facilitate the sustainable mobility transition, there is a need for innovative mobility alternatives that put less strain on the current infrastructure network. There are already numerous approaches that aim to do this, like enhancing public transportation, encouraging bicycle use by improving bicycle lanes, introducing shared vehicles, etc. But these innovations cause other and additional issues to arise, such as '*new and additional public expenditure, changes in the daily routine of drivers and new problems that arise from the commuter point of view*' (Barreto et al., 2018, p. 850). People must change their travel behaviour and attitudes in order for these alternative mobility options/services to be successful (Banister, 2008). Facilitating the behavioural transport change and making people susceptible to that change, requires insight in the objective and subjective perspectives regarding the uptake of sustainable mobility innovations.

1.1. Research problem statement

For years, our mobility network deals with a number of such as greenhouse gas emissions, congestions and nuisance (Farla, Alkemade, & Suurs, 2010; Banister, 2008). In order to tackle these issues, the system is due for innovations to make it more sustainable. This asks for a multi-level collaboration between different actors. The overall aim and challenge is *'[…] how to retain the social and economic benefits associated with mobility while reducing the negative environmental, economic and social impacts from transport'* (Köhler, et al., 2009, pp. 2985-2986). Apart from dealing with the negative impacts of the mobility network, it creates possibilities for economic markets and competitiveness and for commercial and cultural exchanges. In order for the mobility network to remain fruitful without the negative impact on society, a transition is needed into a sustainable mobility network.

The sustainable mobility network depends on alternatives to replace the current network that is mainly focused on car-use. It is difficult to create a new, sustainable transportation network because societies are increasingly dependent on the current mobility network. Integrated land use and transport planning is key in this transition (Van Eenoo, Fransen, & Boussauw, 2022). A key aspect in land use and transport planning is that '[…] *it allows a greater level of public transport usage, walking and cycling, and more localised trip patterns'* (Hickman, Hall, & Banister, 2013, p. 210). The combination of land use planning and information and communication technologies (ICT) have revolutionised shared and sustainable mobility. Mobility hubs are an outcome of this trend. A mobility hub, according to a Deloitte article (2022, pp. 4), is '*…a place with a high concentration of seamlessly integrated modes of transport (i.e. shared vehicles) and facilities (i.e. charging stations) in an attractive urban design'*. These hubs facilitate the mobility transition by offering alternative means of travel to everyone on a demand-only basis. Public transportation, shared bicycles and/or other shared vehicles are brought together to improve the liveability in the city (Deloitte, 2022).

The European pilot project 'eHUB' of Interreg North-West Europe is a pilot that aims to bring electric shared vehicles and charging infrastructure together in cities in Europe at a neighbourhood level. The concept of shared electric mobility hubs (eHUBS) is a further development of the mobility hubs and offer users different shared *electrical* vehicles on demand (Bösehans, et al., 2021). This project was initiated as a way to experiment with and learn from mobility hub experiences in cities all across Europe. This pilot creates insight in ways to lower CO2 emissions in cities, decrease spatial pressure, and help create a growing market for shared electrical modalities. The main goal of the pilot is to learn from the eHUBS and to create a blueprint for other cities to distribute this new transport alternative. The implementation of eHUBS will, hopefully, nudge people into making a conscious choice between transport modes for every trip and break habitual behaviour (Liao & Correia, 2020).

'*[The] … persistent ecological, spatial and social problems related to the current mobility system create a context in which policy makers, business actors, and civil initiatives search for transformative change'* (Loorbach, et al., 2021, p. 2). The Netherlands mainly focus on facilitating innovations and alternatives through markets to guide this change, like offering the eHUBS as a platform for mobility service providers (MSPs) to provide their alternative modalities (like e-bicycles, e-cargo bicycles, and e-cars). The government plays the role of process manager in order to guide the process of collective orientation and interdepartmental coordination (Kemp & Rotmans, 2004). It also has the responsibility to incorporate innovative experiments and programmes for system innovation to guide the transition into a sustainable network (like the eHUBS). Besides the procedural and policy measurements, the importance of individual and socio-psychological perspectives relating to the use of alternative mobility options cannot be underestimated (Gössling, et al., 2018). But the car still has a dominant position in the mobility network in the Netherlands due to the long historical focus on individual automobility. This requires a governance approach that focuses on the social, ecological and spatial sustainability problems and, in order to tackle these issues, acknowledges that people's behaviour and attitude needs to change.

Little is currently known about the outcomes of behavioural change initiatives and what the characteristics of potential users are (Loorbach, et al., 2021; Bösehans et al., 2021). Most research focuses on the uptake of a single shared modality instead of the clustered characteristic of an (e)HUB (Bösehans, et al., 2021) or focuses on only the attitude of people towards using shared vehicles or sustainable mobility modes (Claasen, 2020). In order to understand what behavioural characters cause the motivation to use alternative mobility initiatives, like the eHUB pilot, instead of motorized vehicles, more research is needed. Especially when there is an intent to transfer the pilot to other cities, due to the sensitivity of local factors on behavioural change (Loorbach, et al., 2021). So the evidence base of behavioural transportation change regarding the choice to use an eHUB modality instead of a fossil fuelled option is poor and more research is needed to make a difference in the transferability of the sustainable mobility initiative.

1.2. Research aim and question(s)

The aim of this research is to create more insight in behavioural characteristics that influence ones motivation to use the eHUB facilities in Nijmegen, the Netherlands, like the e-(cargo)bike or e-car instead of a motorized, fossil fuelled vehicle. This will aid in the sustainable mobility transition. The following statement is the main question of this thesis.

The main research question will be answered by the following sub-questions:

'How can insight in the intention to use a multimodal eHUB, based on the theory of planned behaviour, help the sustainable mobility transition?'

> *Sub-question 1: What is the current policy behind the implementation of the eHUBS in Nijmegen?*

This sub-question will bring insight into the previous and current situation regarding the eHUBS in Nijmegen. Interviews will be held to strengthen the theoretical foundation and create insight in the decision making process of the current design choices and possible interim evaluations. This will help in understanding the decision process of the municipality, certain considerations that have been made, and the current policy background. It is important for answering the main question to have an understanding of decision making and the current context in which this research is conducted to lay the groundwork for understanding the demands of the citizens of Nijmegen. This sub question will be answered in chapter 4.

Sub-question 2: How does ones attitude influence the intention to use the eHUB modalities in Nijmegen?
Sub-question 3: How does ones subjective norm influence the intention to use the eHUB modalities in Nijmegen?
Sub-question 4: How does ones perception of perceived behavioural control influence the intention to use the eHUB modalities in Nijmegen?

These sub-questions are important in understanding the characteristics of (non-)users in Nijmegen which will be researched through a survey based on the theoretical framework. The main idea of these questions is to find out if ones attitude, their subjective perception of their social-environment or their confidence in their own ability, has an influence on their motivation to use the eHUB facilities. Answering these sub-questions gives more insight in the behavioural aspect of citizens regarding the choice making process of sustainable travel modalities. This helps in formulating further recommendations for hubs with electrical shared vehicles and to help understand the underlaying process of the uptake of eHUBS. This will aid in the transferability of the mobility innovation service and help in the sustainable mobility transition.

1.3. Societal impact and scientific relevance

Scientific relevance

The rapid changes in the environment call for fundamental changes in the way people live. Because alternative mobility services and options are rapidly emerging, the research on this topic needs to be extended. Shared mobility hubs have shown to be a promising solution to lower the CO2 emissions in cities and to other issues surrounding the pressure on the mobility networks. Even though electrical vehicles and shared mobility are not new concepts, the combination of these trends in eHUBS lack sufficient knowledge regarding the behavioural impact of (potential) users but also its potential impacts (Liao & Correia, 2022). The majority of the empirical research focuses on only one type of e-mobility service, instead of the bundling of shared mobility and electrical vehicles (Claasen, 2020; Liao & Correia, 2022). So, there is a knowledge gap on the concept of multimodal mobility hubs in comparison to monomodal hubs (Bösehans, et al., 2023), which this research will be adding to.

This research will add knowledge on the combination of shared mobility and electrical vehicles in multimodal hubs, the eHUBS in particular, with a user-perspective in mind. Especially about the motivation to use (or not to use) the eHUB service and why, which is a predictor of behaviour (Ajzen, 1991). There are other theories that predict behaviour, but regarding to the uptake of eHUBS, more research is needed (Bösehans, et al., 2021). A research by van Gent, Kreemers, & van Brecht (2020) state a number of psychological concepts that assist in improving the uptake of eHUBS in general. But they acknowledge the importance of examining these concepts in a local environment, as creating behavioural change is a complex matter and needs to be tailored to the specific context of the eHUB. So, this research elaborates on the influence of behavioural characteristics on the uptake of the eHUBS in Nijmegen in order to

Societal relevance

Climate change and its effect on the transportation sector precents fundamental alterations in the way people live and requires attention in order to mitigate CO2 emissions and lower greenhouse gas emissions in cities (Byg & Salick, 2009). In response to this pressing concern, there is a rapid grow in research and alternative mobility services: like shared mobility and electric vehicles. However, most research predominantly focuses on monomodal mobility services, neglecting the aspect of integrating shared mobility and electric vehicles (EVs) in a single hub (Taiebat & Xu, 2019). eHUBS (combination shared mobility and EVs) present a unique opportunity to improve urban mobility but remains relatively unexplored and lacks comprehensive understanding of behavioural impact on potential users. This research aims to bridge this gap by researching the concept of electrical multimodal mobility hubs in a local environment: the city of Nijmegen. The implications of eHUBS are not only prominent on an environmental level, also on a social level. It can improve the liveability in the city and create a safer and healthier living environment (Interreg NWE, 2023). The insights on the feasibility and scalability of eHUBS through behavioural patterns is useful for policymakers and urban planners to be able to reproduce the eHUB services and simultaneously reduce the environmental implications of the mobility system on the city. This research aims to contribute to sustainable urban transportation practices and guide policymakers and urban planners towards more environmentally friendly and efficient mobility solutions. Ultimately, this study seeks to facilitate knowledge to support the transition towards a more sustainable and resilient urban future.

1.4. Thesis outline

This thesis consists of six chapter, where this chapter is the first. It gave an introduction into the context of this research, the problem statement and research aim, questions and relevance. The second chapter discusses the relevant literature for this research in more detail. An overview of relevant theories will also be given, after which the operationalisation and hypotheses for the analysis are formulated. The third chapter gives an insight in the contextual and policy landscape of the eHUBS and initial findings, based on literature review and interviews. it simultaneously answers the first sub-question. The fourth chapter discusses the overarching philosophy and objectives of this research and the method of data collection and analysis. The fifth chapter discusses the results of the survey and based on the analysis, answers the second, third, and fourth sub-questions. The last chapter answers the main question. It reflects on the main topics of this research and based on this, discuses recommendations for further research.

2. Literature review and theoretical framework

The important concepts discussed in the introduction will firstly be discussed in the literature review, drawing from relevant literature. Secondly, a critical overview of relevant theories surrounding the key concepts of this research will be evaluated, explained, and compared. Lastly, the conceptual framework, operationalisation and hypotheses are formulated.

2.1. Literature review – the future of mobility

In recent years, problems within the mobility system have become more prominent. These problems entail issues like congestion, emissions, pollution, traffic accidents and other aspects like noise and lack of space. The conventional way of transport planning that views travel as a derived demand and minimises general travel costs, is not sustainable anymore (Banister, 2008). People are increasingly dependent on their cars since cities are spreading, causing an increase in distance and speed of travel (Banister, 2008; Wegener & Fuerst, 2004; Mokhtarian & Salomon, 2001). A way to induce a modal shift and reduce the number of kilometres travelled by car is through integrated land use and transport planning (Van Eenoo, Fransen, & Boussauw, 2022). But as Bertolini (1999, p. 199) makes clear, extensive decentralization of cities results in '*high rates of consumption of non-renewable resources…*'. As far back as 1999, Bertolini predicted the need for a fundamental and sustainable change regarding the mobility network, which is still the case in the present time.

2.1.1. Defining sustainable mobility

Sustainable mobility has been in disrepute for approximately thirty years, and is still a contemporary topic as the mobility system is reaching its social, economic, and environmental limits (Holden, et al., 2020; Fournier, 2017). But what exactly does sustainable mobility entail? There is a vast number of definitions for sustainable mobility among research, where Black (1996) based his definition on the definition of sustainability given in the World Commission on Environment and Development's 1987 Brundtland report: '*Transport that meets the current transport and mobility needs without compromising the ability of future generations to meet these needs'* (Black, 1996). There are some common concepts among the other definitions, which emphasize the importance of maintaining and equally distributing the environmental, social, and economic capital regarding mobility (Bertolini, le Clercq, & Kapoen, 2005; MOST, 1999; TRB, 1997), minimize the burden for future generations based on the sustainability definition above (Black, 1996; WBCSD, 2001) or 'simply' the need to be able to continue in the long term future (Center of Sustainability, 2004). Some researchers find these definitions insufficient and opt for an even broader definition, like '*Sustainable Urban Mobility+ is a system that incorporates economic viability, environment stability, and social equity by meeting the needs of transport and land use of both current and future generations in an efficient manner'* (Kayal, Singh, & Kumar, 2014).

Many definitions of sustainable mobility are based on the 'three pillars' of sustainability: the environment, economy, and society. But sustainability in real-world situations, as Bertolini (2005) states, is not the only policy goal and will play against economic competitiveness or social equity. This would make the last definition too comprehensive as it involves every domain, making the definition inapplicable for policy makers to use. When properly defined, the effects of sustainable mobility planning will follow through in the social, economic, and environmental domains (Zheng, et al., 2011). A well defined defintition for sustainable mobiltiy can be used as an organizing principle for governments and assist policy makers (Zheng, et al., 2011). As the Brundtland's definition of sustainability is a widely accepted definition, the derived defintion of Black (1996) will be used for this research. This definition (just as the Brundtland's one) can be applied to any social situation and in any economical climate, which makes it widely applicalble.

2.1.2. Sustainable mobility transition

According to Markard, Raven, & Truffer (2012, p. 956), '*Sustainability transitions are long-term, multi-dimensional, and fundamental transformation processes through which established socio-technical systems shift to more sustainable modes of production and consumption'*. Incremental changes in the socio-technical realm will not suffice, as radical change is needed to implement a nonlinear shift from the current system into a new, sustainable system (Markard, et al., 2012; Loorbach, 2017). Loorbach (2017) emphasizes the window of opportunity for this transition, due to the growing worldwide attention for climate change by the COP21 Paris Agreements, formulation of the SDG's, and development of knowledge and technological innovations (renewable energy technologies, electric mobility, platform mobility services). Figure 2 portrays the X-curve of transitions, which shows the dynamics of societal change as an iterative process. Because climate change is a growing worldwide worry and developments in all sectors are seeable, the pressure is growing on current systems. This creates the opportunity for a new, innovative, and sustainable mobility system to be institutionalized.

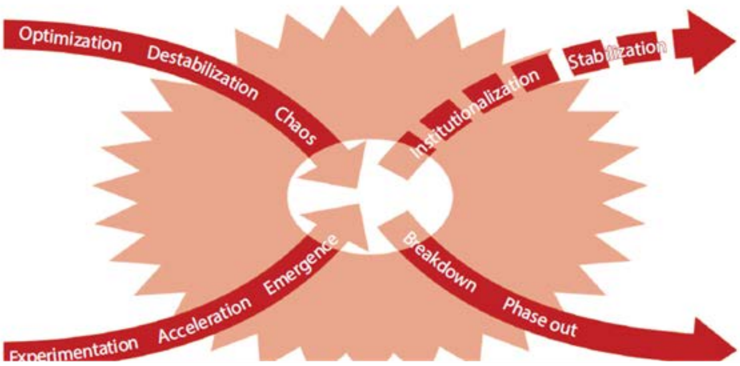


Figure 2. X-curve of transtition (Loorbach, 2014)

The pursuit for sustainable mobility is a holistic transformation of the way our societies function. To foster this transformation, a multidimensional approach is needed, where the social, political, environmental, and economic domains will have to come together in order to cope with the sustainability challenges of the current mobility system. Key to this transition is the societal engagement and necessity in a behavioural shift, as supposed to merely optimizing the mobility network and services (Loorbach, 2017). Sustainable mobility entails a way of planning that involves active citizen support, new forms of communication, cooperation between experts and citizens, and brings together all major stakeholders (Banister, 2008). An important factor in encouraging support and promoting this form of sustainable mobility planning is public acceptability. This can be created by understanding implications and expectations of individuals, creating healthy transport, creating incremental change into the new system, and focussing on individual marketing and information targeting (Banister, 2008). '*The new perspective mainly focuses on quality of life (rather than on merely functional solutions) and on the enlargement of the social basis that benefits from, and supports, mobility solutions'* (Lanzini & Stocchetti, 2021, p. 822). In this way, a more centralised mobility practice evolves that has the potential to be sustainable with the acknowledgement of socio-economic interests in relation to urban mobility systems.

2.1.3. Smart mobility

Advances in the ICT (Information and Communication Technologies) domain boost developments to improve the quality of live in cities and innovate transportation systems, which redefines the future of smart cities. Smart cities are cities ‘*in which ICT is merged with traditional infrastructures, coordinated and integrated using new digital technologies’* (Batty, et al., 2012, p. 481). According to Batty et al., the focus lies on the interconnectedness of hard infrastructure (or physical capital) and the social infrastructure (or human capital). The concept op smart mobility aligns with this vision because it is also strongly oriented towards the societal sphere, aiming to improve the quality of life, and incentivise multimodal mobility in the city (Šemanjski, Mandžuka , & Gautama, 2018). In addition, smart mobility relies heavily on ICT and represents a paradigm shift in transportation, guiding the sustainable mobility transition by integrating data-driven solutions. This sub-paragraph will give an overview of the (relevant) concepts in smart mobility and their implications on transportation systems and urban life.

One of the most promising ICT innovations, elevating smart mobility, is the development of electric vehicles (EVs). The convergence of battery technology advancements, smart charging infrastructure, and renewable energy sources has unlocked the potential for sustainable transportation on an unprecedented scale (Liu, Placke, & Chau, 2022). EVs have the potential to provide emission free use of vehicles, but Bakker, Maat, & van Wee (2014) point out that the vast majority of the consumers are still reserved due to the ‘*limited performance in terms of range and recharging times, as well as the lack of a high-density recharging infrastructure’* (p.53). They also state that despite consumer reluctance, stakeholders (manufacturers, mobility service providers (MSPs), governments) remain involved in promoting EVs to contribute to (behavioural) change that is needed for the transition. The uptake of EVs for private use and ownership has proven to be slow and considered as one of the many significant technology solutions, where integrating multiple innovative mobility solutions is seen as more promising (Friis, 2020).

Shared mobility is becoming more popular around the world. Shared mobility makes privately- or publicly-owned vehicles accessible to multiple users, which combines EVs and other platform-services. It ‘*enables users to obtain short-term access to transportation on an as-needed basis, rather than requiring ownership’* (Shaheen, Cohen, & Zohdy, 2016, p. 2). Shared mobility is growing fast due to technological advances and a change in the social mindset toward car ownership and urban living. Shaheen et al. (2016) state that connecting different transportation modes, so called multimodal mobility, to shared mobility services ‘*is recognized as a best practice to support sustainability and encourage public transit ridership’* (p. 67). More cities around the world assign specific locations for these multimodal mobility services; mobility hubs. These hubs serve as central nodes where numerous modes of transportation converge, providing seamless connections between combining different transport options (Sustainable BUS, 2023).

Where the transport modalities at multimodal hubs are located at and restricted to specific locations, the free-floating system are not limited to predefined locations for pick-up and drop-off locations for the vehicles (Soppert, et al., 2023). The only restriction for the uptake is that there is a predefined operating area, in which the vehicles can be returned or accessed. Some authors state that mobility hubs and free-floating systems can be treated identically, as both systems devide the operating area into zones (Soppert, et al., 2023; Weikl & Bogenberger, 2015; Lu, et al., 2021). But this is not the case, as a pertinent problem with free-floating vehicles is nuisance due to random allocation of the vehicles after use. This is not the case with mobility hubs, as these are assigned locations for the vehicles. Another difference between hubs and free-floating is that the latter does not have strict capacity limits, as is the case at the hub locations (Soppert, et al., 2023). A back-to-many system represent a middle ground, where the modalities still need to be returned at a predefined location, but the the number of hubs are high. This makes it easier to return the modalities at a location close to the where the user needs to be.

Shared mobility services, such as multimodal hubs or free-floating, are increasingly dependent on digital accessibility and interfaces for the planning, booking, and payment of the transport services (Geurs, et al., 2023). Multimodal transport hubs use platform-applications like Mobility as a Service (MaaS), which '*is a solution that integrates multiple modes of transport into seamless trip chains [to] …minimize the capital expenditures as well as the operating expenses'* (Li, Luo, & Hampshire, 2017, p. 1; Rongen, et al., 2022). It is a user-friendly service where the can customize their entire door-to-door travel planning in only one application. Another advantage of MaaS is that the data of the application can be used, interpreted, and analyze to show vehicle availability at every location, user-behaviour, travel movements, etc. MaaS is a way for (shared) mobility services to enable users more easy access to the vehicles and is becoming increasingly popular in the public and private sector (Ho, et al., 2018)

An eHUB is a more specific multimodal hub that houses different types of e-mobility services. '*Shared electric mobility hubs, or eHUBS, offer users access to a range of shared electric vehicles on demand'* (Bösehans, et al., 2021, p. 1). The definition of Kreemers et al. (2021, p. 2) is more concrete: '*eHUBS are physical places in neighbourhoods where shared mobility is offered, with the intention of changing citizens' travel behaviour by creating attractive alternatives to private car use'*. A characteristic of eHUBS is that the electric vehicles are available to the public on an 'as-needed' basis (Shaheen, et al., 2016). So the shared electric vehicles can be charged there and you can make use of other electrical vehicles, like e-bikes, e-scooters, or public transportation options. eHUBS aim to contribute to public health and keep growing cities accessible, all while promoting sustainable mobility. By offering a sufficient amount of eHUBS, a transition can be started where individuals substitute (D&B, 2022). It can give an incentive to make use of e-mobility and contribute to sustainable mobility, especially for those who cannot afford or do not want to buy their own electrical vehicles (Liao & Correia, 2020).

2.2. Theoretical framework

Besides the focus on technological advancements and policy implementations, the sustainable mobility transition as a transdisciplinary field also recognizes the role of human behaviour in the adoption of new mobility services. This theoretical framework offers an overview on existing behavioural theories in shaping sustainable mobility practices.

2.2.1. Behavioural theories

Behavioural theories play a role in guiding and the success of efforts to achieve sustainable mobility goals by providing a deeper understanding in human behavioural habits, motivations and decision-making processes. Behavioural theory approaches acknowledges the complexity of human behaviour and study the interaction between humans and their environment (Levine, Chan, & Satterfield, 2015). Research on this topic varies from point of view. Some researchers try to understand the way humans think and formulate a theory for policy makers to base their decision-making processes on (World Bank, 2014). Others focus on a narrower aspect of the way humans make their decision, as policy makers cannot account for the complexity of human behaviour (Victor, 2015). '*Since formal models are used to inform policy making, the lack of inclusion of social science expertise can considerably limit both the usefulness of formal models and the effectiveness of policies*.' (Schlüter, et al., 2017, p. 22). Because the mobility sector is an interdisciplinary field, this research focuses on social-psychological theories '*to understanding the complexity of mobility behaviour by reflecting the decision-making process and (…) factors leading to particular mobility behaviour'* (Chng, 2021, p. 5).

2.2.2. Theory of Reasoned Action and Planned Behaviour

The field of research that try to understand behaviour and behaviour-change is well established, and still growing. This makes it challenging when choosing an appropriate theory (Chng, 2021). Looking at the available theories, the Theory of Planned Behaviour (TPB) of Ajzen (1991) is the most widely used theory (Chng, 2021) and used in many studies on behaviour change in transport-related research (Schwanen, Banister, & Anable, Rethinking habits and their role in behaviour change: the case of low-carbon mobility, 2012). It has shown to be a useful theory in explaining travel behaviour and explaining the uptake of new transport modes (Eccarius & Chung-Cheng, 2020). Because the TPB is a well-established and accepted theory to examine the behavioural intention of using new shared mobility options (such as eHUBS), and it fits the main-question of this research, this theory is used to gain understanding of the mobility behaviour of (potential) users in the uptake of the eHUBS in Nijmegen.

The forerunner of the TPB, is the Theory of Reasoned Action (TRA) (Ajzen & Fishbein, 1980). '*The Theory of Reasoned Action (TRA) (…) focus on theoretical constructs concerned with individual motivational factors as determinants of the likelihood of performing specific behaviors'* (Montano & Kasprzyk, 2015, p. 95). These constructs act as predictors of behavioural-intention, consisting of one's attitude and subjective norm to the respected behaviour. TRA only measures volitional behaviour, not spontaneous, impulsive, habitual or behaviours which require special skills or resources (Hale, Householder, & Greene, 2002). Ajzen (1991) extended the TRA into the Theory of Planned Behaviour (TPB) because of the '*original model's limitations in dealing with behaviors over which people have incomplete volitional control'* (Ajzen, 1991, p. 181). Ajzen added the construct of perceived behavioural control to extent the predictive power of the TRA (see figure 3 for the conceptual model). This construct accounts for the individual's ability to perform the respected behaviour, as the perception of ability impacts the intention to act.

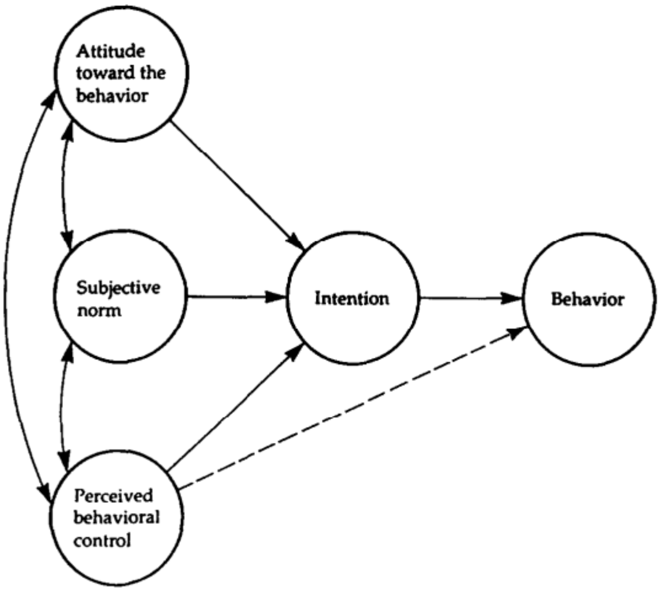


Figure 3. Theory of Planned Behaviour (Ajzen, 1991).

Attitude

Ajzen describes the construct of attitude as follows: '*A disposition to respond favorably or unfavorably to an object, person, institution, or event'* (Ajzen, 2005, p. 3). The attitude is made up of an individual's evaluation of the behaviour and their belief of the perceived consequences of the behaviour. Thus, whether the person thinks if exercising that behaviour will be have a positive or negative outcome. It is shown that the attitude of a person is often dominant in the choice to use a certain transportation mode (Schwanen & Mokhtarian, 2005; Johansson, 2006). The attitude of an individual is based on their experiences and their knowledge of the to be performed behaviour. One links their beliefs about the outcome of the behaviour to attributes like the costs of performing the behaviour or past (positive or negative) experiences (Ajzen, 1991). For example: if a person has had a positive experience with using an e-bike, it is more likely that they will use it again.

The construct of attitude in itself has proved to be insufficient in determining the behaviour directly. The other constructs (subjective norm and perceived behavioural control) need to be included to be able to predict the intention to perform a certain kind of behaviour. It is possible that attitude has, in some cases, a more significant impact on the intentions than the other factors. But all three predictors need to be accounted for in the model in order to predict behavioural-intention.

Subjective Norm

A subjective norm is described by Ajzen (1991) as: '*the perceived social pressure to perform or not to perform the behavior'* (p. 188). This refers to the way a person bases their decision on what a person thinks their social environment (family, colleagues, friends, neighbours, etc.) might think of them when performing the behaviour. Social networks can contribute to the exchange of information which can influence the decision-making of an individual. '*This is quantified as the subjective likelihood that specific salient groups or individuals (referents) think the person should perform the behaviour, multiplied by the person's motivation to comply with that referent's expectation'* (Conner & Sparks, 2005, p. 10). Significant others of the individual under question can have an influence on the behavioural-intention of that individual to perform or not perform the behaviour.

Intention

The intention of an individual to perform a certain behaviour is influenced by motivational factors that indicate the willingness to perform the respected behaviour. The intention shows the effort one is willing to put into performing the behaviour. '*As a general rule, the stronger the intention to engage in a behavior, the more likely should be its performance'* (Ajzen, 1991, p. 181). If one has a favourable attitude, perceives low social pressure regarding the behaviour and perceives behavioural control, the intention to perform, and therefore the performance of the behaviour is realistic. This varies throughout contexts and situations.

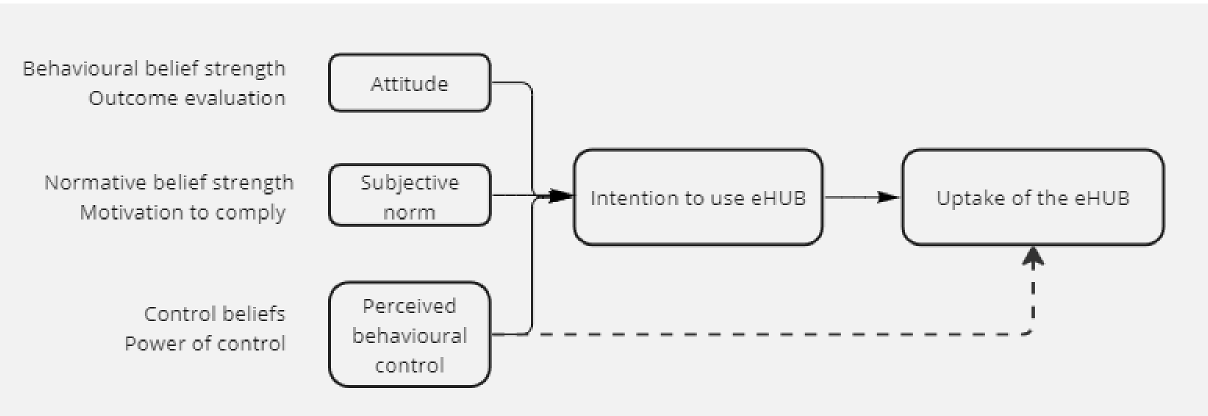
Perceived behavioural control

The perceived behavioural control finds expression in non-motivational factors and represents a person's actual control over the behaviour (Ajzen, 1991). It refers to: '*the perceived ease or difficulty of performing the behavior, and is assumed to reflect past experiences as well as anticipated impediments and obstacles'* (p. 188). One aspect refers to the perceived degree of difficulty of performing the behaviour, where skill and knowledge plays a role. In the case of travel behaviour for instance, the (potential) users must be aware of how to use the applications related to the uptake of the transport modes, know how to use the modalities, and know where the (drop-off) locations of the modalities are. Another aspect is self-efficacy: which is ones confidence in being able to perform the behaviour. If an individual is confident in their own ability to perform, and has the resources, skill and knowledge on performing the behaviour, they are less likely to expect certain barriers and are more likely to (intent) to perform the behaviour (Ajzen, 1991).

Ajzen (1991) sees the perceived behavioural control as a determinant for the behavioural intention, and the behaviour directly (see figure 3). The prediction level of behaviour directly is slim if an individual '*has relatively little information about the behavior, when requirements or available resources have changed, or when new and unfamiliar elements have entered into the situation'* (Ajzen, 1991, p. 185). Thus, a person could have the intention to perform the behaviour, but if ones daily environment (road blocks, congestion, extreme weather, etc.) does not allow the physical performance, one is not able to perform the behaviour (Hardin-Fanning & Ricks, 2017).

2.3. Conceptual model and operationalization

The operationalization will describe the three constructs of the TPB from Ajzen (1991) that make up the intention to perform a respected behaviour. The following conceptual model is constructed based on this theory in order to answer sub-questions 2, 3 and 4.



Attitude refers to the opinion of the individual about using the eHUB facilities, the *subjective norm* regards the position and opinions of the people in the environment of the individual regarding them using the facilities of the eHUB, the *perceived behavioural control* is the perceived ability of the respondent to use the eHUB facilities, and the *intention* refers to the likeliness to perform the behaviour. The TPB states that if one has a favourable attitude, the attitude is aligned with the relevant norms, and if they perceive a high level of behavioural control, it is expected that one has a strong *intention* to use the eHUB. Together with actual control over the behaviour, one is expected to carry through with using the eHUB facilities.

2.3.1. Operationalisation

Ajzen (2006) formulated a format for researcher on how to construct a questionnaire based on the TPB. This format is used as a guideline for the survey of this research. Table 1 shows a brief overview of the questionnaire, the entire questionnaire can be found in Appendix 2.

Concepts	**Indicators**
Descriptive information	- Residency in Nijmegen - Age - Highest completed education - Daily activity - Main means of transportation - Zip code
Past experiences	- Experience eHUB means of transportation - Preference eHUB means of transportation
Intention	- Intention to use eHUB means - High possibility of me ever using the eHUB means - Interested in encouraging people to use eHUB means
Attitude	- Knowledge means of transportation at the eHUB - Using eHUB to travel, seems pleasant - Using eHUB to travel, is environmentally friendly - Using eHUB to travel, reduces CO2 emissions - Using eHUB to travel, is time-effective - Using eHUB to travel, is affordable - Using eHUB to travel, is reliable
Subjective norm	- Comply with other opinions about eHUBS - People like me use the eHUB - Use eHUB if others do as well - People are positive if I use the eHUB
Perceived behavioural control	- Confidence in using eHUB means - Confidence in using eHUB applications - Confidence in being financially able to use eHUB means - Confidence in having the resources and skill to use eHUB means - More likely to use eHUB means if there is more information - More likely to use eHUB means if there is someone to use it with - Physical ability to use eHUB - Implication physical ability in using eHUB means

Tabel 1. Operationalisation questionnaire

2.4. Hypothesis

In order to observe the intention to use the eHUB, a hypothesis is generated based on the TPB. '*A hypothesis is a proposed explanation for a fairly narrow phenomenon or set of observations'* (Field, 2018, p. 5). In this research, the phenomenon is the uptake of the uptake of the eHUB, where the intention is based on three variables. The attitude refers to the opinion of the individual about using the eHUB facilities, the subjective norm regards the position and opinions of the people in the environment of the individual regarding them using the facilities of the eHUB, and the perceived behavioural control is their ability to use the eHUB facilities. Based on the literature review, the following hypotheses will be tested:

H1: Positive behavioural control of eHUB modalities will increase the uptake of the eHUB.

H2: A positive subjective norm of eHUB modalities will increase the uptake of the eHUB.

H3: A positive attitude towards the eHUB modalities will increase the uptake of the eHUB.

3. Methodology

This chapter describes the methodology that aligns with the aim, objectives and questions of this research. The aim of this research is to gain insight and understanding of the motivation of the residents of Nijmegen to use the eHUB modalities. This chapter will start with the research philosophy and strategy, after which the method of data collection is explained, and lastly the method of data analysis is discussed.

3.1. Research philosophy

'*The term research philosophy refers to a system of beliefs and assumptions about the development of knowledge'* (Saunders, Lewis, & Thornhill, 2007, p. 130). These assumptions have implications for the rest of the methodology as it makes the research coherent. The philosophy of this research aligns with a postpositivist worldview, as it focuses on the behaviour and actions of humans. This view recognizes that one cannot be totally certain about the claims that are made when studying behaviour, as an absolute truth can never be found (Creswell & Creswell, 2018). It embraces a critical realistic view, which accepts that having an understanding of reality outside of the researcher is only a partial understanding of that external reality (Creswell & Creswell, 2018). It accepts that the knowledge gained through observations and experimentations is highly probable, but not fixed knowledge. This research combines different methods of data collection in order to exhaust the existing knowledge as best as possible while acknowledging the antecedent conditions. Upholding an objective attitude as a researcher is important in developing relevant and true statements that explain the context of the problem and the causal relationship between behavioural characteristics and the uptake of eHUBS.

3.2. Research strategy

The main objective of this research is to gain insight in behavioural characteristics and their influence on the uptake of the eHUBS in order to understand and react to the needs of (possible) users. The theory of planned behaviour of Ajzen (1991) was used as a foundation for the conceptual model. This gives the research a deductive character, as it starts with an established theory and draws conclusions from the questionnaire which is based on the TPB (Vennix, 2016). The constructs of this theory explain the behavioural intention of a (potential) user of the eHUB modalities and measures the relationship between the constructs. Because this has a confirmatory nature, a quantitative methodology is suitable (Creswell & Creswell, 2018). Another reason why this research has a quantitative character, is because it uses statistical and numeral data to measure and analyse the data (Watson, 2015).

This research uses an exploratory sequential mixed method, which is a method that starts with a qualitative data collection and analysis phase and is followed by a quantitative data collection and analysis phase. Combining the two research methods enables the researcher to get a deeper understanding of the relations of the human and social world (Malina, Norreklit, & Selto, 2011). The first qualitative phase will give more insight into the origin and context of the research question and antecedent conditions before the quantitative data is collected. This will be done through standardized open-ended interviews where the questions are formulated beforehand in a certain order. This kind of interview allows for open and more broad answers and inquiry options while keeping the topic of the interview-questions (and research) in mind (Vennix, 2016). The second phase will build on the gathered knowledge of the first phase, where the researcher has gathered knowledge about the sample under study and specific variables that is necessary to answer the main research question. A survey is used because this gives an overview of the phenomenon provided by data from a large number of research units on a large number of characteristics or variables (Korzilius, 2000). This allows the constructs given by Ajzen (1991) to be researched on a large scale within the context of the eHUBS.

3.3. Methods of data collection

3.3.1. Semi-structured interviews

As a preparatory step in this research, simultaneously the first phase, standardized open-ended interviews are conducted. Table 2 shows the organisations and persons that were contacted. These include the municipality of Nijmegen, Mobility Service Providers (MSP), and other experts. As preparation for the interviews, a multitude of documents have been read, like multiple municipality documents, eHUB websites and other documents regarding the eHUB pilot. The list of themes vary between the interviews, because every actor has a different expertise about the pilot program.

Name/Organization	**Description**	
Groene Metropoolregio	General mail region Arnhem Nijmegen	Contacted
Climmy Hanssen	Communication advisors slim en schoon onderweg	
Deelfiets Nederland	MSP e-bikes	
Amber	MSP electrical cars	
Cargoroo	MSP cargo-bikes	
Paul Veelenturf	Programme manager SSO 2018-2020	
Klaas-Jan Gräfe	Programme manager SSO 2020-heden	Interviewed
Titia Bijma	Policy advisor shared mobility and behaviour	

Table 2. People/organisations contacted and interviewed.

The 'Groene Metropoolregio', Paul Veelenturf and Climmy Hanssen pointed out that Klaas-Jan Gräfe is the person who was most informed and involved in the eHUB project. Because the interviews are meant to obtain more knowledge about the context and systems regarding the eHUB design and implementation, he is the one that was interviewed. Titia Bijma has also been interviewed due to her knowledge on the policy surrounding the implementation of the eHUBS, like choices made about locating the eHUBS. Due to limited time and resources for this research and due to the fact that the survey is the main part of the analysis, only two interviews were conducted. These gave enough insight in the contextual part and origin of the problem in order to continue the research, an overview is given in Chapter 4.

3.3.2. Survey

After the interviews, a sufficient interpretation of the problem and its context is gathered. The survey is a structured questionnaire that is based on the TPB of Ajzen (1991). In order to formulate the necessary questions and for practical reasons, a target group needs to be specified. It is shown that demographic features of people and households, like age, gender, education, income, etc., are not as good predictors of travel behaviour as social psychological features (Hünecke, Haustein, Böhler, & Grischkat, 2010). These include personality traits, beliefs, attitudes, etc. The theory of Ajzen (1991) aligns with this statement. This survey will therefore focus on the constructs that make up the intention to perform a certain behaviour: the attitude towards that behaviour, the subjective norms of the person and the perceived behavioural control (Ajzen, 1991). The report of Ajzen (2006) gives an elaborate guide on how to construct a questionnaire based on the TPB, which was used.

Due to limited resources, the survey is distributed only in Nijmegen. The process in Arnhem of granting permits for the eHUBS and issuing APV's for the Amber cars was slower than in Nijmegen, which left them behind on implementing the hubs. They also implemented the eHUBS on a smaller scale than Nijmegen. That is why this thesis will only be looking at the eHUBS in Nijmegen. As for the target audience, the eHUB project didn't specify one particular group to focus the hubs on. A year after implementing the project in Nijmegen, it is shown that there is a discrepancy between people who claim to have the intention to use the eHUB and the actual number of users (D&B, 2022). They stated that young professionals are the most promising target group as they are more likely to be open to trying and using electrical powered vehicles. They are also the group that are in their phase of life where they purchase their first cars. But in order to depict the gap between the intention and the user numbers, it is interesting to compare people from every age, as long as they are above 18 since this is the demographic that is able to drive a car if they have a driver's license. The sample for this research will therefore consist of respondents from all ages above 18 years, who speak Dutch. The requirements for filling in the survey is that the respondents need to be residents in Nijmegen as the pilot is an experiment focused on the local context. The questionnaire will be distributed through online platforms, such as Facebook groups, Instagram pages, Whatsapp and neighbourhood forums. There will also be QR-codes distributed in a 5 minute walk-range from the StartUp eHUB, as the interviews and the D&B (2022) report point out that people do not want to walk longer than 5 minutes to the eHUBS. If the respondents do not fulfil these requirements, they are directed to the end of the survey.

3.4. Data analysis

3.4.1. Interviews

To analyse the interviews in a systematic way, a thematic analysis is done. This allows the researcher to interpret the data in a flexible way and sort the content in a thematic way (Braun & Clarke, 2008). Because the interviews aid in understanding the context of the eHUB project, this analysis is useful even though it has the risk of being subjectively interpreted. In order to minimize this risk, a semantic approach is applied which means that the interviews are analysed through the explicit content of the transcript (Braun & Clarke, 2008). This enables the researcher to analyse the themes that align with the research. The themes are acknowledged based on the interview guide and theoretical framework, which gives the thematic analysis a deductive character.

Braun & Clarke (2008) describe six steps in order to do a thematic analysis. The first one is to familiarize yourself with the data. This was done by transcribing the recording that was made during the interview. The second step is coding the data. The transcript was uploaded in ATLAS.ti, which allows the user to add codes in the text. The codes were then grouped in an overarching theme, which is step three in the analysis. This gives an overview of the reoccurring themes that is consistent with the ones used in this research. In step four, the themes were critically reviewed. The revised themes and codes are discussed in the beginning of Chapter 5. The themes were then defined (step five) to make them more understandable. Step six requires an overview of the used methodology, description of the data collection and analysis, which the current chapter represents.

3.4.2. Survey

In order to describe and analyse the data collected through the survey, the programme IBM SPSS Statistics Version 29 is used as it has powerful tools for the user to implement for their own functionality (Field, 2018). The data from the questionnaires can be directly imported from Qualtrics into SPSS where the necessary alterations were made. This data will be analysed using descriptive and exploratory analyses. The first analysis will give a description of the dataset and an overview of the respondents. Both the eHUB users and non-users are discussed. The second analysis will start with a factor and reliability analysis which is a multivariate analysis to see whether there if the sample is significant and the scales of the predictors are sufficient. It also shows whether there are latent variables present that correlate with the variables that are not predicted. After this, a regression analysis is done to see if and how strong the relationship between the concepts attitude, subjective norm, and perceive behavioural norm is to the intention to use the eHUBS.

4. Context eHUBS

This chapter will elaborate on the distinctive context of the eHUB project. This will give insight in the administrative considerations, (policy) choices that have been made, challenges regarding the project, and collaboration with the municipality, MSPs, and residents. The interviews will also be included in this chapter, as they are relevant to the context of the project. This chapter simultaneously answers the first sub question: *'What is the current policy behind the implementation of the eHUBS in Nijmegen?'*.

4.1. Interreg eHUB project

With a need for more sustainable mobility options to reduce CO_2 emissions in cities, there is a growing interest in EVs. E-mobility solutions are becoming more popular, yet not commonly used. The Interreg North-West Europe Programme (referred to as Interreg) '*fosters transnational cooperation to make Northwestern Europe a key economic player and an attractive place to work and live, with high levels of innovation, sustainability and cohesion'* (Interreg, n.d.). In line with their goal, they designed the eHUB project to promote sustainable and accessible transport in cities and to take a step towards the adaptation of e-mobility solutions (eHUB, 2023). The main goal of the pilot is to create knowledge, best practices, and set up a blueprint for other cities and regions to reproduce the pilot in the hope that with a wide spread uptake of the eHUBS, it will contribute to the reduction of pollution and congestion in cities. By doing so, Interreg creates a growing market for shared e-mobility providers together with local governments that initiates the transition of trading privately owned cars for more sustainable options.

Interreg's idea of an eHUBS is that they are dedicated, on-street locations that provide a variety of electrical alternatives for the use of private cars. These alternatives can be all kinds of EVs: electrical bikes, electrical cargo bikes, electrical cars, or electrical scooters. Offering a wide range of options can provide personalised trips that suits each individual's need and improve their quality of life (Aydin, Seker, & Özkan, 2022). The number and variety of available modalities is dependent on the location, design, demand, and supply. The eHUBS can be located anywhere, ranging from big public spaces to small neighbourhoods, often connected to other public transportation options. The key characteristic of an eHUB is that it should accommodate the supply and demand in that area (eHUB, 2023). This translates different to each city, as they are liberated to their own interpretation for locating, designing and collaborating on the eHUBS.

In order to create a diversified field of knowledge for this project, five countries and seven cities participated by implementing eHUBS based on their own vision, needs, and policy. These are the following: Amsterdam (NL), Arnhem (NL), Nijmegen (NL), Leuven (BE), Manchester (UK), Dreux (FR), and Kempten (DE). These cities, along with other organisations such as educational institutions and MSPs, were granted the subsidy from Interreg in the beginning of 2019. The eHUB project ran from 2019 until 2023. The initial duration was until 2021, but due to the interruption of the covid pandemic, they had to postpone the end date. The region Arnhem-Nijmegen have always been quite ambitious when it comes to sustainability, even before they engaged in the eHUB pilot. Nijmegen was the Green Capital of Europe in 2018 and are still active when it comes to environmental, social, and economic sustainability. A big part of their ambition document is dedicated to mobility, in particular investing in new sustainable mobility services. The project is an addition to their vision because it offers knowledge and experience on shared mobility and the opted transition to ‘emissionless driving’ (Gemeente Nijmegen, 2019).

4.2. Design of the eHUBS in Nijmegen

Although Nijmegen is keen on its sustainability goals and projects, but they were (surprisingly) not the one who initiated the participation in the Interreg project. The MSPs, Urbee (e-bikes) and Cargoroo (e-cargobikes), contacted the municipality of Nijmegen (Interview 1, 2023). The goal of the eHUB project fitted the objective of the municipality of creating larger support for shared mobility in the city. Thus, Nijmegen saw potential in in the pilot and decided to create a consortium together with the MSPs and included Amber (e-cars), who joined after the subsidy was granted. Other MSPs were not interested, because they preferred a free-floating system where they are not bound to one location when providing their modalities, such as MSPs for electrical scooters like Felix or Check (Interview 1, 2023). The consortium made agreements where the participating MSPs needed to develop their own business model and the municipality was in charge of the communication marketing, design of the hubs, and providing the necessary charging infrastructure for the vehicles with the subsidy of Interreg (Interview 1, 2023). So the subsidy wasn’t used to exploit the MSPs’ business model, but the municipality could demand changes if needed to suit the eHUB design. Dijksterhuis & van Baaren (D&B) is a research and consultancy agency for behavioural change. They were included in the project by the municipality to investigate the uptake of the eHUBS and accordingly, set up a marketing and communication campaign. They evaluated and monitored the support among Nijmegen citizens and formulated interventions to improve the uptake of the eHUBS. This lead to the realisation of 3 eHUBS in Arnhem and 10 in Nijmegen that opened in April 2019 (see Figure 6). Nijmegen was the leading city because they got off to a good start with the number of eHUBS and the success in uptake (Interview 2, 2023). As for Arnhem, there were complications in granting the permits for the eHUBS, causing a delay in implementation and number of eHUBS.

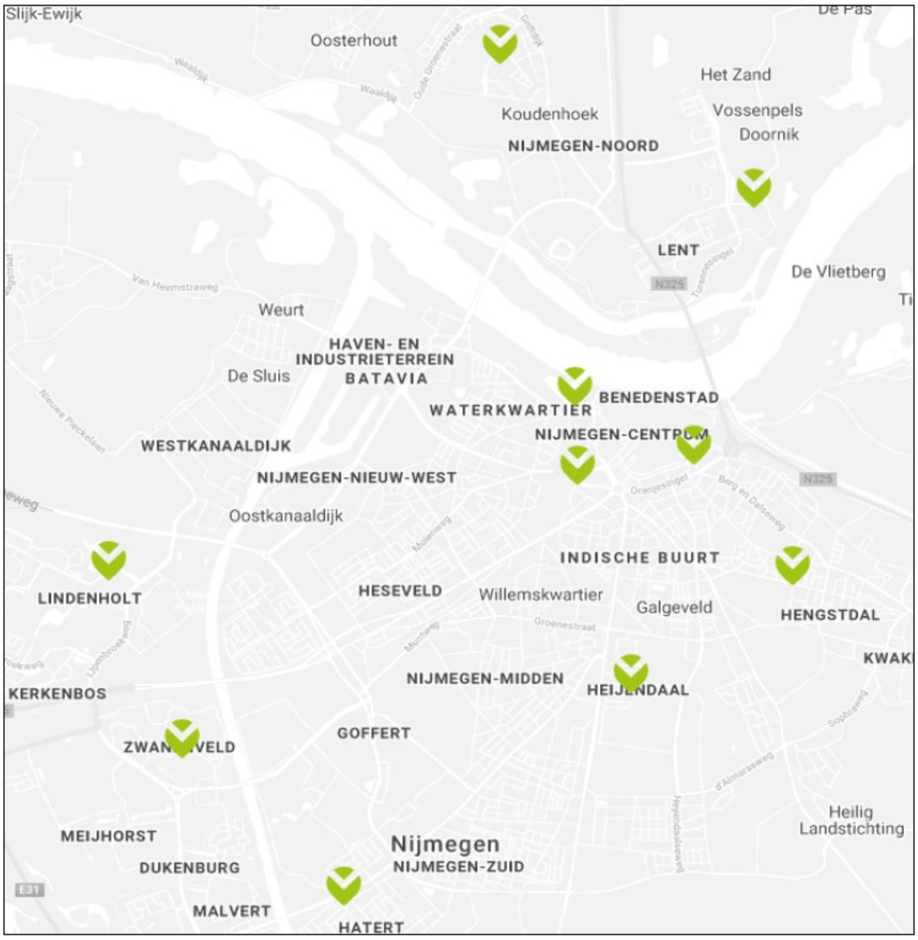


Figure 4. Locations of the eHUBS (Van Hout & Bruls, 2021).

The following criteria were taken into account for the choice of location for the eHUBS (Interview 2, 2023):

1. Sufficient residents in the immediate vicinity (300 to 500 meters)
2. Support in the area based on road density and potential for shared mobility
3. Distribution across the city and in different living environments
4. Sufficient room to realise the eHUB

To include the residents, they could request an eHUB if they were interested by signing up at the website ikwileenehub.nl ('iwantanehub.nl'). Although, it has been shown that residents who were interested generally weren't keen on having one in front of their house (Interview 2, 2023). Because of this, the municipality also spoke to representatives of neighbourhood councils and businessowners about placing the eHUBS closer to public spaces or stores. The locations were chosen based on differences in population, so that they can compare the results in the end to get insight in the demographic features of the (non-) users. Other criteria regarding the location choice were regarding the surroundings, like the distance from the curb or street, parking need, or placement away from trees. The municipality was mostly focused on the demand- and experiment-side of the project, resulting in loosely interpreting these criteria. The eHUBS could therefore be implemented faster and corresponded with the broad and experimental character of the project (Interview 1, 2023). If the municipality wants to continue the eHUB project after it is over, they need to regard these criteria more seriously. So the location choice of the ten eHUBS were mostly based on the wish to gain experience, rather than to comply with hard criteria (Van de Klift & Bruls, 2023).

4.3. Implementation of the eHUBS: challenges and changes

D&B conducted interviews and research about the support from residents before the eHUBS were realised. The most important motives to use the modalities of the eHUBS among residents were the speed of travel, health reasons, and the environment (D&B, 2022). The most important barriers for not using the eHUB modalities are the habit of using own modalities, the costs of using the eHUB, and doubts about the availability of the modalities. In order to overcome these barriers, D&B renewed the signs of the eHUB to make it stand out, more user-friendly, and increases self-efficacy of potential users. Figure 7 shows on the left the communication signs when the eHUBS first opened, and on the right the improved sign.

Figure 5. Improved communication signs of the eHUB (D&B, 2022).

Is has shown to be difficult to keep the availability of the modalities constant at the eHUBS. A big part is because of vandalism and theft. The batteries and other parts of the Urbee e-bikes were frequently stolen and vandalised. This made Urbee eventually leave the consortium and Deelfiets Nederland took over with more robust bikes and a different docking station. During the covid pandemic and lockdown, there was a decrease in use, but less than was expected. The facilities of Cargoroo and Amber were used the most and they even increased the number of available vehicles. Even though there can be seen a growth in uptake, there is still a discrepancy between the positive attitude and intention of people to use the eHUBS, and the actual uptake (D&B, 2022). Another difficulty concerns the connection to the charging infrastructure. The company that was assigned to arrange the charging stations was uninterested in the project. The reason for this is that the electrical cars takes up the assigned electrical parking space, even if the battery is full. This delayed the installation of the loading stations near the eHUB locations (Interview 1, 2023).

4.4. The future of eHUBS

The resources to implement the eHUBS and invest in shared mobility are available, but it has shown that the interest in using electrical vehicles can still be improved (Interview 2, 2023). A way of doing this is to increase the availability of vehicles (Van de Klift & Bruls, 2023). This project showed that MSPs are more interested in a free-floating system or (staying within the possibilities for the project) a back-to-many system. Having multiple, smaller hubs in the area would possibly increase the uptake because it is easier to find a vehicle as there are more hubs to choose from in the area. This would only be successful if the availability can be assured. If one is able to reserve a vehicle beforehand, and is assured of its availability, the use of an eHUB becomes more flexible and trustworthy (Interview 1, 2023). There are multiple options to enable this, like combining the eHUBS with other EV services or extent the possibility for mobility services to offer their services on a more flexible basis. This can create a tailored travel advice that, in their turn, can be connected to other mobility networks, like public transportation or fast-bike routes.

4.5. Conclusion

The municipality needs to be more strict when choosing a location for the hubs after the project is over. The criteria mentioned at the end of chapter 4.2. needs to be considered more carefully. The residents should also have a say in the design and location choice in order to create support from the neighbourhoods. If the municipality wants to further increase the uptake, they need to understand the demand in a neighbourhood for a hub. Free-floating service can help in understanding where the demand is biggest, as it shows where most modalities are used and dropped of (Interview 1, 2023). This insight could be used to choose the locations for the new hubs. The collaboration between the municipality and MSPs can be improved by communication and creating possibilities for the MSPs to be more flexible by offering a back-to-many system (Van de Klift & Bruls, 2023).

5. Results

The previous chapters covered the theoretical, methodological, and eHUB project background. This chapter will discuss the analysis of the collected data. First, the topics of the interviews related to the TPB are briefly discussed, based on the thematic analysis. The policy and contextual insights of the interviews are given in the previous chapter. Then, the quantitative analysis is described by elaborating on descriptive and inferential statistics. Lastly, sub-questions 2, 3, and 4 are answered in the conclusion statement of this chapter.

5.1. Qualitative analysis

This paragraph looks at the interviews through the lens of the concepts of the TPB and conceptual model. Interview 2 (2023) states that people are generally positively dispositioned towards the eHUBS, but only if they do not experience nuisance from them. When the eHUBS takes up parking space in an already crowded neighbourhood or in case of disturbance in public areas, peoples attitude becomes more negative (Interview 1, 2023). As for the implementation of the eHUBS, the municipality has focused on promising neighbourhoods who were already investing and interested in sustainable developments. By putting shared mobility on the map and embedding it in the culture of Nijmegen, helps increase the uptake of the shared e-mobility vehicles (Interview 2, 2023). One way to positively increase the perceived behavioural control is to offer some sort of guarantee that a vehicle is available at the nearest eHUB. This creates more trust in the eHUB modalities and with that, people are more likely to make use of the eHUB modalities.

5.2. Quantitative analysis

5.2.1. Descriptive statistics

There were 164 reported answers from users and non-users of the eHUB. 6 respondents represented the test group and these responses were deleted as the survey was not yet officially distributed. 14 respondents did not live in Nijmegen and were therefore deleted. From the remaining respondents, 47 did not completely finish the questionnaire. Not all of these were deleted as 15 respondents completed enough of the questionnaire to remain in the analysis. All 15 respondents filled in all the questions that supposedly measures attitude, of which 7 also completed the questions on subjective norm, and only 2 filled in the questions on perceived behavioural norm. The other (47 – 15 =) 32 responses were deleted as they did not complete enough of the survey. After deleting the un-usable responses, there are 112 responses left: 102 non-users and 10 users.

Looking at the duration of filling in the questionnaire, the fastest time was 123 seconds (2,05 minutes) which is plausible. The highest was 59158 seconds (16,4 hours), which is still plausible because it was possible to pause the questionnaire during the response. The responses of the highest durations were checked, and no outliers or other anomalies were detected. There were no respondents filtered based on the duration, which left the sample size with 112 respondents, of which 10 users and 102 non-users. Due to the big difference between the user and non-user ratio, the choice has been made to only statistically analyse the non-users and to interpret the users by looking at the 10 responses individually. This will not be statistically significant, but could imply something about the uptake of the eHUBS of users when combining the data with the qualitative analysis.

The confidence level of the sample size will determine how certain the results are. A common way to calculate the sample size is the one of Yamane (1967): Where n = the sample size, N = the population size, and e = the level of precision. At 1 Januari 2022, the population size of Nijmegen residents is estimated at (N =) 150137 for all who are above 18 years old (CBS, 2022). For a confidence interval of 95% (e = ,10), the sample size needs t be (n =) 99,93. So the sample size for this research of 102 respondents is a valid number for analysis with an confidence interval of 90%.

$$n = \frac{N}{1 + N(e)^2}$$

The final sample of non-users consists almost half of respondents between 18 and 25 years old (46,1%), 14,7% is between 25 until 35 years old, and 39,2% is 35 years or older. Most people have completed a University degree (45,1%) or is still studying (41,4).

	N	%		N	%
Age			**Occupation**		
18 – 24 years	47	46,1%	Student	42	41,4%
25 – 34 years	15	14,7%	Working	34	33,3%
35 years or older	40	39,2%	Entrepreneur	2	2%
Highest education			Unemployed	1	1%
Highschool	16	15,7%	Pensionado	21	20,6%
MBO	6	5,9%	Student and working	2	2%
HBO	31	30,4%			
WO	46	45,1%			
Other, ….	2	2%			
No education completed	1	1%			

Table 3. Descriptive information on non-users

Looking at the main transportation mode, the bike is the main mode for the majority of respondents (65%). Comparing the main travel mode to the age (see Figure 8), it seems that people between the age of 18 and 25 use their bikes most often and as one gets older, the use of cars increases. Although this is the same as D&B (2022) claims, it is not significant from this dataset. Looking at the postal codes of the respondents (Figure 9), most respondents are from 'Stadscentrum', which is the area around the eHUB at the station. The survey was distributed through the mailboxes in this area because of the potential of the eHUB together with public transportation options, so this was expected. Due to limited time and resources, this was the only place the questionnaires were (physically) distributions. See Chapter 6 for a discussion on the limitation posed by this.

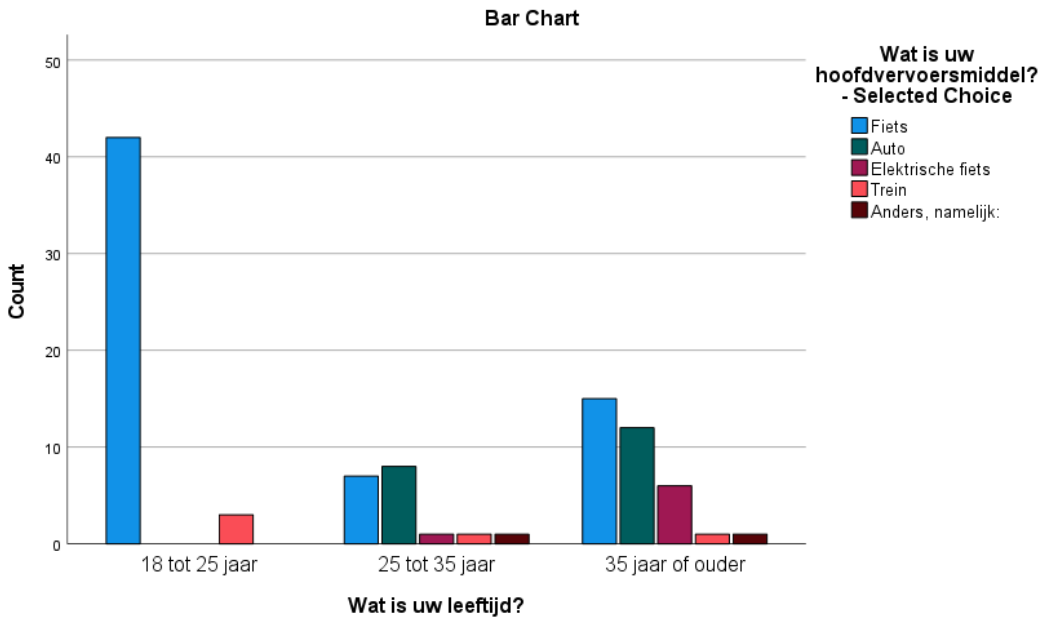


Figure 6. Main transport mode per age.

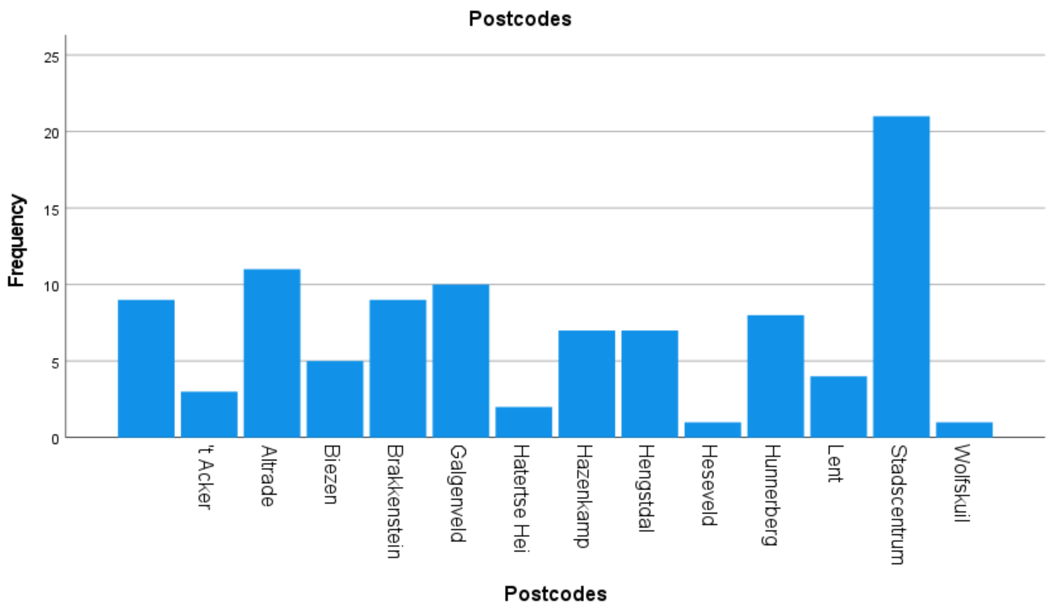


Figure 7. Residential area of respondents.

Figure 10 shows the main mode to travel of the respondents (X-axis) set out to their preferred means of transportation available at the eHUB locations (Y-axis). It shows that people who travel mainly by bicycle, prefer to use the e-bike and Figure 11 shows they would use it to travel from public transportation. It is worth noting that the ones who mainly use their car to travel, want to use the e-bike if they would use any means from the eHUB. Their preferred journey to use the eHUB facilities, is not in combination with public transportation (Figure 11). This is in line with Figure 12, which shows what transportation modes the respondents prefer and for what travel purpose they would like to use it. The e-bike would be used most in the journey from and to public transportation options, while the e-car would be used for other purposes.

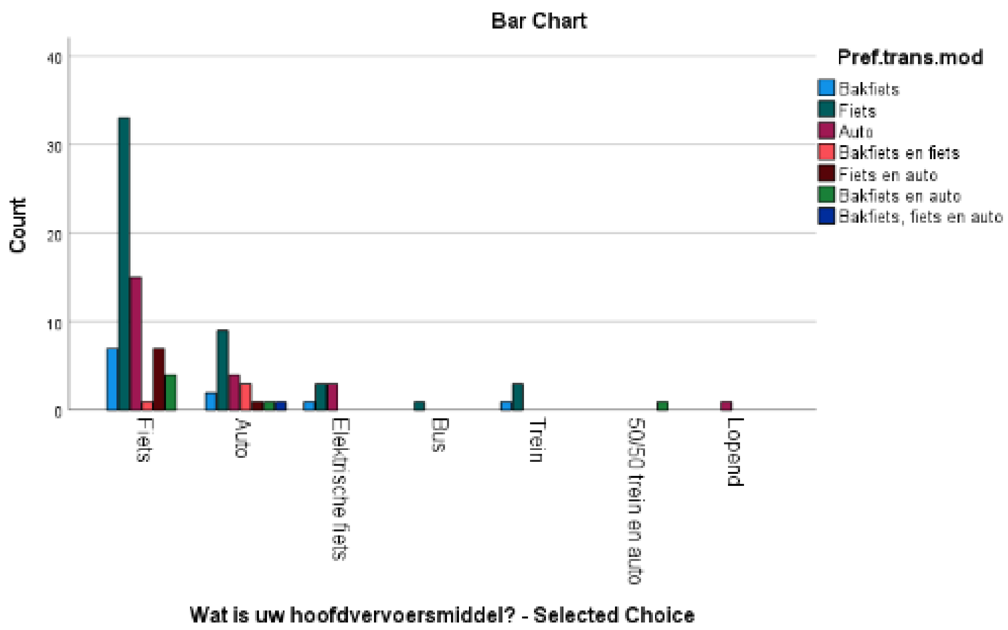


Figure 8. Main transportation mode vs preferred transportation mode

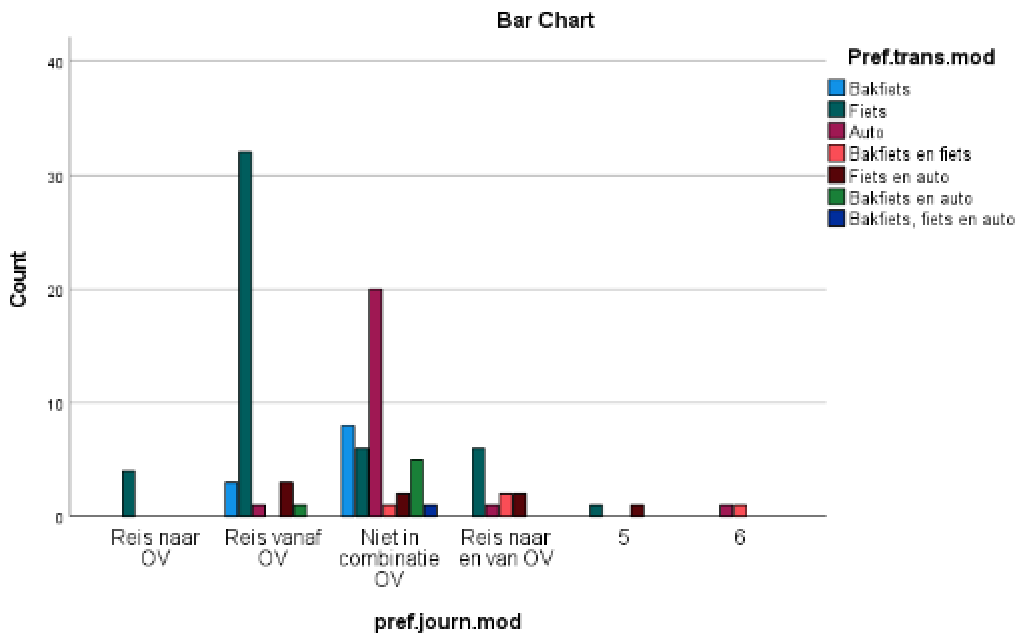


Figure 9. Preferred journey vs preferred transportation mode

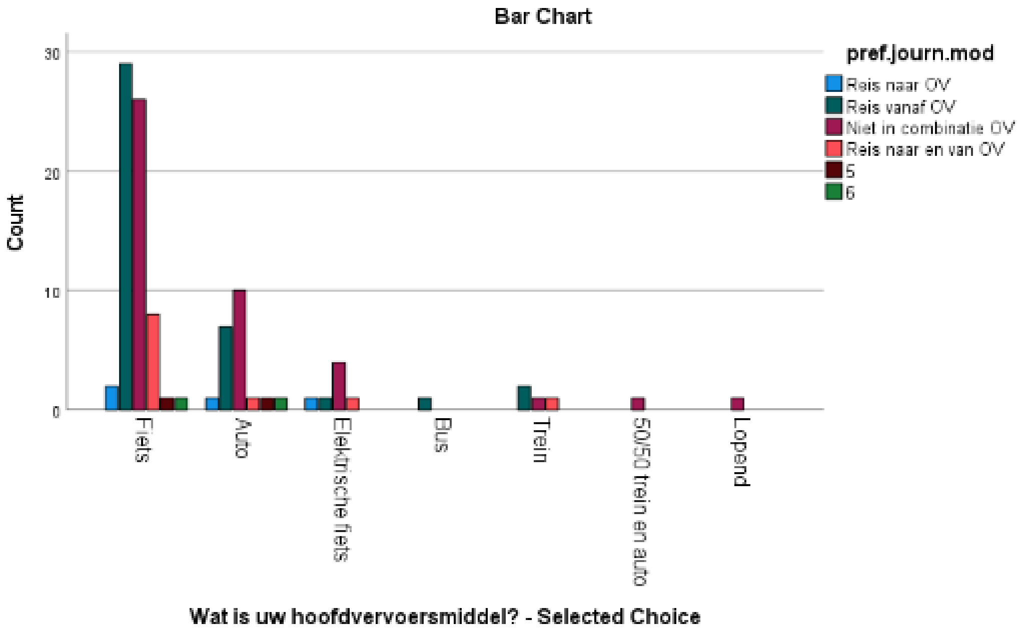


Figure 10. Main mode of transport vs. preferred journey

Comparing the familiarity of users and non-users with the eHUB means of transportation in Figure 13, shows that non-users are not aware of the offer. But even among the users, there is some confusion of what means of transportation there is in total.

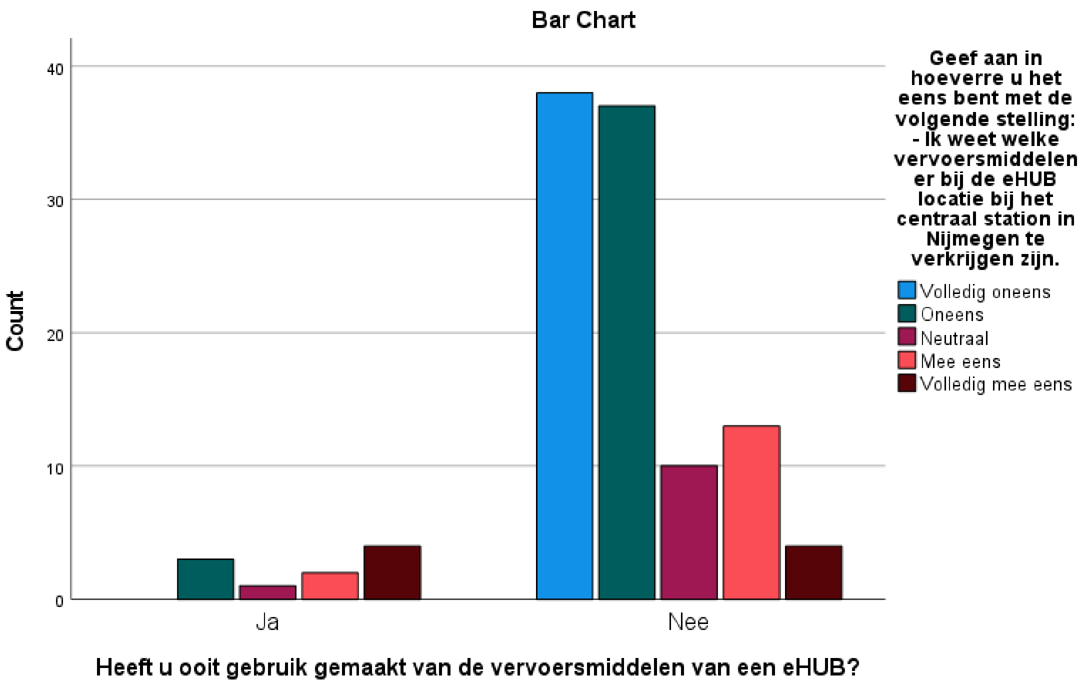


Figure 11. Familiarity of users and non-users with eHUB facilities

Interpretation eHUB users

As there are only 10 respondents that have used the eHUB facilities in the past, these are interpreted by the researcher as this sample is not high enough to perform a statistical analysis. There are 4 respondents between the age 18 and 25 years old and 6 who are between 25 and 35 years old. From these respondents, 70% have a University degree where 60% are working and 40% are students (see Table 4). Figure 12 shows that the cargo-bike is the most popular preferred mode to travel from public transportation modes. This is in line with the interviews, which show that the cargo-bikes are the most popular options from the eHUB facilities. The ones who use their bikes as main transportation mode also prefer the cargo-bikes, see Figure 14.

	N	%		N	%
Age			**Occupation**		
18 – 24 years	4	40%	Student	4	40%
25 – 34 years	6	60%%	Working	6	60%
Highest education					
Highschool	1	10%			
HBO	2	20%			
WO	7	70%			

Table 4. Descriptives users

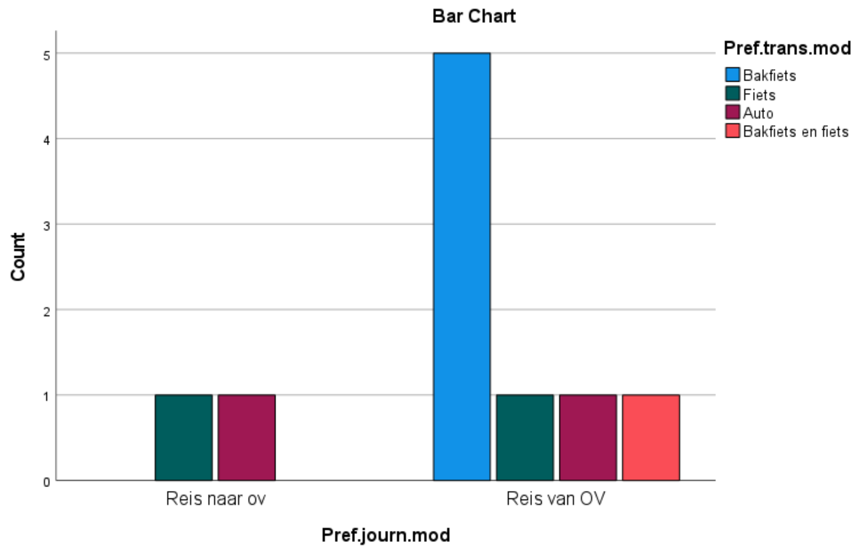


Figure 12. Preferred journey mode vs preferred transportation mode

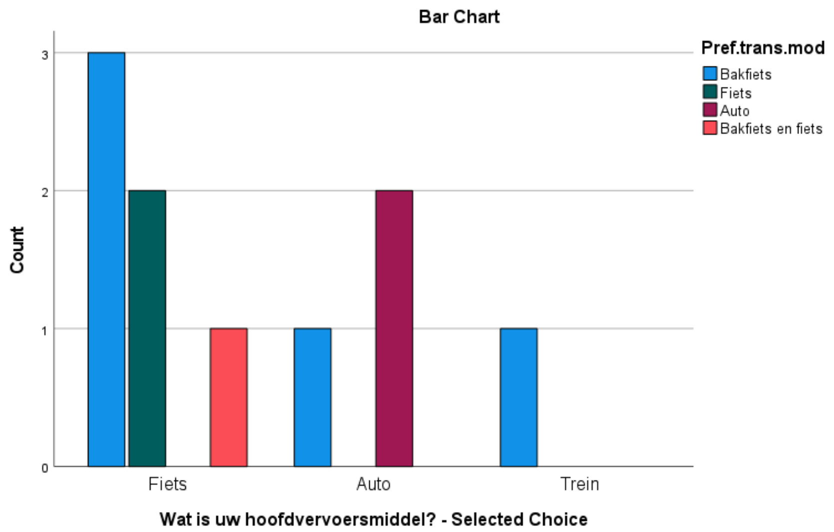


Figure 13. Main transportatin mode vs preferred transportatin mode

5.2.2. Factor analysis

The goal in factor analysis is '*the identification of underlying constructs that summarize a set of variables'* (Ford, MacCallum, & Tait, 1986, p. 296). This research uses scales to measure the variables (attitude, subjective norm, perceived behavioural control, and intention) in order to investigate the concept of eHUB uptake, even though it was not measured directly. That is why a factor analysis is suited to investigate the intention to use an eHUB from the data sample. The set of variables measured in the questionnaire, will be reduced to a smaller number of variables (factors) through a process called data reduction. This requires interpretation by the researcher, which is a subjective process of assigning meaning or labels to the results of the factor analysis (). In order to limit the researchers' bias, a confirmatory factor analysis (CFA) is applied. CFA is most commonly used in social science and requires a pre-existing theory (TPB in this case) in order to formulate hypothesis, assign meaning to the factors, and to confirm or reject the hypothesis (Kline, 2023; Brown, 2015). Before the factor analysis, a reliability analysis is done to test the internal consistency of the individual items of the scale derived from the questionnaire.

5.2.3. Reliability analysis

Before the factors are indicated, a few tests need to be done to check if the data is suitable to do a factor analysis. These tests are the Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO-test) and the Bartlett's Test of Sphericity (Bartlett's test). The value of the KMO-test should be superior to .50 with a significant Bartlett's test, which is the case (see Table 5). This shows that the principal components of this research are reliable. The Bartlett's test of sphericity is calculated by SPSS see whether the correlations between the questions is significant. Table 5 shows only high values, which means that the data is homogeneous and strong enough to use CFA to reduce the data and identify the factors (Wicklin, 2022).

KMO and Bartlett's test				
Variable	KMO-test	Bartlett's test: Approx. Chi-Square	df	Sig.
Attitude	,695	126,638	15	<,001
Subjective norm	,648	42,096	6	<,001
Perceived behavioural control	,685	147,824	10	<,001
Intention	,608	77,376	3	<,001

Table 5. KMO- and Bartlett's test

After the sample was tested, a reliability analysis is carried out to see whether the measurement scale that was used in the survey is internally consistent by looking at the Cronbach's alpha (α). This tests the significance of the correlation between the questions and each corresponding variable. An acceptable value for the Cronbach's alpha lies between 0.6 and 0.8 (Shi, Mo, & Sun, 2012). Looking at Table 6, all the variables have a score above 0.6. Although the values are good, further inspection is done to check if the reliability of the scale can be improved.

Reliability Statistics		
Variable	Cronbach's alpha	N of items
Attitude	,712	6
Subjective norm	,601	4
Perceived behavioural control	,663	6
Intention	,738	3

Table 6. Cronbach's alpha.

To further improve the scale of the questionnaires, the 'Item-Total Statistics' is used, more directly the 'Cronbach's Alpha if Item Deleted'. This table shows what deletion of an individual item does with the internal consistency of the scale. The higher the Cronbach's Alpha, the better the internal consistency. Table 7 shows the initial findings related to all the scales. The Cronbach's alpha for the attitude (α = .712) and subjective norm (α = .601) scales cannot be increased by deleting an item. Both scales have a sufficient Cronbach's Alpha value and because this value cannot be increased, no items are deleted.

This is not the case for perceived behavioural control, where the items PBC_3, PBC_6 and PBC_5 are deleted one at a time in that order. These items are measured by the following questions: PBC_3: '*I am financially able to use the eHUB modalities';* PBC_5: '*Gaining more information about using the eHUB modalities will encourage me to use it';* and PBC_6: '*Having someone to use the eHUB modalities with, motivates me to use the modalities'.* By removing these three items, the Cronbach's alpha of perceived behavioural control will increase from .663 to .822. Only deleting PBC_3 will increase the Cronbach's alpha by .075 (α = .738) which is a big improvement. Removing PBC_5 and PBC_6 will increase it by another .0144 (α = .822). After this, there are no improvements that can be made.

If all three items were deleted, there would only be three items left. At a certain point, the researcher should question whether this takes away from the theoretical structure of the variable that the items compute. The fact that the Cronbach's Alpha increases when items are deleted is not a hard criteria for the deletion of those items. According to Worthington & Whittaker (2006) '*Conceptual interpretability is the definitive factor-retention criterion'* (p. 822). Because the Cronbach's Alpha increases to .738 when only PBC_3 is deleted and because this is still reliable value, only PBC_3 is deleted.

As for the intention, when item INT_3 is deleted, the Cronbach's alpha will increase to .817. But there will only remain two items to measure the intention-scale, which is insufficient (Worthington & Whittaker, 2006) and is insufficient to run a decent reliability analysis. As a Cronbach's alpha value of .738 is a sufficient value for the intention scale, no items are deleted.

Item-Total Statistics							
	ATT_1	**ATT_2**	**ATT_3**	**ATT_4**	**ATT_5**	**ATT_6**	**Total**
Cronbach's Alpha if Item Deleted	,626	,676	,707	,670	,678	,678	,712
	SNO_1	**SNO_2**	**SNO_3**	**SNO_4**			
Cronbach's Alpha if Item Deleted	,593	,583	,485	,446			,601
	PBC_1	**PBC_2**	**PBC_3**	**PBC_4**	**PBC_5**	**PBC_6**	
Cronbach's Alpha if Item Deleted	,525	,534	,738	,595	,594	,681	,663
PBC_3 is deleted	,633	,631	-	,717	,700	,761	,738

PBC_6 is deleted	,617	,622	-	,725	,822	-	,761
PBC_5 is deleted	,761	,663	-	,810	-	-	,822
	INT_1	**INT_2**	**INT_3**				
Cronbach's Alpha if Item Deleted	,510	,605	,815				,738

Table 7. Attitude, subjective norm, perceived behavioural control and intention scale improvement

5.2.4. Factor analysis

After the internal consistency of every scale is revised, the factors can be extracted. It is expected that the items will load on their respected component in CFA. It can also be the case that an item load on its respected component and one or more latent components, called cross-loading. This means that the items measures more than one construct. There are different ways to solve this. One is to alter the rotation method. '*The aim of rotation is to simplify the factor structure of a group of items, or in other words, high item loadings on one factor and smaller item loadings on the remaining factor solutions'* (Williams, Onsman, & Brown, 2010). This helps with the interpretation of the factors by moving the axes to a different position in order for the data points to fit the factors better. The communalities of each item needs to be above a value of .50 in order for the item to fit the opted scale. Not only factor rotation is a way of determining whether the items cross-load, the cumulative percentage of variance expected and its respective eigenvalues indicates this. Multiple eigenvalues higher than 1 indicates cross-loading.

Appendix 3 shows that the items for attention and perceived behavioural control load on more than one component. First, attention is examined. It seems that the items ATT_2 and ATT_3 both load on a different construct. The questions regarding these items are '*Using the eHUB modalities will make me more environmental aware*' (ATT_2), and '*Using the eHUB modalities is important to lower the CO2 emission in the city'* (ATT_3). It seems that the items on the positive environmental impact of electrical shared vehicles load on a different construct than anticipated. Appendix 3 shows that changing the rotation method makes no difference regarding the cross-loading. Looking at the Total Variance Explained, the first component explains 41% of the variance, while the second explains only 21%. This shows the initial assumption that ATT_2 and ATT_3 measures a different construct and are therefore deleted from the analysis.

For the items that respectively measures perceived behavioural control, items PBC_5 and PBC_6 cross-load. As mentioned in the reliability analysis, these were the items: '*Gaining more information about using the eHUB modalities will encourage me to use it'* (PBC_5) and '*Having someone to use the eHUB modalities with, motivates me to use the modalities*' (PBC_6). The other items cover the respected ability to use the eHUB means of transport, as these items regard the internal motivation of using the means. The rotation method has no effect on the cross-loading of these items (see Appendix 3). As these items would increase the Cronbach's alfa (previous paragraph) and does not load on the respected factor, these items are deleted from the analysis.

After the reliability analysis and factor analysis, the variables 'Attitude', 'Subjective', 'Behaviour', and 'Intention' are computed as one score in order to do the regression analysis.

5.3. Regression analysis

A regression analysis is done to see whether the independent variables have an influence on the dependent variable. The regression analysis will reject or support the hypothesis stated in chapter 2.4. The hypothesis are as follows:

$H0_1$: Positive behavioural control of eHUB modalities has no impact on the uptake of the eHUB.
Ha_1: Positive behavioural control of eHUB modalities will increase the uptake of the eHUB.

$H0_2$: A positive subjective norm of eHUB modalities has no impact on the uptake of the eHUB.
Ha_2: A positive subjective norm of eHUB modalities will increase the uptake of the eHUB.

$H0_3$: A positive attitude towards the eHUB modalities has no impact on the uptake of the eHUB.
Ha_3: A positive attitude towards the eHUB modalities will increase the uptake of the eHUB.

In order see whether the independent variables (attitude, subjective norm, and perceived behavioural control) have an influence on the intention to use the eHUBS, the correlations between the variables are checked using the Pearson's Correlation. This value gives an indication of the strength of the relationship between two variables and the direction of this relationship. It is important to note that this value says something about the correlation, not what causes the relation. A Pearson's Correlation of 0 means that there is no linear relationship between variables, where a score of -1 and 1 resembles a perfect negative or positive correlation. A value between 0 and .30 (.00 and -.30) is considered a negligible correlation, between .30 and .50 (-.30 and -.50) is a low positive (negative) correlation, between .50 and .70 (-.50 and -.70) is a moderate positive (negative) correlation, between .70 and .90 (-.70 and -.90) high positive (negative) correlation, and between .90 and 1 (-.90 and -1) is a very high positive (negative) correlation.

Table 8 shows that all variables significantly correlate ($\alpha = 0.01$) with the dependent variable. There are no very high correlation values, which is a sign of multicollinearity. All variables significantly correlate with the intention. Attitude ($r = .510$; $p<.001$) and subjective norm (r - .609; $p<.001$) display a moderate positive correlation with intention, where behaviour ($r = 372$, $p<.001$) shows a low positive correlation in this respect. Although the variable behaviour goes up as a response to the value of intention going up, the relationship is not very strong. To see what the cause of this is and if the independent variables are predictors of intention, a multiple linear regression is performed.

Correlations				
		Attitude	**Subjective**	**Behaviour**
Subjective	**Pearson Cor.**	,553**	1	
	Sig. (2-tailed)	<,001		
	N	96	96	
Behaviour	**Pearson Cor.**	,273**	,306**	1
	Sig. (2-tailed)	,009	,003	
	N	91	91	94
Intention	**Pearson Cor.**	,510**	,609**	,372**
	Sig. (2-tailed)	<,001	<,001	<,001
	N	89	89	89

**. Correlation is significant at the 0,01 level (2-tailed).

Table 8. Pearson's correlation test

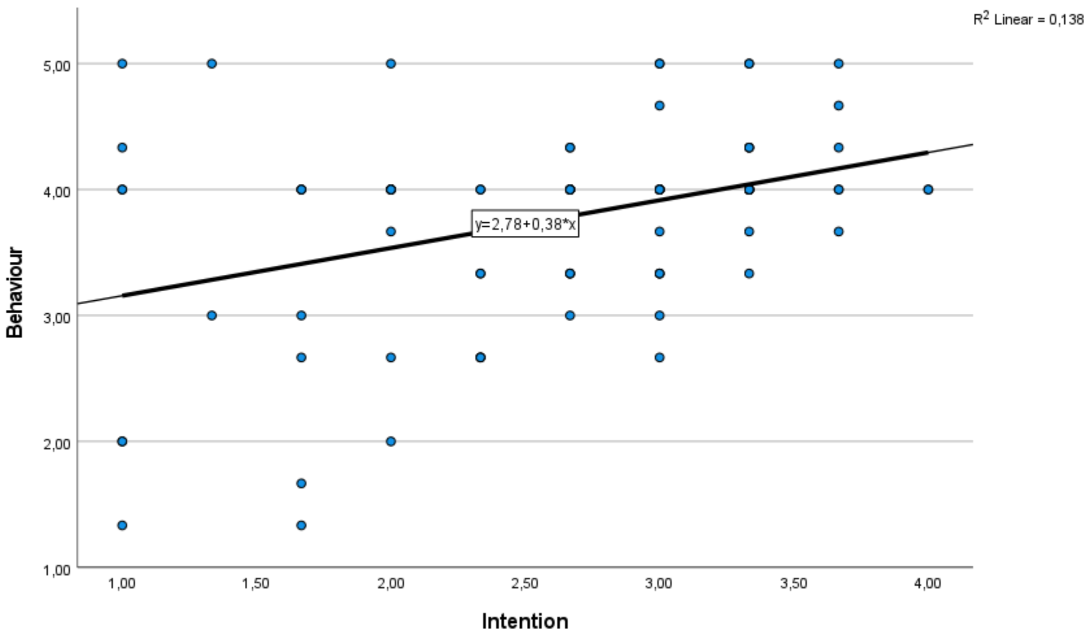


Figure 14. Scatterplot relation behaviour and intention

The results of the Multiple Linear Regression Analysis is showed in Table 9, 10, and 11. The model summary shows the equation of the regression: Intention = -.445 + .289 (Attitude) + .565 (Subjective Norm) + .177 (Perceived Behavioural Control). The R^2 variable shows how much of the variance in the model is explained by the predictor variables, which is 44,4%. The Adjusted R^2 adjusts for the number of predictors in the model as a higher number of predictors increases the R^2 as each predictor explains some of the variance due to chance (Bruin, 2006). The model does not account for 66,6% of the variance in the relationship with intention. This does not mean that the model is not useful, this model still has statistically significant explanatory power. The difference between a high and low Adjusted R^2 is the spread of the data points around the linear regression line (Frost, sd). Table 9 shows a low Adjusted R^2 and the data is therefore widespread. A higher Adjusted R^2 would show in more clustered data point around the regression line. This does not take away from the explanatory power, because the model still shows the (positive) relationship between the predictors and intention.

Table 10 shows the ANOVA test, which indicates if the regression model is statistically significant, which it is ($F(3,85) = 22.637$; $p<.001$). So, the three predictor variables, attitude, subjective norm, and perceived behavioural control, have a positive significant effect on the intention. Table 11 shows the Coefficients table which looks closer at the influence of the individual predictors on intention. All three variables are significant at an alpha level of .05. This means that all variables are a predictor of Intention. The standardized Beta coefficient shows which independent variable has a bigger impact on intention. Subjective norm (Beta = .432; $p<.001$) has the strongest impact on intention, after which attitude (Beta = .223; $p = .025$), and then perceived behavioural norm (Beta = .181; $p = .037$) has the strongest impact.

Model summary[b]				
Model	**R**	**R Square**	**Adjusted R Square**	**Std. Error of the Estimate**
1	,666[a]	,444	,424	,58885

a. Predictors: (Constant), Behaviour, Attitude, Subjective
b. Dependent variable: Intention

Table 9. Variance explained by predictors

ANOVA[a]						
Model		**Sum of Squares**	**Df**	**Mean Square**	**F**	**Sig.**
1	**Regression**	23,548	3	7,849	22,637	<,001[b]
	Residual	29,474	85	,347		
	Total	53,021	88			

a. Dependent vairable: Intention
b. Predictors: (Contstant), Behaviour, Attitude, Subjective Norm

Table 10. ANOVA test.

Coefficients[a]							
Model	**Unstandardized Coefficients**		**Standardized Coefficients**			**Collinearity Statistics**	
	B	**Std. Error**	**Beta**	**t**	**Sig.**	**Tolerance**	**VIF**
(Constant)	-,445	,409		-1,089	,279		
Attitude	,289	,126	,223	2,289	,025	,687	1,456
Subjective	,565	,129	,432	4,387	<,001	,675	1,482
Behaviour	,177	,084	,181	2,116	,037	,893	1,120

a. Dependent variable: Intention

Table 11. Coefficients.

Conclusion

As the regression analysis shows, all three independent variables are significant at an Alpha of .05. This means that all null-hypotheses are rejected, as all variables differ significantly from 0 and have a positive influence on the intention. The interviews show that people have a positive attitude towards the eHUBS and that in many neighbourhoods there is a positive culture toward sustainability and shared mobility. However, people want to experience as little inconvenience as possible and there is a need for more certainty in the availability of the eHUB means of transport. The regression analysis shows that the opinions of people have the most influence on the intention. The interviews state as well that a 'sustainable culture' is important for people to use the eHUBS. Most can be achieved in people's trust in the supply of the eHUBS and with that their ability to use the vehicles. A kind of guarantee can be given that there is always a vehicle available if one want to use it. It shows that when the subjective norm, attitude, and perceived behavioural control are positively present, the intention to use the eHUB facilities increase as well.

6. Conclusion and discussion

This conclusion will answer the sub-questions after which the main-question will be answered. In the discussion, the recommendations, and the limitations and implications of this research will be discussed.

6.1. Conclusion

In order to battle the issues regarding mobility network (GHG-emissions, congestions, nuisance, etc.), a radical shift to more sustainable modes of transportation is needed (Markard, et al., 2012). A multi-level collaboration between different actors, public, private, and societal, is crucial to make this work. The government in the Netherlands focus on facilitating innovations and alternatives for the current mobility network to guide the sustainable mobility transition. While creating a more sustainable and durable transportation network, the social and economic values in a city or area need to be retained, which is a challenge (Kohler et al., 2009). A combination of land use planning and ICT innovations have led to growth in the shared and sustainable mobility sector. An innovation is the eHUB-pilot, which is a shared e-mobility service which offers multiple EVs on demand by using a single application. This is an interdisciplinary pilot, where the focus lies not only on land use planning and policy, behavioural change is important for the success of the eHUB-pilot. The interception of shared mobility and the mobility alternative service – eHUBS – can be an opportunity to institutionalize a new and innovative sustainable mobility system.

Sub-question 1: *'What is the current policy behind the implementation of the eHUBS in Nijmegen?'*

The eHUB project was called to life by a consortium of the municipality Nijmegen and MSPs: Amber (e-car), Cargoroo (e-cargo bike), and, eventually, Deelfiets Nijmegen (e-bikes). Other MSPs, like Felix and Check (e-scooters), were interested as they did not wanted to be confined to a single place to locate their modalities. The municipality was in charge of the subsidy for the communication marketing, design, and technical necessities (like loading infrastructure). The MSPs needed to develop their own business model and offer their own modalities to the eHUB. The goal of the pilot was to lower the CO2 emissions in cities, create a growing market for shared e-mobility, and learn from the pilot to create a blueprint for other cities (Van de Klift & Bruls, 2023). Due to the experimental character, the location choices for the eHUB did not meet all criteria that are normally necessary. Residents could request an eHUB online if they were interested. Eventually, the municipality distributed the eHUBS across the city, in different neighbourhoods with sufficient residents in the area (Interview 1, 2023).

Sub-question 2: '*How does ones attitude influence the intention to use the eHUB modalities in Nijmegen?'*

It shows that people are generally positive about the eHUBS, but the location-choice has an impact on their attitude. The interviews and D&B report show that the residents of Nijmegen are positive, as long as the eHUB is not a nuisance or takes away from existing parking places. Looking at the analysis of people who never used the eHUB, it is clear that there is a positive relation between attitude and intention (Beta = .223; p = .125). This rejects the null-hypothesis, and accepts the hypothesis that a positive attitude towards using the eHUB, contributes to the intention to use the eHUB modalities.

Sub-question 3: '*How does ones subjective norm influence the intention to use the eHUB modalities in Nijmegen?'*

Seen from the data analysis, the subjective norm has the biggest influence on the intention to use the eHUB modalities (Beta = .432, $p < .001$). Both interviews also show that it is important to embed shared e-mobility in the culture of Nijmegen in order to increase the uptake of shared EVs. If the use of eHUB modalities were generally accepted, the feeling to comply with the social standard will create a new social standard to use sustainable options to travel.

Sub-question 4: '*How does ones perception of perceived behavioural control influence the intention to use the eHUB modalities in Nijmegen?'*

The interviews show that in order to create behavioural change, it is most important to familiarize people with the concept of shared mobility. Once they are familiar with the working of an eHUB, the intention to use will follow because one is more confident they can use the eHUB. The interviews show that non-users are not always aware of the facilities, and have low expectations when it comes to the availability of the eHUBS. Figure 13 shows that non users are often not aware of what EVs are present at the eHUBS, which plays a part in their perceived behavioural control. Even though, the analysis shows a positive relation between the control belief of the non-users and the intention to use the modalities (Beta = .181, $p = .037$).

Main-question: '*How can insight in the intention to use a multimodal eHUB, based on the theory of planned behaviour, help the sustainable mobility transition?'*

Due to the world-wide attention to the impacts of climate change, there is a need for fundamental change in the mobility sector. As the impacts are seeable everywhere and the possibilities of ICT innovative mobility services grow, there is an opportunity to institutionalize new systems. As this is a multidimensional approach, the social, political, and economic domains need to work together to implement behavioural (habit) change. The interception of shared mobility and electrical multimodal mobility hubs is promising (Shaheen, Cohen, & Zohdy, 2016), especially when focussing on behavioural change. Behavioural-intention can be a predictor of the behaviour itself, and is constructed of the attitude, subjective norm, and perceived behavioural control (Ajzen, The theory of planned behavior, 1991). Residents of Nijmegen show to be favourable towards the eHUBS, but can easily shift towards a negative attitude when causing nuisance. The intention to use the eHUBS is especially dependent on their social environment and the embedded sustainable mobility culture. People oftentimes are not aware of the mobility options and modalities offered at the eHUB. Nonetheless, non-users are still confident in their ability to use the modalities, which is also an indicator of the intention to use the eHUB. By focusing on the location-choice of the eHUBS, embedding shared mobility in the cities' culture, and investing in information systems, the intention to use the multimodal eHUB will provide an institutionalization of sustainable mobility services that aid in the sustainable mobility transition.

6.2. Discussion and implication of research

Discussion

The eHUB project has shown where the weaknesses and strengths of shared e-mobility lie. It is clear that the social environment is the highly influential and that it can be improved by focusing on embedding the culture of sustainability in the city. Even though this seems the case in Nijmegen, there is still a discrepancy in the intention and actual uptake (D&B, 2022), as the multitude of the respondents were non-users. A way of improving this, could be to implement more and smaller eHUBS (back-to-many) in order to provide more access points. The interviews pointed out that the lack of focus on demographic features for the location-choices, formed a supply-driven approach. In order to locate where the demand is highest, a free-floating approach is suggested. This results in a lot of nuisance in the city, which is unfavourable as it decreases the attitude towards the uptake of eHUBS. A middle-ground is again a back-to-many system. This shows the number of users, which can be an indicator for demand, but could also suggest a lack of information supply. This does, however, show the need for a more demand-driven perspective. Another factor that became evident, is the need and challenge in keeping the availability of the modalities consistent. This increases trust in the system, which can lead to higher level of uptake of the modalities. Important to note is that due to the experimental character of the eHUB-pilot, the hard location-criteria were not entirely fulfilled. If the eHUB design, in whatever way, is continued on a national level, choices can be made to uphold certain standards addressing the availability and diverseness of the provided modalities. Overall, the pilot provided a multitude of lessons learned which provide a better understanding of the inner-workings of multimodal electricity hubs.

Discussion

Despite the best intentions to the design and execution of this research, there are some limitations that need to be addressed. The first limitation of this research is of practical nature. Due to the limited time and resources, the sample size was relatively small. Especially the imbalance between the number of users and non-users. In order to statistically analyse the users, more data was needed. Comparing the two groups can give insight in the alleged gap between the intention to use the eHUBS and the actual uptake (D&B, 2022).

Another limitation of this research regards the questionnaire. An elaboration of descriptive information would have given more information on the demographic characteristics of the (non) users. This gives insight to policymakers on formulating a target group which helps in choices regarding locating the eHUBS in the city. In addition, the distribution of the questionnaire was focused around the central station of Nijmegen, as documents and the interviews pointed out that the combination of eHUB modalities to public transportation was most promising. This was also due to the lack of time and resources. Distributing the questionnaire in different neighbourhoods around the city, could diversify the responses and give a better overview of (potential) users.

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Appendix 1. Operationalisation questionnaire

Variable	Dimensions	Question/statement
Information respondent	Descriptive information	Do you live in Nijmegen? - yes/no What is your age? - 0-18_:_18-25_:_25-35_:_35+ What is your highest educationlevel? - No education - Basisonderwijs - Highschool - HBO - WO - Other, ….. What is your occupation? - Student/Working/Entrepreneur/ Unemployed/Other - How did you receive this questionnaire? - ……….. What is your main travel-mode? - bicycle/car/motorcycle/e-bike/OV bike/e-motorcycle/ecar/bus/train/other, ….. What is you postal code? - ……… - Rather not tell
Behavioural belief/ attitude	Direct attitude scale	Using the eHUB modalities is pleasant. I know what modalities are present at the StartUP eHUB location.
	Behavioural belief strength	Using the eHUB modalities will make me more environmental aware. Using the eHUB modalities is important to lower the CO2 emission in the city. Using the eHUB modalities is a time-effective way to travel. Using the eHUB modalities is an affordable way to travel. Using the eHUB modalities is a reliable way to travel.
	Outcome evaluations	Living a more environmental aware life is… - Good:_1_2_3_4_5_6_7_:bad Emitting less CO2 is… - Good:_1_2_3_4_5_6_7_:bad
Normative beliefs/ subjective norm	Direct perceived norm scale	People in my direct environment use/have used the eHUB modalities. - If so, those people expect me to do so too.

		- If not, they do want to use them. Most people like me use the eHUB modalities
	Normative belief strength (injunctive and descriptive)	If people in my direct environment use the eHUB modalities, I also want to. If I use the eHUB modalities, people in my direct environment will think positively about me.
	Motivation to comply	I want to comply with the opinion of people in my close environment when it comes to using the eHUB modalities.
Control beliefs/ perceived behavioural control	Direct perceived control scale	I am confident I can use the eHUB modalities. I am confident I can use the applications needed to use the eHUB modalities.
	Control belief strength	I am physically able to use the eHUB modalities. I am financially able to use the eHUB modalities. I have the necessary resources and skills to use the eHUB modalities.
	Power of control factors	Being physically able (or unable) ensures me (obstructs me) to use the eHUB modalities. Getting more information about using the eHUB modalities will encourage me to use it (more). Having someone to use the eHUB modalities with, motivates me to use it (more).
Motivation to comply/not-comply with behaviour	Intention	I am intended to use the eHUB modalities in the future. The chance of me using the eHUB modalities in the future is high. I am interested to motivate people in my close environment to use the eHUB modalities.
Past behaviour	Past experiences	I have used the eHUB modalities. - Yes/no - If so, using the eHUB modalities was a positive experience. - If so, I have used the bike/cargobike/car for my travel. - If not, I think I will have a positive experience when I would use the eHUB modalities.
Limitations	Individuals needs	Do you ever use public transportation?

		- If so, do you use the eHUB modalities for the beginning or end of your travel?

Appendix 2. Interview guide

Interview guide

Beste [naam interviewer],

Bedankt voor het meewerken aan dit interview. Ik zal mijzelf eerst voorstellen en herhalen waar mijn scriptie over gaat. Ik ben Iris van Straaten en studeer aan de Radboud Universiteit. Ik ben bezig met mijn scriptie voor de master Spatial Planning. Hierin onderzoek ik de achterliggende gedragsfactoren van bewoners die mogelijk invloed hebben op het gebruik van de eHUBS in Nijmegen. Ik probeer te kijken vanuit de vraag van bewoners, wat ze motiveert om gebruik te maken van de eHUBS en waar nog kansen liggen voor het ontwerp ervan.

Dit is een inleidend interview voor mijn onderzoek voordat ik enquêtes ga verspreiden. Hiermee hoop ik meer inzicht te krijgen in het initiële besluitvormingsproces, de uitvoering en mogelijke evaluatie van het pilot project.

Mag ik dit interview opnemen? Mag ik uw naam gebruiken in mijn thesis, of wilt u liever anoniem blijven?

Deel 1: voorbereiding.

In 2018 is er een Europese Interreg-subsidie aangevraagd en toegekend.

- Wat zijn de stappen van de gemeente geweest ter realisatie van de eHUBS?
    - Hoe zijn de aanbieders en belanghebbenden benaderd?
    - Wat voor afspraken zijn er van tevoren gemaakt?
    - Hoe zijn de locaties van de eHUBS bepaald (o.b.v. omgeving, doelgroep, ruimte)?
- Het D&B heeft vooral gekeken naar of en welke vervoersmiddelen men zou kiezen, maar niet welke zij graag willen zien.
  De nadruk voor interventies lag, zoals ik het las, voornamelijk op design en communicatie. Niet perse het aanbod.
  Is er ook gekeken naar de vraag van bewoners naar aanbod in plaats van de interesse in het aanbod bevragen?
    - In hoeverre zijn de bewoners meegenomen in het besluitproces?
- Waren er onvoorziene gebeurtenissen?

Deel 2: uitvoering.

Rond april 2019 is het project van start gegaan.

- Er zijn bovenregionale, regionale en lokale ‘buurt’ eHUBS, waar Nijmegen vooral op de laatste vorm heeft gefocust. Wat is de regen hiervoor geweest?
- Is de start van het project in 2019 gegaan zoals gepland?
    - Wat was de invloed van corona?
    - Hoe is het contact tussen de aanbieders, bewoners en gemeente/regio gelopen? Heeft iedereen zich aan hun afspraken gehouden?
- Er zit, volgens het D&B onderzoek, een gat tussen de intentie en daadwerkelijk gebruik van de eHUBS. Waar komt dit door denk je?
- Zijn de controle locaties uiteindelijk ook bijgewerkt o.b.v. de successen van de interventielocaties?
- Waren er nog andere onvoorziene gebeurtenissen?

Deel 3: evaluatie.

Het project heeft uiteindelijk tot eind 2022 geduurd.

- In de Raadsinformatiebrief van 2020 staat dat Nijmegen zou bijdragen aan de ontwikkeling van een standaard methode voor de implementatie van eHUBS en aan modellering voor gedragsverandering.
    - Is het mogelijk gebleken om o.b.v. het project een standaard methode voor implementatie op te stellen?
    - Is het mogelijk gebleken om o.b.v. het project gedragsverandering te modelleren?
- De raadsbrief van eind januari dit jaar liet weten dat het belangrijk is om goed samen te werken tussen de gemeente en de aanbieders. Het bleek lastig om snel te schakelen door alle regels en lange procedures.
    - Kan je me hier meer over vertellen?
    - Hoe is de samenwerking uiteindelijk gegaan?
- Hoe zie jij de toekomst van de eHUBS in? (APV loopt nog maar tot 1 mei).
    - Gaan er wezenlijke verschillen zijn tussen de samenwerking met de aanbieders?
- Zijn er dingen die je achteraf graag anders had gezien of had aangepakt?

Heb je nog laatste opmerkingen of vragen aan mij?

Is er een mogelijkheid om via de gemeente of regio bewoners te bereiken voor het invullen van mijn enquête?

Nogmaals bedankt voor het meewerken!

Appendix 3. SPSS output

Descriptive statistics

Wat is uw leeftijd?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	18 tot 25 jaar	51	45,5	45,5	45,5
	25 tot 35 jaar	21	18,8	18,8	64,3
	35 jaar of ouder	40	35,7	35,7	100,0
	Total	112	100,0	100,0	

Wat is uw hoogste afgeronde opleiding? - Selected Choice

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Middelbare school	17	15,2	15,2	15,2
	Middelbaar beroeps onderwijs (MBO)	6	5,4	5,4	20,5
	Hoger beroeps onderwijs (HBO)	33	29,5	29,5	50,0
	Wetenschappelijk onderwijs (WO)	53	47,3	47,3	97,3
	Anders, namelijk:	2	1,8	1,8	99,1
	Geen opleiding afgerond	1	,9	,9	100,0
	Total	112	100,0	100,0	

Wat is uw bezigheid - Selected Choice

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Student	46	41,1	41,1	41,1
	Werkend	40	35,7	35,7	76,8
	Ondernemer	2	1,8	1,8	78,6
	Werkloos	1	,9	,9	79,5
	Anders, namelijk	23	20,5	20,5	100,0
	Total	112	100,0	100,0	

Reliability analysis

Attitude:

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		,695
Bartlett's Test of Sphericity	Approx. Chi-Square	126,638
	df	15
	Sig.	<,001

Subjective norm:

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		,648
Bartlett's Test of Sphericity	Approx. Chi-Square	42,096
	df	6
	Sig.	<,001

Perceived behavioural control:

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		,685
Bartlett's Test of Sphericity	Approx. Chi-Square	147,824
	df	10
	Sig.	<,001

Intention:

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		,608
Bartlett's Test of Sphericity	Approx. Chi-Square	77,376
	df	3
	Sig.	<,001

Attitude:

Reliability Statistics

Cronbach's Alpha	N of Items
,712	6

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted

ATT 1. Het gebruik van de eHUB vervoersmiddelen lijkt mij aangenaam.	17,63	6,117	,594	,626
ATT 2. Gebruik maken van de eHUB vervoersmiddelen is goed voor het milieu.	17,01	6,505	,437	,676
ATT 3. Gebruik maken van de eHUB vervoersmiddelen zorgt voor minder CO2 uitstoot in de stad.	17,11	7,444	,321	,707
ATT 4. Gebruik maken van de eHUB vervoersmiddelen is een tijd-effectieve manier van reizen.	17,68	6,102	,464	,670
ATT 5. Gebruik maken van de eHUB vervoersmiddelen is een betaalbare optie om te reizen.	17,83	6,536	,433	,678
ATT 6. Gebruik maken van de eHUB vervoersmiddelen is een betrouwbare manier van reizen.	17,75	7,083	,435	,678

Subjective norm:

Reliability Statistics

Cronbach's Alpha	N of Items
,601	4

Case Processing Summary

		N	%
Cases	Valid	96	94,1
	Excluded[a]	6	5,9
	Total	102	100,0

a. Listwise deletion based on all variables in the procedure.

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted

SNO 1. Als het gaat om het gebruik maken van de eHUB vervoersmiddelen, wil ik meegaan in wat de mensen in mijn omgeving ervan vinden.	7,71	3,619	,307	,593
SNO 2. De meeste mensen zoals ik gebruiken de eHUB vervoersmiddelen.	8,16	4,070	,305	,583
SNO 3. Als mensen in mijn naaste omgeving gebruik maken van de eHUB vervoersmiddelen, wil ik er ook gebruik van maken.	7,45	3,260	,436	,485
SNO 4. Als ik gebruik zou maken van de eHUB vervoersmiddelen, zullen mensen in mijn naaste omgeving dat als positief ervaren.	6,78	3,457	,498	,446

Case Processing Summary

		N	%
Cases	Valid	91	89,2
	Excluded[a]	11	10,8
	Total	102	100,0

a. Listwise deletion based on all variables in the procedure.

Perceived behavioural control:

Reliability Statistics

Cronbach's Alpha	N of Items
,663	6

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted

PBC 1. Ik heb er alle vertrouwen in dat ik de eHUB vervoersmiddelen zou kunnen gebruiken.	17,58	8,113	,646	,525
PBC 2. Ik heb er alle vertrouwen in dat ik de applicaties die nodig zijn voor de eHUB vervoersmiddelen kan gebruiken.	17,38	8,062	,611	,534
PBC 3. Ik zou het financieel kunnen veroorloven om de eHUB vervoersmiddelen te gebruiken.	17,56	11,605	,018	,738
PBC 4. Ik beschik over de nodige middelen en vaardigheden om de eHUB vervoersmiddelen te gebruiken.	17,22	9,751	,507	,595
PBC 5. Het krijgen van meer informatie over de eHUB vervoersmiddelen zal mij aansporen er gebruik van te maken.	18,00	8,578	,461	,594
PBC 6. Iemand hebben om de eHUB vervoersmiddelen samen mee te gebruiken, zal me aanmoedigen om er gebruik van te maken.	17,97	9,988	,229	,681

Case Processing Summary

		N	%
Cases	Valid	91	89,2
	Excluded[a]	11	10,8
	Total	102	100,0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
,738	5

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
PBC 1. Ik heb er alle vertrouwen in dat ik de eHUB vervoersmiddelen zou kunnen gebruiken.	14,00	7,267	,651	,633
PBC 2. Ik heb er alle vertrouwen in dat ik de applicaties die nodig zijn voor de eHUB vervoersmiddelen kan gebruiken.	13,80	7,072	,649	,631
PBC 4. Ik beschik over de nodige middelen en vaardigheden om de eHUB vervoersmiddelen te gebruiken.	13,64	9,123	,438	,717
PBC 5. Het krijgen van meer informatie over de eHUB vervoersmiddelen zal mij aansporen er gebruik van te maken.	14,42	7,601	,484	,700
PBC 6. Iemand hebben om de eHUB vervoersmiddelen samen mee te gebruiken, zal me aanmoedigen om er gebruik van te maken.	14,38	8,506	,326	,761

Case Processing Summary

		N	%
Cases	Valid	91	89,2
	Excluded[a]	11	10,8
	Total	102	100,0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
,761	4

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
PBC 1. Ik heb er alle vertrouwen in dat ik de eHUB vervoersmiddelen zou kunnen gebruiken.	10,82	4,613	,710	,617
PBC 2. Ik heb er alle vertrouwen in dat ik de applicaties die nodig zijn voor de eHUB vervoersmiddelen kan gebruiken.	10,63	4,481	,697	,622
PBC 4. Ik beschik over de nodige middelen en vaardigheden om de eHUB vervoersmiddelen te gebruiken.	10,46	6,029	,538	,725
PBC 5. Het krijgen van meer informatie over de eHUB vervoersmiddelen zal mij aansporen er gebruik van te maken.	11,24	5,541	,361	,822

Case Processing Summary

		N	%
Cases	Valid	91	89,2
	Excluded[a]	11	10,8
	Total	102	100,0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
,822	3

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
PBC 1. Ik heb er alle vertrouwen in dat ik de eHUB vervoersmiddelen zou kunnen gebruiken.	7,68	2,531	,673	,761
PBC 2. Ik heb er alle vertrouwen in dat ik de applicaties die nodig zijn voor de eHUB vervoersmiddelen kan gebruiken.	7,48	2,208	,764	,663
PBC 4. Ik beschik over de nodige middelen en vaardigheden om de eHUB vervoersmiddelen te gebruiken.	7,32	3,308	,635	,810

Case Processing Summary

		N	%
Cases	Valid	89	87,3
	Excluded[a]	13	12,7
	Total	102	100,0

a. Listwise deletion based on all variables in the procedure.

Intention:

Reliability Statistics

Cronbach's Alpha	N of Items
,738	3

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
INT 1. Ik ben van plan om de eHUB vervoersmiddelen te gaan gebruiken.	5,37	2,736	,702	,510

INT 2. De kans is groot dat ik de eHUB vervoersmiddelen ooit ga gebruiken.	4,83	2,369	,603	,605
INT 3. Ik ben geïnteresseerd om mensen in mijn omgeving aan te moedigen om de eHUB vervoersmiddelen te gebruiken.	5,17	3,074	,417	,815

Factor analysis

Attitude:

Varimax rotation:

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2,492	41,533	41,533	2,492	41,533	41,533	2,114	35,231	35,231
2	1,243	20,717	62,249	1,243	20,717	62,249	1,621	27,019	62,249
3	,780	12,992	75,242						
4	,631	10,515	85,757						
5	,471	7,847	93,604						
6	,384	6,396	100,000						

Extraction Method: Principal Component Analysis.

Rotated Component Matrix[a]

	Component	
	1	2
ATT 1. Het gebruik van de eHUB vervoersmiddelen lijkt mij aangenaam.	,785	
ATT 2. Gebruik maken van de eHUB vervoersmiddelen is goed voor het milieu.		,800
ATT 3. Gebruik maken van de eHUB vervoersmiddelen zorgt voor minder CO2 uitstoot in de stad.		,880

ATT 4. Gebruik maken van de eHUB vervoersmiddelen is een tijd-effectieve manier van reizen.	,814	
ATT 5. Gebruik maken van de eHUB vervoersmiddelen is een betaalbare optie om te reizen.	,496	
ATT 6. Gebruik maken van de eHUB vervoersmiddelen is een betrouwbare manier van reizen.	,737	

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 3 iterations.

Quartimax rotation:

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2,492	41,533	41,533	2,492	41,533	41,533	2,190	36,507	36,507
2	1,243	20,717	62,249	1,243	20,717	62,249	1,545	25,742	62,249
3	,780	12,992	75,242						
4	,631	10,515	85,757						
5	,471	7,847	93,604						
6	,384	6,396	100,000						

Extraction Method: Principal Component Analysis.

Rotated Component Matrix[a]

	Component	
	1	2
ATT 1. Het gebruik van de eHUB vervoersmiddelen lijkt mij aangenaam.	,798	
ATT 2. Gebruik maken van de eHUB vervoersmiddelen is goed voor het milieu.		,783
ATT 3. Gebruik maken van de eHUB vervoersmiddelen zorgt voor minder CO2 uitstoot in de stad.		,879

ATT 4. Gebruik maken van de eHUB vervoersmiddelen is een tijd-effectieve manier van reizen.	,813	
ATT 5. Gebruik maken van de eHUB vervoersmiddelen is een betaalbare optie om te reizen.	,522	
ATT 6. Gebruik maken van de eHUB vervoersmiddelen is een betrouwbare manier van reizen.	,738	

Extraction Method: Principal Component Analysis.
Rotation Method: Quartimax with Kaiser Normalization.
a. Rotation converged in 3 iterations.

Subjective norm:
Varimax rotation

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	1,850	46,250	46,250	1,850	46,250	46,250
2	,932	23,295	69,545			
3	,658	16,451	85,996			
4	,560	14,004	100,000			

Extraction Method: Principal Component Analysis.

Rotated Component Matrix[a]

a. Only one component was extracted. The solution cannot be rotated.

Perceived behavioural control
Varimax rotation:

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2,545	50,904	50,904	2,545	50,904	50,904	2,218	44,363	44,363
2	1,239	24,785	75,689	1,239	24,785	75,689	1,566	31,327	75,689

3	,543	10,856	86,545						
4	,409	8,184	94,729						
5	,264	5,271	100,000						

Extraction Method: Principal Component Analysis.

Rotated Component Matrix[a]

	Component	
	1	2
PBC 1. Ik heb er alle vertrouwen in dat ik de eHUB vervoersmiddelen zou kunnen gebruiken.	,794	
PBC 2. Ik heb er alle vertrouwen in dat ik de applicaties die nodig zijn voor de eHUB vervoersmiddelen kan gebruiken.	,871	
PBC 4. Ik beschik over de nodige middelen en vaardigheden om de eHUB vervoersmiddelen te gebruiken.	,876	
PBC 5. Het krijgen van meer informatie over de eHUB vervoersmiddelen zal mij aansporen er gebruik van te maken.		,804
PBC 6. Iemand hebben om de eHUB vervoersmiddelen samen mee te gebruiken, zal me aanmoedigen om er gebruik van te maken.		,869

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 3 iterations.

Quartimax rotation

Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2,545	50,904	50,904	2,545	50,904	50,904	2,262	45,232	45,232

2	1,239	24,785	75,689	1,239	24,785	75,689	1,523	30,457	75,689
3	,543	10,856	86,545						
4	,409	8,184	94,729						
5	,264	5,271	100,000						

Extraction Method: Principal Component Analysis.

Rotated Component Matrix[a]

	Component	
	1	2
PBC 1. Ik heb er alle vertrouwen in dat ik de eHUB vervoersmiddelen zou kunnen gebruiken.	,807	
PBC 2. Ik heb er alle vertrouwen in dat ik de applicaties die nodig zijn voor de eHUB vervoersmiddelen kan gebruiken.	,879	
PBC 4. Ik beschik over de nodige middelen en vaardigheden om de eHUB vervoersmiddelen te gebruiken.	,871	
PBC 5. Het krijgen van meer informatie over de eHUB vervoersmiddelen zal mij aansporen er gebruik van te maken.		,794
PBC 6. Iemand hebben om de eHUB vervoersmiddelen samen mee te gebruiken, zal me aanmoedigen om er gebruik van te maken.		,868

Extraction Method: Principal Component Analysis.
Rotation Method: Quartimax with Kaiser Normalization.
a. Rotation converged in 3 iterations.

Intention:

Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2,007	66,902	66,902	2,007	66,902	66,902

2	,705	23,502	90,404			
3	,288	9,596	100,000			

Extraction Method: Principal Component Analysis.

Rotated Component Matrix[a]

a. Only one component was extracted. The solution cannot be rotated.

Regression analysis

Correlations

		Attitude	Subjective	Behaviour	Intention
Attitude	Pearson Correlation	1	,553**	,273**	,510**
	Sig. (2-tailed)		<,001	,009	<,001
	N	102	96	91	89
Subjective	Pearson Correlation	,553**	1	,306**	,609**
	Sig. (2-tailed)	<,001		,003	<,001
	N	96	96	91	89
Behaviour	Pearson Correlation	,273**	,306**	1	,372**
	Sig. (2-tailed)	,009	,003		<,001
	N	91	91	91	89
Intention	Pearson Correlation	,510**	,609**	,372**	1
	Sig. (2-tailed)	<,001	<,001	<,001	
	N	89	89	89	89

**. Correlation is significant at the 0.01 level (2-tailed).

Model Summary[b]

					Change Statistics					
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	df1	df2	Sig. F Change	Durbin-Watson
1	,666[a]	,444	,424	,58885	,444	22,637	3	85	<,001	1,754

a. Predictors: (Constant), Behaviour, Attitude, Subjective

b. Dependent Variable: Intention

ANOVA[a]

Model	Sum of Squares	df	Mean Square	F	Sig.

1	Regression	23,548	3	7,849	22,637	<,001[b]
	Residual	29,474	85	,347		
	Total	53,021	88			

a. Dependent Variable: Intention

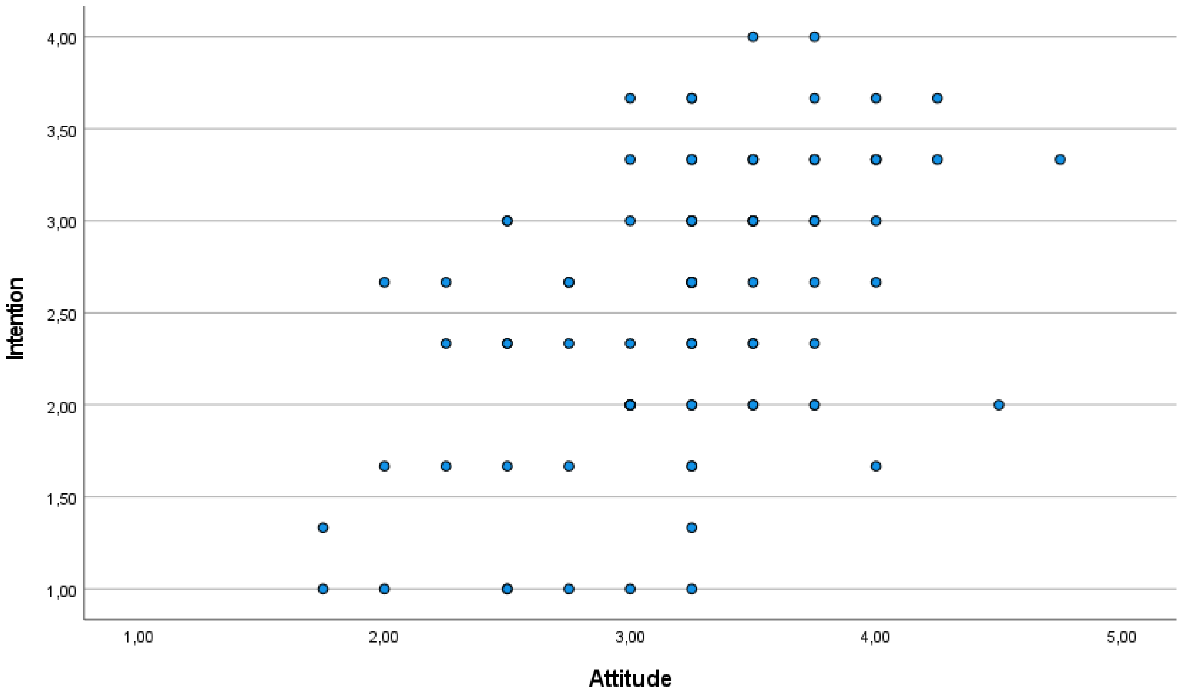
b. Predictors: (Constant), Behaviour, Attitude, Subjective

Coefficients[a]

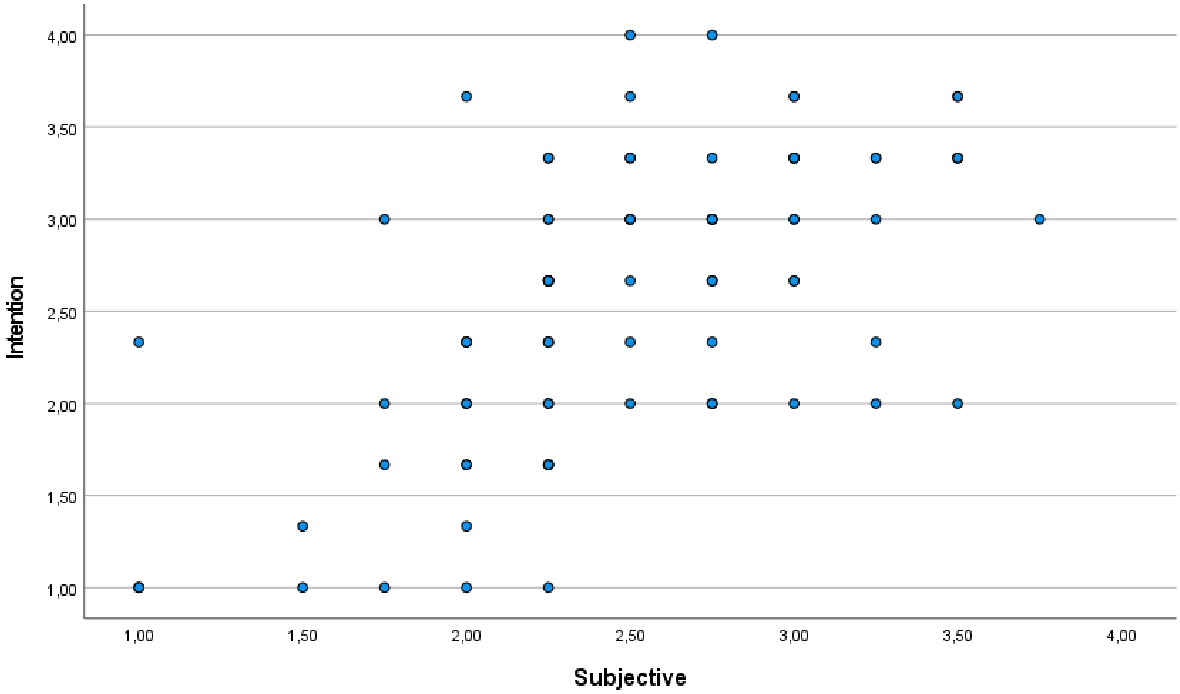
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95,0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	-,445	,409		-1,089	,279	-1,259	,368
	Attitude	,289	,126	,223	2,289	,025	,038	,541
	Subjective	,565	,129	,432	4,387	<,001	,309	,820
	Behaviour	,177	,084	,181	2,116	,037	,011	,344

a. Dependent Variable: Intention

Intention * attitude:



Intention * subjective norm:



Intention * perceived behavioural norm: