Gender and Accessibility: An Intersectional Approach

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Iris Roeleven

Student number: 4839501

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Graduation committee

Chairperson	: Dr.ir. M. Kroesen, Section Transport and Logistics
First Supervisor:	: Dr.ir. T. Verma, Section Policy Analysis
Second Supervisor	: Dr.ir. M. Kroesen, Section Transport and Logistics
External Supervisor	: Dr.ir. J. Goncalves, Faculty of Architecture, Department of Urbanism

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I.R. Roeleven

4839501

Master's thesis

Complex Systems Engineering and Management

TU Delft

Preface

Before you lies my Master thesis about gender and accessibility, with which I finish my Master Complex Systems Engineering and Management at the TU Delft. Having been interested in gender equality subjects for most of my life, I feel very thankful that I got to work on this subject for my thesis. I would like to thank Juliana Goncalves for thinking of this subject, putting it online and helping me develop it into what it has become, and for her supervision throughout the process of writing this thesis. Additionally, I would like to thank Maarten Kroesen for his extremely helpful tips without which the quantitative part of the analysis would not have worked as well as it has, and Trivik Verma, whose constructive feedback was also very helpful for me in finishing this project. I would also like to thank the CUSP team, who have created a very supportive environment in which to discuss my and others' theses. Lastly, I would like to thank my family. I would like to thank my parents, who have continuously supported me throughout my studies and, thankfully, also forced me to take small breaks at times when I needed them. Additionally, I would like to thank my grandparents, who are not around anymore to see this, but who, incredibly, still found a way to support me during my studies even though they are gone.

Iris Roeleven, August 10, 2023

Executive Summary

In today's world, the transport system is essential in helping people reach the activities they want or need to attend. Using the various modes available to them, people can access economic opportunities like their work, or social opportunities important for their well-being. However, like in many other fields, inequality can exist in access to various opportunities based on personal characteristics. This unequal access can lead to the social exclusion of certain groups. Vulnerable groups like the elderly or people with a low income can become socially excluded because of their accessibility levels.

While various definitions of accessibility exist, perceived accessibility is seen as very important in this context, as people's perception of their surroundings is the basis on which they will make decisions with regard to their mobility. Certain factors, like being older or having a lower income can affect perceived accessibility. Another factor which can have an effect on perceived accessibility is gender. Women tend to have different mobility patterns than men and are generally underrepresented in the transport system. However, little research has been done into the way gender, and accompanying intersectional factors, affect perceived accessibility. The select number of studies that have included gender found either no effect or found that being a woman had a positive effect on perceived accessibility. Yet, an explanation for this (positive) effect cannot be found in literature.

This thesis aims to fill this knowledge gap with regard to gender and perceived accessibility, where the focus is on urban areas in The Netherlands. Therefore, the following main research question is used: *How do gender and intersectional factors affect the perceived accessibility of people in urban areas in The Netherlands?* To answer this question a mixed-methods research approach is used. Firstly, two literature reviews are done. The first literature review aims to find the general factors which impact perceived accessibility, as to make a general conceptual model of perceived accessibility. Next, the gender intersectional perspective is added to this framework by using a second literature review which includes this perspective. After this, a quantitative analysis, more specifically using a Structural Equation Model, is done using survey data to assess the strength of relationships between the various factors in the constructed conceptual model. Finally, a workshop is carried out to validate the main results and give them more context.

The main findings in this thesis show a number of insights. Firstly, perceived accessibility is impacted by many factors, including but not limited to, perceived safety, primary mode used, individual characteristics like abilities and socio-demographic factors. Secondly, four important relationships between gender (intersectional) factors and perceived accessibility are found, being:

- Of all socio-demographic factors, gender is the only factor that significantly relates to perceived accessibility when the mediating factors are not taken into account, showing that women's perceived accessibility tends to be lower.
- Gender has a negative relationship with perceived safety at night, meaning that women tend to feel less safe when travelling at night using public transport, cycling, or walking. In turn, this lower perceived safety at night results in lower perceived accessibility.
- Women with young children are shown to feel more restricted in their choice of transport mode when trip chaining, which in turn is negatively related to their perceived accessibility. This effect is not found for men with young children.
- For men, income positively relates to access to a car, showing that men with a higher household income tend to have more access to a car and vice versa. This effect is not found for women, while for both men and women, car access has a positive relationship with perceived accessibility.

Finally, these results are put into context using a workshop. Given the limited attention that has been given to increasing safety (at night) in the past in The Netherlands, this factor still playing a role in transport gender inequalities is not surprising. Additionally, the traditional gender roles that exist in The

Netherlands to this day are still very relevant, where the role of women as the primary caretaker for the children and the role of men as primary breadwinners and thus primary users of the car when this can be afforded is reflected in the results.

There are various potential subjects for future research following this thesis. Future research could go further into these quantitative results using qualitative methods to find further explanations for these relationships and especially what type of policy exactly could help to reduce gender inequalities in perceived accessibility. Additionally, the impact of perceived safety at night could be investigated more by specifically looking at differences in perceived accessibility at night and during the day. Lastly, the scope of this thesis means that the further effects of (low) perceived accessibility levels are not taken into account in the quantitative analysis, however, for future research this effect would be interesting to investigate further.

A more elaborate summary for those with limited time can be found in Appendix A.

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1. Introduction

1.1 Context of topic

In a world where people who live in various places want to do various spatially distributed activities, the transport system is essential. Using the various transport modes available to them, people can, or cannot, travel to the places they need or want to go. This is important on multiple accounts. From an economic perspective increased access to activities will enable people to access more work opportunities. From a social perspective, it enables people to meet and have social contact which is important for their wellbeing. However, this also means that there is a significant risk when inequities exist in access to activities, as this can lead to the social exclusion of certain groups.

The way the transport system is set up can thus cause some groups of people to have greater benefits than others, which can result in the social exclusion of certain groups. The concept of social exclusion is closely related to people's accessibility levels as poor access to transport can be the cause of people's social exclusion (Dixit & Sivakumar, 2020). In the United Kingdom, the Social Exclusion Unit (2003) also shows that there is a significant link between social exclusion and accessibility factors like transport and land use. This kind of transport-related social exclusion can impact a wide range of areas, where people can be affected physically, financially, and personally (Mackett & Thoreau, 2015). Social exclusion can have far-reaching impacts on people's lives, as socially excluded people have a higher probability to be unemployed, have higher rates of bad health and on average have fewer years of education (Mackett & Thoreau, 2015).

Accessibility and social exclusion are closely related subjects, as low levels of accessibility can lead to social exclusion. However, levels of accessibility are not straightforward to determine. They can be measured in various ways, ranging from calculated (objective) accessibility metrics to perceived (subjective) accessibility measures, and ranging from place-based to person-based measures (Ryan & Pereira, 2021). One way of determining accessibility is by looking at people's perceived accessibility. Perceived accessibility is a very relevant concept in this context. Where calculated accessibility measures use objective measurements to calculate accessibility, perceived accessibility looks at how people perceive their own accessibility levels. Perceived accessibility can be defined as "*how easy it is to live a satisfactory live using the transport system"* (Lättman et al., 2016b, p.2). Perceived accessibility levels are often correlated with calculated accessibility measures, however, mismatches often do exist (Ryan & Pereira, 2021). This is very relevant, as people's perceived accessibility is the factor they will use to make choices with regard to their mobility behaviour. Equity in perceived accessibility thus helps in getting equitable mobility. However, perceived accessibility is not always equitable, even for people living in the same place.

Low levels of accessibility in the transport system can be due to various individual factors like income, age or gender (Mackett & Thoreau, 2015). Gender, like age and income, has also been shown to have a significant effect on mobility behaviour (Carboni et al., 2022; Miralles-Guasch et al., 2016) and perceived accessibility (Dixit & Sivakumar, 2020). Being a woman can significantly alter one's experience in the transport system, which can be reinforced by the extent to which traditional gender roles are still adhered to. For example, women are still often more responsible for childcare, which means they have to travel with children more, which can limit their transport options (Craig & van Tienoven, 2019). It can be questioned whether women's needs are properly included in the transport sector. Especially given that the Horizon Europe 2020 Transport Innovation Gender Observatory project approximates that only a third of the needs of EU citizens are met in today's transport system, and given that only 22-27 per cent of the people who work in the transport sector in the EU are women (Bridgman et al., 2022).

Additionally, when looking at these types of (accessibility) issues from a gender perspective, intersectionality is a very important concept (Shields, 2008). Intersectionality is a concept that originates

in feminist studies and can be defined as *"the interconnected nature of categorisations including (but not limited to) gender, race, class, disability, faith and age and how different power structures interact, creating an interdependent system of discrimination and disadvantage"* (Bridgman et al., 2022, p. 68). An intersectional perspective is very relevant when it comes to perceived accessibility, as factors like age or income could also significantly affect perceived accessibility levels (Jamei et al., 2022). It does thus not seem unlikely that being a part of another minority group, e.g. the elderly, strengthens the disadvantage experienced because of gender with regard to accessibility (Bridgman et al., 2022). However, little research can be found on how intersectionality could or should be included in transport policy (Bridgman et al., 2022).

Gender equity, from an intersectional perspective, is thus in general a very important subject. Gender equity has also been for years, and is still, strived for in The Netherlands (Rijksoverheid, n.d.). However, inequities between men and women still exist in today's Dutch society in all kinds of areas, as is shown every other year in the emancipation monitor (e.g. Portegijs & van den Brakel, 2016). Differences in (perceived) accessibility levels could be a part of the inequities based on gender, however, little to no research has been done on the impact of gender on perceived accessibility levels in The Netherlands.

This thesis aims to find how gender and intersectional factors affect perceived accessibility levels in The Netherlands. This way, a clearer understanding can be gained of what gender inequities are still present from a mobility and accessibility perspective in The Netherlands, which in turn could contribute to a more equitable transport system. In doing so, it also aims to introduce a framework of perceived accessibility, including the main factors which affect perceived accessibility according to the literature.

1.2 Knowledge gap

To look more into the exact knowledge gap that exists when it comes to gender and perceived accessibility, a literature review is done. In this literature review, papers are included that look into perceived accessibility and include some element of equity or equality, indicating that they look at differences between groups or factors and their differences in perceived accessibility. Using Scopus and Google Scholar, 16 papers were selected for the review. The exact search process can be found in Appendix C.1

To get an overview of the articles found, and to what extent these include gender and intersectional factors, an analysis is done. In this analysis, it is assessed in what country the study is done, and the method that is used. Additionally, it is investigated whether gender was included in the research as an indicator for perceived accessibility and whether intersectionality in any shape or form was used to explain perceived accessibility. This article analysis can be found in Table 1.

Table 1 Article analysis for knowledge gap

Article	Country	Methods used	Gender included as indicator?	Intersectionality discussed or included?
(Calvert et al., 2022)	United Kingdom	Data from surveys analysed with statistical tests	✓	✗
(Al-Rashid et al., 2021)	Pakistan	Data from Questionnaires analysed using confirmatory factor analysis	✓	~*
(Lättman,, et al., 2016a)	Sweden	Data from surveys analysed using k-means clustering	✗	✗
(Liu et al., 2021)	China	Panel data analysed using statistical tests and panel model	✗	✗

(Tiznado-Aitken et al., 2021)	Chile	Data analysed using statistical tests	✗	✗
(Wang et al., 2021)	USA	Data from surveys analysed using Structural Equation Modelling (SEM)	✓	✗
(M. Ryan et al., 2016)	Australia	Data from surveys analysed using statistical tests	✗	✗
(Pot et al., 2020)	The Netherlands	Focus groups	✗	✗
(Laatikainen et al., 2017)	Finland	Data from surveys used for clustering and accessibility calculations	✓	✗
(Friman et al., 2020)	Norway, Sweden, Denmark, Finland	Data from surveys analysed using SEM	✓	✗
(Lättman et al., 2016a)	Sweden	Information from telephone surveys analysed using factor analysis and statistical tests	✓	✗
(van der Vlugt et al., 2019)	Germany, United Kingdom	Data from surveys analysed using factor analysis	✓	✗
(Lättman et al., 2020a)	Sweden	Information from telephone interviews analysed using exploratory factor analysis	✗	✗
(Márquez et al., 2019)	Colombia	Data from surveys analysed using discrete choice experiment and latent variables analysis	✗	✗
(Vitman-Schorr et al., 2019)	Israel	Data from questionnaires analysed using statistical tests	✓	✗
(Olsson et al., 2021)	Sweden	Data from surveys analysed using statistical tests	✓	✗

** While this article looks into the perceived accessibility of elder women, an intersectional group, it makes no comparisons and does not mention the term intersectionality in any way*

A number of conclusions can be drawn from the analysis as presented in Table 1. In line with the findings of Jamei et al. (2022) about the recent increase in attention to perceived accessibility, most articles found are fairly recent, with the earliest one being from 2016, while 9 of 16 articles are from 2020 or later. Furthermore, most of the research has been done in Western countries, which is helped by the fact that Olsson, Lättman and Friman have together written (at least) 4 articles on the subject in Sweden and Scandinavia. Only one article was found that looked into perceived accessibility in The Netherlands. The analysis done in The Netherlands is different from other research as it used focus groups to qualitatively look at the perceived accessibility of various people, whereas most other articles use a quantitative approach.

In more than half of the studies, gender is used as an indicator for explaining perceived accessibility. However, in none of these papers is this the prime focus. What is intriguing is that a number of papers which include gender as an indicator find that being a woman has a positive effect on perceived accessibility (e.g. Lättman et al., 2019). This conflicts with literature which shows that an important factor for perceived accessibility is perceived safety (Jamei et al., 2022) and research by Wang et al. (2021) that shows that women generally have a lower perceived safety. This suggests that there are other factors which compensate for this negative effect on perceived accessibility. However, no research has been found on this. This thus presents an interesting knowledge gap, as no research has been found that tried to identify through which factors gender impacts perceived accessibility. Lastly, Table 1 shows

that none of the papers address the effect of intersectionality on perceived accessibility. This is not surprising as the search term "perceived accessibility" combined with "intersectionality" yields zero results in Scopus. Even the broader search term "intersectionality AND accessibility AND transport" in Scopus yields only four results in Scopus, which on further investigation do not go into the knowledge gap identified here. Only the paper by Al-Rashid et al. (2021) includes intersectionality and perceived accessibility to some extent as it looks at the factors influencing perceived accessibility for elderly women. However, it makes no comparisons to other intersectional groups.

1.3 Research questions and approach

Given the identified knowledge gap in the previous Section, the main research question can be formulated. It is clear that intersectionality has not yet been discussed with regard to its effect on perceived accessibility. Additionally, few to no papers have focussed on the impact of gender on accessibility and its explaining factors. Moreover, the limited number of papers that do include gender in their quantitative investigation of perceived accessibility do not use The Netherlands as a case study. However, the country is relevant in these types of investigations as different cultures can affect the outcomes of these analyses. In formulating the research question, it is chosen to focus on urban areas for a more consistent context. Thus, the research question is formulated as follows:

How do gender and intersectional factors affect the perceived accessibility of people in urban areas in The Netherlands?

To be able to answer the main research question, various elements need to be researched. Firstly, it is important to find out what factors, including socio-demographic factors, can affect perceived accessibility according to existing literature (Sub-question 1). Secondly, a gender intersectional perspective needs to be added to this model to get a proper overview of how gender and intersectional factors could potentially affect perceived accessibility levels (Sub-question 2). The first two Sub-questions will thus lead to a conceptual model with various factors which could affect perceived accessibility factors. Next, it is relevant to find out to what extent these factors affect perceived accessibility (Sub-question 3). Finally, the results from sub-question 3 can be related back to the existing transport system in The Netherlands to put the results into context (Sub-question 4). The resulting four sub-questions are:

1. *What factors influence perceived accessibility?*
2. *How can perceived accessibility be conceptualized from a gender intersectional perspective?*
3. *To what extent do the found factors impact perceived accessibility from a gender intersectional perspective in urban areas in The Netherlands?*
4. *How do the main factors found to be relevant for perceived accessibility from a gender intersectional perspective relate to the past, present and future (urban) transport system in The Netherlands?*

To answer each sub-question, and finally, the main question, different research methods will be used. For both sub-question 1 and 2, a literature review will be done. Given that a literature review is especially good for integrating previous findings and as a basis for a conceptual model (Snyder, 2019) it is well suited for this part of the research. This way a proper basis can be built for the consequent research. To answer sub-question 3 a quantitative approach will be used, more specifically Structural Equation Modelling (SEM). This method is useful as it can investigate paths between various (latent) factors (Streiner, 2006). Moreover, it has been used before in similar research, showing its applicability (e.g. Friman et al., 2020b; Wang et al., 2021). Using this method, the strengths of relations between the various factors found in the first two sub-questions can thus be investigated. To get data for this part of the analysis, surveys will be used. Lastly, a qualitative method, namely a workshop substantiated with various(policy) documents, is used to answer sub-question 4. The workshop will be used to get a

balanced view from multiple experts on the factors found in the quantitative analysis and their relationship with the Dutch transport system. Together these methods lead to a balanced answer to the main question.

This research is part of the Complex Systems Engineering and Management Master at the TU Delft and uses various methods, the most important here being Structural Equation Modelling, taught in its contents. Additionally, its focus on accessibility fits very well with the content of the Transport and Logistics specialisation. This concept is both important for the public and private domain, as these both make decisions and policies which affect the complex transport system in various ways.

1.4 Thesis outline

This thesis is structured as follows. In the next Chapter, the research approach and methodology are elaborated on. Chapter 3 gives theoretical context to the research and introduces and explains the literature review about perceived accessibility factors (Sub-question 1) as well as the literature review regarding a gender and intersectional perspective in mobility and accessibility (Sub-Question 2). Next, Chapter 4 explains the results of the quantitative analysis and thus the extent of the impact on perceived accessibility of the various factors found (Sub-question 3). After this, Chapter 5 presents the final qualitative results with which the factors found can be put in context (Sub-question 4). Next, a discussion discusses these results and relates them to existing literature and a reflection reflects on the scientific and societal merit of the thesis. Finally, the conclusion presents the conclusion of the research and thus answers the main research question and discusses the limitations and possibilities for future research.

2. Research approach and methods

In this Chapter, the research approach that will be used in this thesis is presented in Section 2.1. Next, the methods that will be used for the various stages of the research are elaborated on in Section 2.2.

2.1 Research approach

To answer the main research question a specific research approach is chosen. Given the fact that both a quantitative approach and a qualitative approach are very useful for this research, the conclusion is drawn that a mixed methods approach is most suitable. A mixed-method approach is especially useful for understanding a research problem better (Ivankova et al., 2006). A particular strength of a mixed-method approach is that the quantitative and qualitative approaches can complement each other, which makes for more robust research (Ivankova et al., 2006). Within this mixed methods approach, the qualitative part of the research will complement the quantitative results (see Schoonenboom & Johnson, 2017).

Various types of mixed methods design exist, such as the sequential explanatory or exploratory design, the embedded design or the transformative design (Cresswell et al., 2003; Creswell & Plano Clark, 2011).Variations exist in these designs. For example, a design can either involve the quantitative and qualitative phases being concurrent or sequential (Ivankova et al., 2006). Therefore, a choice needs to be made on which design to use. After consideration of different designs, the choice is made to use a sequential explanatory design, in which the qualitative data can be used to further explain or build on the quantitative research results (Creswell & Plano Clark, 2011). This is chosen as it fits with the sub-research questions where the last (qualitative) sub-question builds on the results of the third (quantitative) sub-question. Thus, this design will consist of two phases for this research. First, quantitative data will be collected and analysed, after which qualitative data can be used to elaborate on or explain the quantitative results (Ivankova et al., 2006). The sequence of the approaches used is shown in Figure 1.

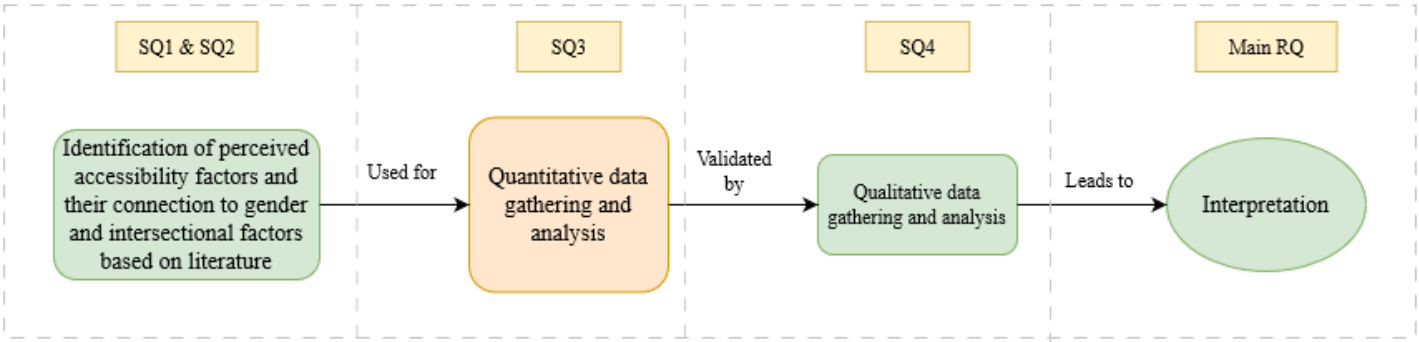

Figure 1 Setup of mixed research approach

The different steps as shown in Figure 1 can be found in the different Chapters of this report. In the next Chapter, the factors influencing perceived accessibility will be investigated, which will be linked to gender and intersectional factors. This way a hypothesis can be made of how gender and intersectional factors can influence perceived accessibility, and thus answer sub-questions 1 and 2. To be able to test the importance of these factors for perceived accessibility in The Netherlands, a quantitative approach will be useful. This way relationships between these factors and perceived accessibility can be compared on strength and significance (Chapter 4), for which a quantitative approach is especially well suited (Creswell, 2009). The results of these steps can be insightful. However, to make them more meaningful it is important to link them to the real world and the way the transport system and gender roles work in The Netherlands to be able to pinpoint potential problem areas. For this part, a qualitative approach is more suitable, wherein multiple perspectives can be used to be able to get a good overview of potential problem areas (Chapter 5).

The complete research design is shown in Figure 2. Section 2.2. explains the methods used in more detail.

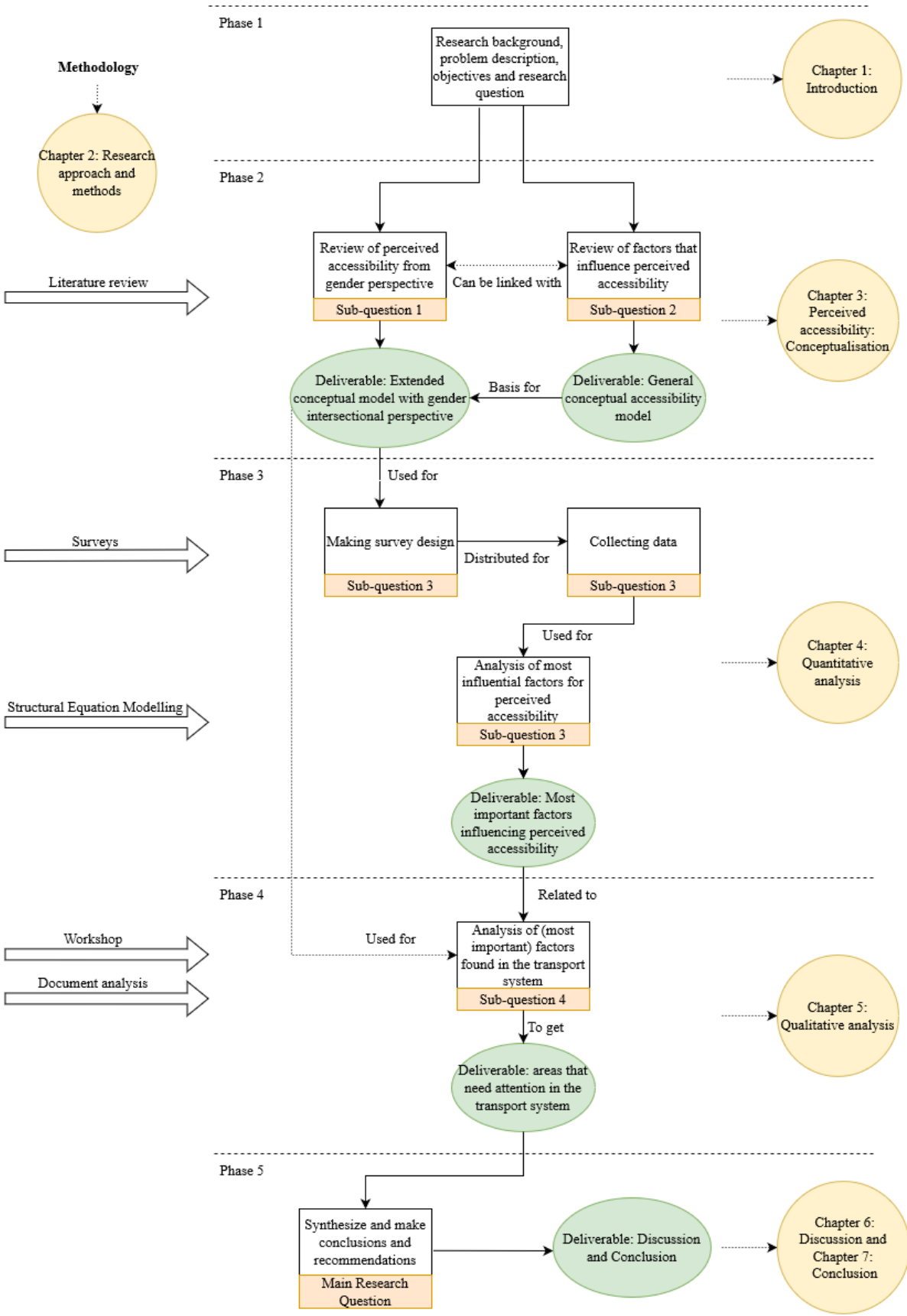

Figure 2 Detailed research design. Methods used for the various stages of the research are shown on the left with arrows. On the other side, the phases of the research are shown and connected to the sub-research questions and the research deliverables. The accompanying Chapters are shown in yellow circles.

2.2 Research methods

This Section elaborates on the methods used for the research, including desk research, quantitative and qualitative methods.

2.2.1 Desk research: literature review

The first step in the research will be to build a theoretical basis concerning perceived accessibility and the factors influencing it, hereby answering sub-research questions 1 and 2. To answer these questions literature will be very relevant as some research has already been done on this, therefore desk research, and more specifically literature reviews are used. A literature review will be very useful in this case as this method can be used to integrate previous findings and to create a basis for creating a conceptual model (Snyder, 2019).

The first sub-research question concerns investigating the factors that influence perceived accessibility according to the literature. To answer this question a specific search term and selection process (see Appendix C.2) will be used to select articles which include perceived accessibility and discuss the factors that (could) influence it. Using these articles a large list of factors and their relationships can be made, where overlapping factors can be grouped together. Next, this list can be used to make the general conceptual accessibility model showing the complex influence of various factors on perceived accessibility. To answer sub-research question 2, a gender intersectional perspective will be added to the conceptual model made previously. To achieve this, literature will be selected (see Appendix C.3) and analysed to find how gender can be connected to mobility and accessibility. Using this information, the conceptual model made can be extended into the extended conceptual model with gender intersectional perspective by including the found gender and intersectional factors.

2.2.2 Quantitative method

This section presents the method that will be used for the quantitative part of the research. First, the survey used for data gathering is explained (Section 2.2.2.1), after which the statistical method is elaborated on (Section 2.2.2.2). Lastly, the selected data-analysis tool is introduced (Section 2.2.2.3).

2.2.2.1 Survey

To perform a quantitative analysis, data will be needed. As no data is available which includes the factors of interest, a survey will be used to gather data. A survey can be described as a "*systematic method for gathering information from (a sample of) entities for the purposes of constructing quantitative descriptors of the attributes of which the entities are members*" (Groves et al., 2009, p. 2). In this case, the survey will be used to gather data from a sample of people who live in The Netherlands with which, using the statistical method that is explained in the next section, conclusions can be drawn with regard to the population in The Netherlands and their different experiences in the transport system. The survey questions will be made based on the factors found in the desk research. A more detailed description of the survey questions will therefore be given in Section 4.1, after the factors influencing perceived accessibility are identified. Additionally, descriptives of the data will also be presented in Chapter 4. To make the (online) surveys, Qualtrics will be used. The survey will be available in three languages, being the languages that the makers of the survey are fluent in: Dutch, English and Brazilian Portuguese.

The survey will be distributed in various ways. Firstly, the author's own network, as well as that of a fellow Master student, will be used to distribute the survey. Secondly, the survey will be distributed via social media, specifically Facebook and LinkedIn. Lastly, flyers with a QR code to the survey will be distributed in the author's own neighbourhood (in Leidschendam-Voorburg), as well as in Delft and Rotterdam.

2.2.2.2 Structural Equation Modelling

The main method that will be used for the quantitative analysis is Structural Equation Modelling. In this section, this general method is explained, after which the specific steps taken in using this methodology for this research are discussed.

Structural Equation Modelling in general

In the quantitative part of the research the impact of the factors found to (potentially) influence perceived accessibility in The Netherlands will be investigated. To do this, a quantitative approach will be used. More specifically, Structural Equation Modelling (SEM). SEM is an extension of path analysis (Streiner, 2006), and a very useful statistical tool (Thakker, 2020) A Structural Equation Model is used to "*test or validate a theoretical model for theory testing and extension*" (Thakkar, 2020, p.1,). Thus, based on theory, relationships between factors can be assessed simultaneously in one model that includes multiple equations (Thakkar, 2020). Another useful aspect of SEM is that it can test hypotheses across samples using a multiple-group analysis (Bagozzi &Yi, 2012). This way it can be tested whether the influence variables have on each other is the same for different groups (Bagozzi & Yi, 2012), e.g. for men and women. A SEM is often used for confirmatory purposes, but can also be used as an exploratory technique (Schreiber et al., 2006).

To put together and use SEM, various steps are conventionally gone through. Firstly, the basis of a Structural Equation Model is theory. Therefore, theory needs to be gathered and investigated before going on to the next step: model specification (Thakkar, 2020; Bollen & Noble, 2011). In this next step, the model is constructed based on theory. Here it is relevant that various types of variables can be included in SEM, namely:

- **Latent variables** *(graphically represented as an oval)*: These variables cannot be measured directly, but can be seen as an underlying factor which can be measured by multiple other variables. (Thakkar, 2020)
- **Observed variables** *(graphically represented as a rectangle)*: These variables can be observed directly, for example, the age of people. (Thakkar, 2020)
- **Exogenous variables**: These variables can affect other variables in the model, but are not affected by any of the other variables. Exogenous variables can be latent variables or observed variables, depending on the model construction. (Schreiber et al., 2006)
- **Endogenous variables**: These variables are influenced by exogenous variables and/or other endogenous variables. Endogenous variables can be latent variables or observed variables, depending on the model construction. (Schreiber et al., 2006)

Once these different types of variables have been used to construct the model, the gathered and prepared data can be put in and the model can be tested (Thakkar, 2020) In this testing phase, the model is run using an appropriate available estimation method (Enders & Bandalos, 2001), after which it is important to investigate the model fit of the model (Bollen & Noble, 2011). A relatively large variety of model fit indices exists with which the model fit can be assessed, of which usually a select number are chosen to test the model fit. Given the cutoff values that are relevant for the different indices according to literature, it can be assessed whether the model fits the data well or not (Hu & Bentler, 1999). If the model fit is acceptable (or even good), the results can be presented and interpreted (Thakkar, 2020).

Using SEM, paths can thus be investigated between different (latent) variables (Streiner, 2006). This is a very useful functionality for this research, as it is of interest through which in-between factors gender and intersectional factors impact perceived accessibility. Having been used before for similar studies (e.g. Friman et al., 2020b; Wang et al., 2021), it is a method that is well suited for this type of research.

To use a Structural Equation Model properly, a sufficiently large sample will be needed. The specific sample size that is needed varies drastically per case, however, a rule of thumb is that there should be at least ten cases for each variable (Wolf et al., 2013). This limits the size of a SEM model if there is a limited sample size. A weakness of SEM is that it can provide correlations, but cannot conclusively prove causations (Bullock et al., 1994). This shows the value of the consequent qualitative validation research stage.

Structural Equation Modelling process for this research

To perform this research, a specific modelling process will be used, wherein multiple models will be made: a simple model with two intersectional sub-models, a general model and two intersectional models. Before these models can be constructed, the data needs to be prepared for the models. Next, this modelling preparation is elaborated on, after which the construction and testing of the different models is discussed.

Modelling preparation

Before the models will be constructed, the data acquired from the survey needs to be examined to find whether all variables can be used for the model. For this, two things are important: for each variable more than one answer option for this variable needs to be represented in the data set for it to be able to add information to the model, and the data of the endogenous variables in the model need to be normally distributed. This last element is important because of the estimation method used for the Structural Equation Model: Maximum Likelihood Estimation. (Full Information) Maximum Likelihood Estimation has been shown by Enders & Bandalos (2001) to be especially effective, compared to other methods, in estimating models which include some missing data points. This is relevant for this research to deal with missing values that will likely exist in the data, due to, for example, respondents who do not wish to disclose some specific information like income. However, for this estimation method, a normal distribution of the variables is important to get a reliable outcome. To examine the normality of the different variables, the Skewness and Kurtosis values will be useful. Research by Curran et al. (1996) has shown that a kurtosis value higher than 7.0 (or lower than -7.0) and a skewness value higher than 2.0 (or lower than -2.0) can cause significant problems in SEM because of the extent of non-normality in these variables. This is something that will be considered when constructing the model.

Secondly, as this is a complex model with a large number of factors, it is worth examining whether any similar factors can be made into one factor, which can be done by adding the scores up to make a sum score. To make sure that factors are similar enough to do this, a Confirmatory Factor Analysis (CFA) can be used. A CFA is similar to SEM, however, the goal of a CFA is to analyse whether a set of measured factors is similar enough to be part of a single factor (Bagozzi & Yi, 2012). When a measured factor has a factor loading of at least 0.5, it is usually seen as sufficiently similar to the other measured factors in the model (Hair et al., 2009). To further check the reliability of adding factors into one sum score, it is commonplace to investigate Cronbach's alpha, a measure of reliability (Bagozzi & Yi, 2012). The common rule of thumb, in this case, is that the Cronbach's alpha of the similar factors should be higher than 0.7 (Taber 2018). By walking through these steps it can be determined whether multiple factors can be included in one sum score. The steps used in preparing the data for the model is shown in Figure 3.

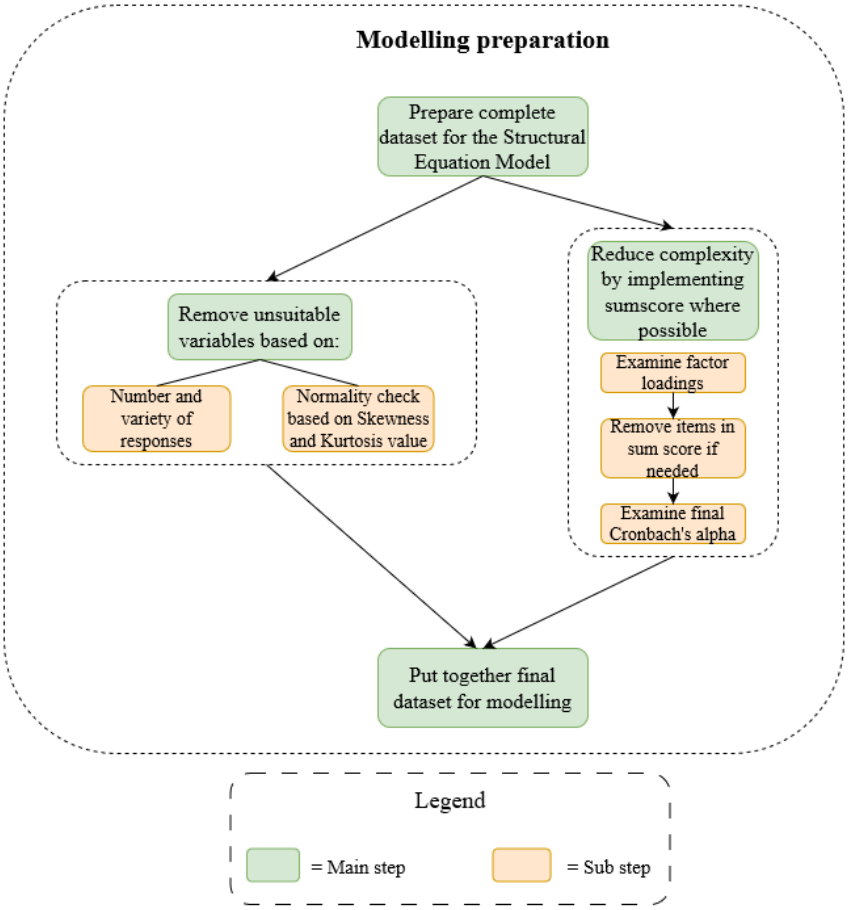

Figure 3 Modelling preparation. The Figure shows the steps (green) and sub-steps (orange) that will be used to prepare the data for the Structural Equation Model.

Simple model

Once the data has been prepared, the models can be constructed and tested. Firstly, before the general model based on the conceptual model is introduced, a 'simple' model will be made in which only the socio-demographic variables and the latent factor of perceived accessibility will be included. This way, it can be investigated whether any direct relationships exist between these socio-demographic variables and perceived accessibility. To examine this, the socio-demographic factors and perceived accessibility will be included in one Structural Equation Model.

Next,, the model can be run, after which the model fit will be examined. For this examination, three model fit indices which are conventionally used will be investigated, being the Chi-square probability, the CFI value and the RMSEA value (Hu & Bentler, 1999). If these values are within the appropriate range as shown in Table 2, e.g., if the Chi-square probability value is higher than 0.05, this means the model fits well with the data, and that results are reliable and can be interpreted.

Table 2 Model fit indices and their cutoff values

	Cutoff value
Chi-square probability	> 0.05 (Bagozzi & Yi, 2012)
CFI	> 0.95 (Hu & Bentler, 1999)
RMSEA	< 0.06 (Hu & Bentler, 1999)

To also look at intersectional results in this simple model, the data will be split up to make a model using data from women and a model using data from men. In these two new models, the factor gender will be removed as this does not include any new data when the model is only used for one gender. Next, the

same process is gone through as for the simple model with all data included, where the model fit is examined after which the results can be interpreted. The processes gone through for all three simple models are shown in Figure 4.

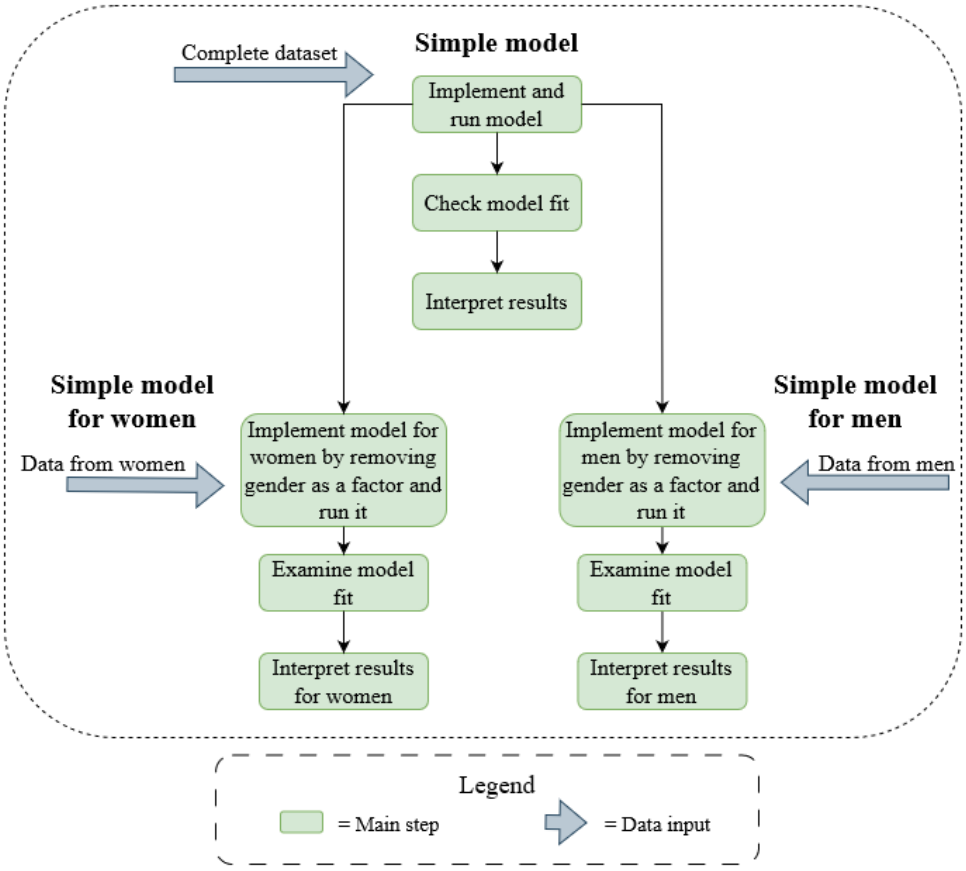

Figure 4 Modelling process for simple model. At the top of the Figure the steps for the simple model are shown. Below, the similar steps gone through for the simple model just for women and just for men are shown.

General model

Next, a general model will be made by translating the conceptual model made into a Structural Equation Model. To end up with a well-working model, multiple steps will be gone through, similarly to the simple model, as shown on the left side of Figure 5. To construct the model the factors in the final data set can be included in one Structural Equation model. The model will be run after which non-significant relationships (with a p-value > 0.05) will be removed incrementally to reduce complexity and make a more parsimonious model. Once only significant relationships remain in the model, the model fit will be examined in the same way as explained for the simple model, and if found to be good or acceptable, results can be interpreted.

Intersectional models

After this general model, it is of interest how the relationships between factors differ between women and men. To examine this a multigroup analysis will be done, where the data from women and the data from men will be used for two separate models. For both models, the same model will be used as for the general model, as shown on the right side of Figure 5, however, the factor of gender will be removed as this factor does not add any new information when only data from one gender group is used. The same process can be used to get to reliable results as described for the general model, where first the non-significant relationships are removed separately for each model, after which the model fit can be examined and the results can be interpreted.

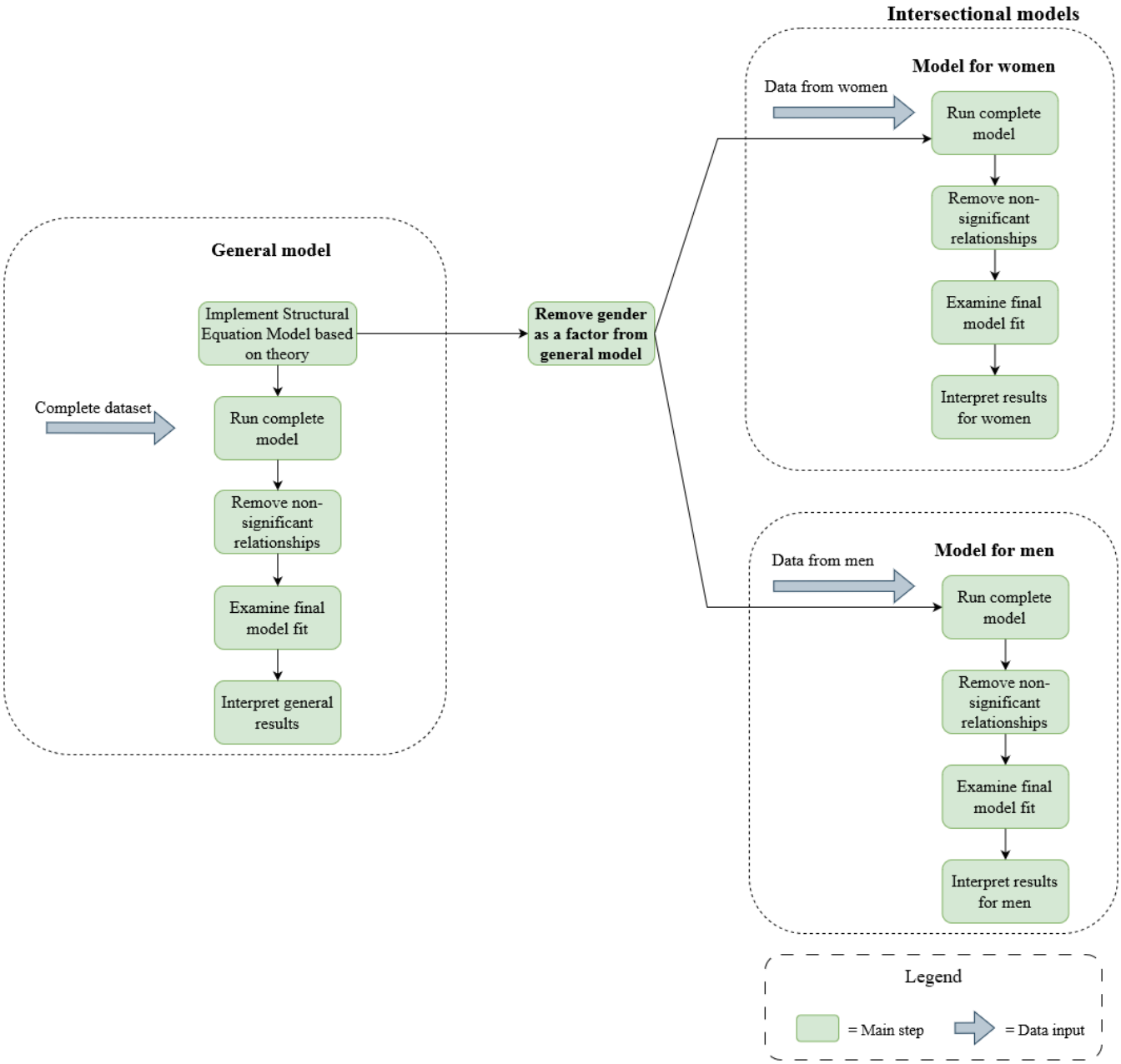

Figure 5 Modelling process of general and intersectional models. The left side of the figure shows the steps gone through to construct the general model. The right side of the figure shows how the general model is changed to get the intersectional models for men and women.

2.2.2.3 Data-analysis tool

Structural Equation Modelling can be done using various tools. In this research, the choice is made to use Amos. Amos can be used to confirm a theory and uses Machine Learning to estimate a SEM (Puteh & Ong, 2017), making it a useful software tool for the research. Amos has several advantages. For example, its graphical interface helps in building models which are easy to understand visually. Additionally, it can be used to make models using data from different populations and it has the ability to reflect complex relationships in attitudinal models quite well (Thakkar, 2020). Another advantage of Amos is that it does not require complex programming language knowledge for its operation (Purwanto & Sudargini, 2021).

2.2.3 Qualitative method

To answer sub-question 4, two methods will be used. Firstly, a workshop with experts will be organised to get a further understanding of the main factors in the context of the transport system. Secondly, document analysis will be done to obtain supplementary information on the subjects that come forward in the workshop

Further understanding of the transport system and related gender components will first be obtained through a workshop. A workshop is very useful as it can "*produce reliable and valid data about the domain in question*" (Ørngreen & Levinsen, 2017, p.72). It can thus be used to get real-world data that can be connected to the quantitative results, which is very fitting for this research. For this workshop, people with different points of view will be invited as this can give a balanced view of the transport system.

To get appropriate data for the workshop, its structure will be designed to consist of three main parts as shown in Figure 6. The first part will consist of a presentation (see Appendix F.1) in which the research will be introduced and the main results from the quantitative analysis will be shown. This way participants are informed about the content of the research. Next, participants will be asked to use their knowledge to connect the main results from the quantitative analysis to the past, current, and future transport system in The Netherlands. To provide structure, an online Miro board will be used as shown in Appendix F.2. Finally, a general discussion will be held to reflect on the findings of the workshop.

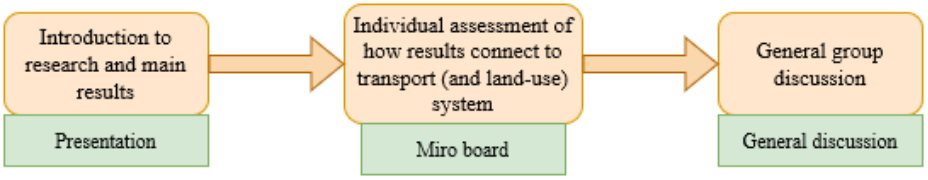

Figure 6 Structure of workshop with steps used (in orange) and the tools used for each step (in green)

The workshop will thus result in two data sources that can be used. Firstly, the Miro board will include each participant's notes on their thoughts about the various subjects. Additionally, the discussion afterwards will be transcribed to have another source of data. For both these two sources of data, an overview will be made in the form of a Table in the results section.

To get some further information on subjects brought up in the workshop, (formal) documents, being reports or agreements from/between public institutions like municipalities or from public transport companies, will be used. Documents can be used to get a good description of the world (Owen, 2014), and can thus be very useful in this case to get more information on real-world practices. Using documents from public institutions like national ministries or municipalities, but also from other institutions like public transport companies, some additional real-world practices with regard to the subjects from the workshop can be elaborated on.

3. Perceived accessibility: Conceptualisation

In this paper, perceived accessibility is a central subject and the main dependent factor of investigation. Two concepts that are important for the context of perceived accessibility are accessibility and social exclusion. In Section 3.1 these concepts are introduced using state-of-the-art literature to make the context of the research clear. After this, it is important for the research to find what factors potentially affect perceived accessibility. Therefore, next, a literature review is done to answer the following sub-research question:

Sub-question 1 (SQ1): *What factors influence perceived accessibility?*

To be able to give context to the research and to answer the above research question, first papers are selected based on criteria explained in Appendix C. Next, the selected papers are analysed to find factors found to influence perceived accessibility in literature, as presented in section 3.2. In Section 3.3 these factors are used to make a general conceptual accessibility model. Next, a gender intersectional perspective is added to this model to answer sub-question 2:

Sub-question 2 (SQ2): *How can perceived accessibility be conceptualized from a gender intersectional perspective?*

To answer this second question, papers selected using the process described in Appendix C are analysed to find how gender connects to the perceived accessibility framework, which is shown in Section 3.4. Finally, Section 3.5 presents the extended conceptual accessibility model with a gender and intersectional perspective.

3.1 Social Exclusion and Accessibility

In this Section, the core concepts that lie at the basis of the research are elaborated on, being accessibility, social exclusion and its connection to gender, after which the concept of perceived accessibility is discussed.

3.1.1 Accessibility in Transport

A well-functioning society needs a certain level of accessibility to destinations by various transport modes (van Wee, 2016). Not surprisingly, this concept has thus gained attention in the last two decades, both in science and policy (Geurs & van Wee, 2004; Ryan & Pereira, 2021; van Wee, 2016). However, there is still no consensus on the exact meaning of accessibility. Various definitions are used in studies. Some examples are: "*the extent to which land-use and transport systems enable (groups of) individuals to reach activities or destinations by means of a (combination of) transport mode(s)*" (Geurs & van Wee, 2004, p. 128) or the "*ease with which people can access goods and services*" (Curl et al., 2015, p. 1). The common factor in most definitions is that they include both activities or destinations and travel resistance (van Wee, 2016).

Accessibility to opportunities can be seen as the result of four components: the land-use component, the transportation component, the temporal component and the individual component (Geurs & van Wee, 2004). These four components interact in various ways, making accessibility different for various populations and individuals. There are various ways in which accessibility levels can be determined. Geurs & van Wee (2004) group these ways into four basic perspectives on the measurement of accessibility:

- **Infrastructure-based measures**: concerns the performance of transport infrastructure, for example, by measuring the level of congestion
- **Location-based measures**: concerns the level of accessibility in reaching spatially distributed destinations, for example, by measuring the number of jobs that can be reached in 30 minutes.
- **Person-based measures**: analyses accessibility from an individual perspective, for example, the activities a person can participate in in a certain timeframe

- **Utility-based measures**: concerns the economic advantage that people get from accessing various, spatially distributed, destinations and activities

Each of these measures looks at the journey times between origins and destinations, to various extents (Curl, 2013). Two measures that are very commonly used in research and determining policy are sub-measures of location-based measures: contour (or cumulative) measures and potential (or gravity) measures (Curl, 2013). Using contour measures, it can be determined how many opportunities or members of the population can be reached from the origin within a certain time threshold (Curl et al., 2011). On the other hand, potential measures are based on work by Hansen (1959) and calculate accessibility based on the distance between origins and destinations, where longer distances mean there is a decreasing attractiveness (Curl, 2013; Curl et al., 2011).

The various ways of measuring accessibility that exist, mean that determining what measure to use needs careful consideration, keeping the goal and possibilities of a study in mind. Especially, as accessibility measures are commonly used to determine policy and transport investments, which can improve accessibility and therefore well-being (Pereira, 2019). From an equity perspective, it is important that measures pay attention to the individual component. Common measures like the described contour and potential measures however tend to pay little attention to the heterogeneity in individual characteristics (Ryan & Pereira, 2021). Yet, these characteristics can be very important, as various countries, especially Europe and North America, want to include equity aspects in their transport planning and accessibility metrics (Pereira, 2019). Person-based accessibility measures can be used in this regard, which looks at the interaction between transport, locations, and personal characteristics (Ryan & Pereira, 2021). However, these measures tend to not look at subjective views on accessibility, something which is especially relevant as this subjective view is the main factor that will influence the choices individuals make with regard to transport and mobility (Ryan & Pereira, 2021).

3.1.2 Social exclusion

One reason why people's accessibility levels are important is the relationship between accessibility and social exclusion. There are multiple reasons why it would not be wanted for certain groups of society to have lower (perceived) accessibility. While it is in itself undesirable, a lack of accessibility can also result in transport-related social exclusion (Busco et al., 2023; Mejía-Dorantes & Soto Villagrán, 2020). This transport-related social exclusion can be defined as people being excluded from (part of) society due to their lack of access to activities which are essential for social inclusion (Ryan & Wretstrand, 2019). Exclusion can occur based on seven dimensions (Busco et al., 2023):

- Physical exclusion
- Geographical exclusion
- Exclusion from facilities
- Economic exclusion
- Time-based exclusion
- Fear-based exclusion
- Space exclusion

The reduction of social exclusion has become a key subject over the years for scholars, as well as policymakers around the world (Dobbs, 2007; Montoya-Robledo & Escovar-Álvarez, 2020). One important area that can be affected by transport disadvantage and social exclusion is employment. As stated by Gupta & Bhamoriya (2021, p. 8) "*Mobility is a key feature of labour force participation*". This means that inadequate transport facilitation can curtail job opportunities for certain groups. Groups that are generally seen as more vulnerable to transport disadvantage and thus social exclusion are "*the elderly, people with health problems, women, the unemployed, low-income people and adolescents*" (Busco et al., 2023, p. 2). In this paper, gender and intersectional factors are central, therefore the next

section will go more specifically into what type of impact gender can have on accessibility and transport-related social exclusion.

3.1.3 Gender and social exclusion

Several studies point to potential transport-related social exclusion aspects for women. Thynell (2016) shows that women tend to depend more on public transport, even if that means that they will miss out one better work or higher incomes. Furthermore, women are more inclined to prioritize short commuting distances over higher-paying jobs (Gil Solá & Vilhelmson, 2022). Both of these factors show that there is a risk of social exclusion from certain employment opportunities when they are less accessible, especially for women. This adds a double disadvantage, given the disadvantages that women already face in employment because of their caretaker obligations (Dobbs, 2007). Another factor with regard to gender and social exclusion that is very relevant as shown by Lo & Houston (2018) and Gil Solá & Vilhelmson (2022) concerns the activity space of women. In general, women are shown to have a higher fixity in space and time (Lo & Houston, 2018), meaning that they tend to travel less far than their male counterparts. In itself, this does not necessarily point to social exclusion, as women could just want to do activities that happen to be closer to home. However, research by Gil Solá & Vilhelmson (2022) notes that while men tend to compensate for a lack of nearby activities by travelling further distances, women tend to limit activity participation. Thus, in places where one has to travel further to reach activities, there is a bigger risk of women being socially excluded. This shows the importance of good (perceived) accessibility from a gender perspective.

3.1.4 Perceived accessibility

The risk of social exclusion and its connection to perceived accessibility shows why perceived accessibility is an important concept. The concept of perceived accessibility was already recognised in the 1970s (Morris et al., 1979), however, it has only recently started to gain more attention in research (Curl et al., 2011; van Wee, 2016). Perceived accessibility looks at the individual dimension of accessibility (Lättman et al., 2018). It takes into account factors like subjective feelings, expectations, perceptions and satisfaction (Vitman-Schor et al., 2019) and complements the objective, calculated, approach (Lättman et al., 2018). Doing a separate study on perceived accessibility is very relevant, as various studies (e.g. Curl, 2013; Laatikainen et al., 2017; Lättman et al., 2018) have shown that perceived accessibility can be significantly different from calculated accounts of accessibility. This may not be surprising as the individual's perceptions of the transport system around them, which can include factors like perceived safety and service quality, affect their perceived accessibility (Friman et al., 2020b). Given that perceived accessibility will be the main determinant for people when they make their transport and mobility choices, this is an important measure from an equity and social exclusion perspective (Pot et al., 2021).

Perceived accessibility is a difficult factor to give a value to as it considers people's perception, which is not something that can be objectively measured. Additionally, two different types of perceived accessibility can be established. Firstly, one can measure the perceived accessibility of a specific destination like a supermarket and secondly, one can measure the overall perception of accessibility (Tanimoto & Hanibuchi, 2021). The overall perception does not look into the accessibility of specific destinations but does include people's feelings of (in)convenience in their day-to-day lives (Tanimoto & Hanibuchi, 2021). This overall perception of accessibility is the focus of this thesis. To measure the overall perceived accessibility of people, the Perceived Accessibility Scale was developed by Lättman et al. (2016b). In this scale, four questions are asked to determine an individual's perceived accessibility, either with a specific transport mode (Lättman et al., 2016a) or in general (Friman et al., 2020b).

Given the relevance of the overall perceived accessibility for equity and social exclusion, establishing a complete framework of the various factors that can affect perceived accessibility and therefore play a part in any inequities with regard to these factors is extremely relevant. This is discussed further in the next Section.

3.2 Factors influencing perceived accessibility

The first sub-question which is researched is: *What factors influence perceived accessibility?* To answer this question a literature review is done. The approach used in finding articles for the literature review can be found in Appendix C.2. In the next section, the found factors are presented and described. Based on this a general conceptual accessibility model can be made to which gender and intersectional factors can be added in the next part.

An analysis of the articles found as described in Appendix C.2 was done to find all the factors which influence perceived accessibility according to literature. A significant amount of factors were found. Some were the same or similar and therefore grouped under one name. Others were related but not the same and were therefore grouped into one category. The resulting categories and factors are elaborated on next, after which an overview of the categories and factors influencing perceived accessibility can be found in Table 3.

Perceived safety

Perceived safety has been shown by Lättman et al. (2016a) and van der Vlugt et al. (2019) to have a significant effect on perceived accessibility. This can be explained, as a person who does not feel safe using a certain type of transport will be less inclined to use this type of transport which inhibits the ease with which they can go about their lives. For example, it has been well documented that women often feel less safe travelling at night (Abenoza et al., 2018; Yavuz & Welch, 2010), this can make it more difficult for them to (comfortably) do the activities they want to do at night. Perceived safety can be related to two main factors. Firstly, the physical surroundings of someone in their residential area can make them feel more or less safe (Jamei et al., 2022). Secondly, aspects of (public) transport itself can make them feel safer, e.g. the service quality of Public Transport (Jamei et al., 2022).

Primary transport mode

Various studies have shown that someone's main transport mode (Lättman et al., 2018, 2019) or the frequency with which they use a certain transport mode (Tanimoto & Hanibuchi, 2021; van der Vlugt et al., 2019) affects their perceived accessibility. The study by Lättman et al. (2019) shows a positive effect of having a car or walking as a main transport mode of perceived accessibility among older people in Northern Europe. Another study by Lättman et al. (2018) also presents the results which show that the average accessibility significantly differs for people in Sweden if they have a different main transport mode. Furthermore, car availability has been shown to have a significant effect on perceived accessibility (van der Vlugt et al., 2019) as well as frequency of driving, using public transport (Lättman et al., 2016a), cycling and walking (Tanimoto & Hanibuchi, 2021).

Socio-demographic factors

Socio-demographic factors can be grouped under the individual component, as was done by Pot et al. (2021). However, in this case, it is kept separate because of the large influence of socio-demographic variables on perceived accessibility, which has been shown by various papers. In these papers, the factors that were found to have an impact are:

- *Age*: Various studies have shown older people to have lower perceived accessibility (e.g. Lukina et al., 2021; Tanimoto & Hanibuchi, 2021). One interesting result from the study by Lättman et al. (2016), is that next to older people, people around the age of 34 also have a considerably lower perceived accessibility. The study argues that this may be due to people of this age more often being parents of dependent children, which significantly changes their activity patterns.
- *Education*: Some studies show that education has a significant impact on perceived accessibility, while others do not find this in their results (Jamei et al., 2022). Results in the studies that do find a significant effect differ, with Lukina et al. (2021) finding that people with

the highest level of education have a lower perceived accessibility, while van der Vlugt et al. (2022) find that having a higher education means having a higher (walking) accessibility.

- *Gender*: The effect of gender on perceived accessibility is not entirely clear, with some showing that being a woman has a positive effect on perceived accessibility (e.g. Friman et al., 2020a), while in others there is no relationship between gender and perceived accessibility (e.g. Márquez et al., 2019) (Jamei et al., 2022).
- *Disability/health*: As would be expected, various studies like the ones by Márquez et al. (2019) and Tanimoto & Hanibuchi (2021) show that being of poor health or having a disability has a negative effect on perceived accessibility, due to people's limited physical mobility.
- *(Household) income*: Multiple studies have shown a significant effect of income on perceived accessibility. However, the direction of this impact is not entirely clear, as Márquez et al. (2019) show a positive effect while van der Vlugt et al. (2019) show a negative effect.

(Perception of) service quality

Service quality can have an important impact on perceived accessibility, as is also noted by Jamei et al. (2022). Service quality mostly relates to Public Transport. However, this does not mean it is irrelevant for a general framework. Public Transport availability has an important impact on perceived accessibility (Pot et al., 2020). Better service quality of public transport will make more people see it as an option making general perceived accessibility better.

Various papers discuss the parts that together can be seen as service quality. They vary in different ways. Some include transport cost and time, however, in this paper, this will be included in the perception of the transport system. Based on the sources presented in Table 3, the factors that together are understood to constitute service quality are:

- *Information* (e.g. Jamei et al., 2022; Sukwadi et al., 2022)
- *Functionality* (e.g. Jamei et al., 2022; Lättman et al., 2016a)
- *Comfort* (e.g. Jamei et al., 2022; Lättman et al., 2020)
- *Courtesy* (e.g. Jamei et al., 2022; Lättman et al., 2016a)
- *Simplicity* (e.g. Lättman et al., 2016a; Pot et al., 2020)

Individual component

Some factors that impact perceived accessibility are understood to be unique for different individuals and cannot be grouped under the other variables.

Temporal constraints of activities and personal temporal constraints which are mentioned by Pot et al. (2021) are split up in this paper. Personal temporal constraints are understood to be the temporal constraints for travelling someone has based on their own time schedule and activities they need to do. For example, if a person has three or more activities they need to do in a day, some transport modes will be too slow to be able to do this. Or, someone could have to travel at night, when availability of public transport is low.

Transport flexibility is mentioned by van Wee (2022) as a factor which can impact perceived accessibility. This factor considers how easy people find it to switch to another (main) transport mode. High flexibility could mean that more efficiency can be achieved in getting to destinations.

There are various types of abilities. Pot et al. (2021) mention examples of abilities like being able to read online public transport timetables or finding the right information. Another ability which could impact perceived accessibility is whether someone is allowed to drive a car. This could, in turn, affect car availability which is relevant with regard to perceived accessibility (Curl, 2018) as well as the amount of transport options someone has to get to a destination.

Social environment

Two factors have been grouped under social environment. Firstly, a person's social network can impact someone's perceived accessibility as it constitutes the help people can get from other people to do their necessary activities (van Wee, 2022; Pot et al., 2020). For example, if a person cannot drive, but they do have a person in their social network who will drive them to destinations like the hospital this will likely increase their perceived accessibility.

Social norms is another factor that impacts perceived accessibility (Pot et al., 2020). Mainly, this factor impacts someone's main transport mode, as some people will feel that a certain transport mode is more acceptable. Some people might feel that Public Transport is more acceptable as it is more environmentally friendly and used more by people in their environment. Others may feel taking the car makes one look more professional in their professional environment and is generally used more by people in their environment. This will give a certain pressure to take a certain transport mode. Additionally, it may directly impact perceived accessibility as the expectation of accessibility can change based on social norms.

(Perception of) physical environment

The land-use system, presented as a factor which influences perceived accessibility as shown by van Wee (2022) and Pot et al. (2021), has been renamed in this paper to (Perception of) physical environment to include a number of factors, based on the sources presented in Table 3:

- *Residential area*: what kind of neighbourhood does a person live in. (e.g. Jamei et al., 2022; Tanimoto & Hanibuchi, 2021)
- *Rate of choice destinations*: How good does a person think the activities they can participate in are? (Pot et al., 2021; van der Vlugt et al., 2019)
- *(Perception of) activity distribution*: How does a person think activities are distributed in their environment? (Pot et al., 2021; van Wee, 2022)
- *Awareness of activities*: does a person know all the possible activities they can do in their environment? (Chen et al., 2022)

These factors show the perception of people of their environment, which is a relevant part of how well they think they can reach the activities they want to do.

(Perception of) temporal component

(Perception) of temporal component is one of the main parts of the model of perceived accessibility made by Pot et al. (2021). It reflects the temporal possibility people have to participate in activities. Perception of travel time is grouped under this category and concerns people's perceptions of their (potential) travel times (Jamei et al., 2022). Perception of temporal constraints activities concerns the temporal constraints people think their preferred activities have (van Wee, 2022). For example, an interaction of personal temporal constraints and temporal constraints of activities can make an activity like grocery shopping less accessible for someone who works during the main opening hours of a grocery store.

(Perception of) transport system

Another factor shown by Pot et al. (2021) to have an important impact on perceived accessibility is (perception of) the transport system. Pot et al. (2021, p.3) include "*Perceptions of transport supply*" and "*perceptions of travel resistance*" in this category. Perceptions of the transport supply include the perceptions someone has of the possibilities for transport in their environment. Perception of travel resistance can include many factors like comfort, safety, time and cost. However, in this case, some of these factors are so important that they have been addressed separately in this model (comfort in service quality and safety as a separate factor, for example). Cost is therefore the main part of travel resistance

in this model. Another factor which has been added to this category is the perception of transport modes, which is mentioned by Chen et al. (2022) and van der Vlugt et al. (2019) to be an indicator of perceived accessibility. For example, if someone has a negative view of Public Transport, this can either mean they avoid it, which limits their travel options or mean they are generally unsatisfied with this transport mode when they use it. A summary of all (categories of) factors can be found in Table 3.

Table 3 Factors which have a relationship with perceived accessibility as found in literature

Factors with an impact on perceived accessibility	Transport mode	Paper(s)
Perceived Safety	General, walking, PT	Friman et al., 2020b; Jamei et al., 2022; Lättman et al., 2016a; van der Vlugt et al., 2019
Primary transport mode	General	Lättman et al., 2016, 2019, 2020; Pot et al., 2020; Tanimoto & Hanibuchi, 2021; van der Vlugt et al., 2019
Socio-demographic factors (van Wee, 2022)		
Age	General, Sustainable transport, PT	Curl, 2018; Friman et al., 2020a, 2020b; Jamei et al., 2022; Lättman et al., 2016a, 2019; Liu et al., 2021; Lukina et al., 2021; Tanimoto & Hanibuchi, 2021
Education	General, walking	Jamei et al., 2022; Lukina et al., 2021; van der Vlugt et al., 2022
Gender	General, sustainable transport, walking, PT	Friman et al., 2020a, 2020b; Jamei et al., 2022; Lättman et al., 2019; Lukina et al., 2021; Tanimoto & Hanibuchi, 2021
Health/disability	General, walking	Márquez et al., 2019; Tanimoto & Hanibuchi, 2021; van der Vlugt et al., 2019
(Household) income	General, walking	Jamei et al., 2022; Márquez et al., 2019; Tanimoto & Hanibuchi, 2021; van der Vlugt et al., 2019, 2022)
(Perception of) service quality		Friman et al., 2020a; Jamei et al., 2022; Pot et al., 2020; Sukwadi et al., 2022
Information	PT	Jamei et al., 2022; Lättman et al., 2016a, 2020; Pot et al., 2020; Sukwadi et al., 2022
Functionality		Jamei et al., 2022; Lättman et al., 2016a, 2020
Comfort		Jamei et al., 2022; Lättman et al., 2020; Pot et al., 2020; Sukwadi et al., 2022
Courtesy		Jamei et al., 2022; Lättman et al., 2016a
Simplicity		Lättman et al., 2016a; Pot et al., 2020
Individual component		Pot et al., 2021; van Wee, 2022
Personal temporal constraints	General	Pot et al., 2021; van Wee, 2022
Transport flexibility		van Wee, 2022
Abilities		Pot et al., 2020; van Wee, 2022
Past experiences		Lättman et al., 2020; Pot et al., 2021
Social environment		Chen et al., 2022
Social network support	General, PT	Al-Rashid et al., 2021; Pot et al., 2020; van Wee, 2022
Social norms	General, PT	Al-Rashid et al., 2021; Pot et al., 2020
(Perception of) physical environment		Lukina et al., 2021; Pot et al., 2020, 2021; van Wee, 2022
Residential area	General, sustainable transport	Friman et al., 2020a; Jamei et al., 2022; Lättman et al., 2018; Tanimoto & Hanibuchi, 2021
Rate of choice destinations	General	Pot et al., 2021; van der Vlugt et al., 2019
(Perception of) activity distribution	General	Pot et al., 2021; van Wee, 2022
Awareness of activities	General, bike	Chen et al., 2022
(Perception of) temporal component		Pot et al., 2021; van Wee, 2022
(Perception of) temporal constraints activities	General	Pot et al., 2021; van Wee, 2022
(Perception of) travel times	General	Jamei et al., 2022; Pot et al., 2021
(Perception of) transport system		Pot et al., 2021; van Wee, 2022
(Perception of) travel supply	General	Chen et al., 2022; Pot et al., 2021; van Wee, 2022
(Perception of) travel resistance (cost)	General	Friman et al., 2020a; Liu et al., 2021; van Wee, 2022
Perception of transport modes	General, bike	Chen et al., 2022

3.3 General conceptual accessibility model

Based on the factors found to influence perceived accessibility in the literature review and the relationships between them a general conceptual model is made which shows these factors. This conceptual model is presented in Figure 7.

The left of Figure 7 shows the socio-demographic components found to potentially impact perceived accessibility. These factors could affect the factors in the middle, as shown by the grey arrow pointing to the middle square, or directly affect perceived accessibility itself. The factors shown in the middle square are endogenous factors which can also impact perceived accessibility. Additionally, various factors can affect each other. The individual component, perception of accessibility components and service quality are all correlated to some extent (Pot et al., 2021). Primary transport mode and perceived safety are also correlated, as feelings of safety in certain transport modes can affect people's choice of transport mode, but the used transport mode will also affect feelings of safety in daily travel (Jamei et al., 2022). Perception of service quality can affect both perceived safety (Friman et al., 2020b; Lättman et al., 2016a) and primary transport mode, as a better service quality of public transport is likely to result in people using it more. Additionally, the residential area, with its specific socio-economic status, someone lives in can affect their perceived safety when travelling (Jamei et al., 2022), as well as past (unpleasant) experiences in transport (Lättman et al., 2020). Individual characteristics will have an impact on the primary transport mode. For example, if someone does not have the ability to drive a car they will likely not use the car as their primary mode, or if someone has significant time restriction they will choose the most convenient transport mode with regard to speed. Lastly, social norms also affect the primary transport mode someone uses (Pot et al., 2020). All these factors have the potential to affect perceived accessibility, as discussed in the previous sections, which is shown by the grey arrow connecting the centre square to the perceived accessibility oval. It should be noted here that due to the limited time and budget of this thesis, the effects that perceived accessibility has on other factors like well-being are not included in this research.

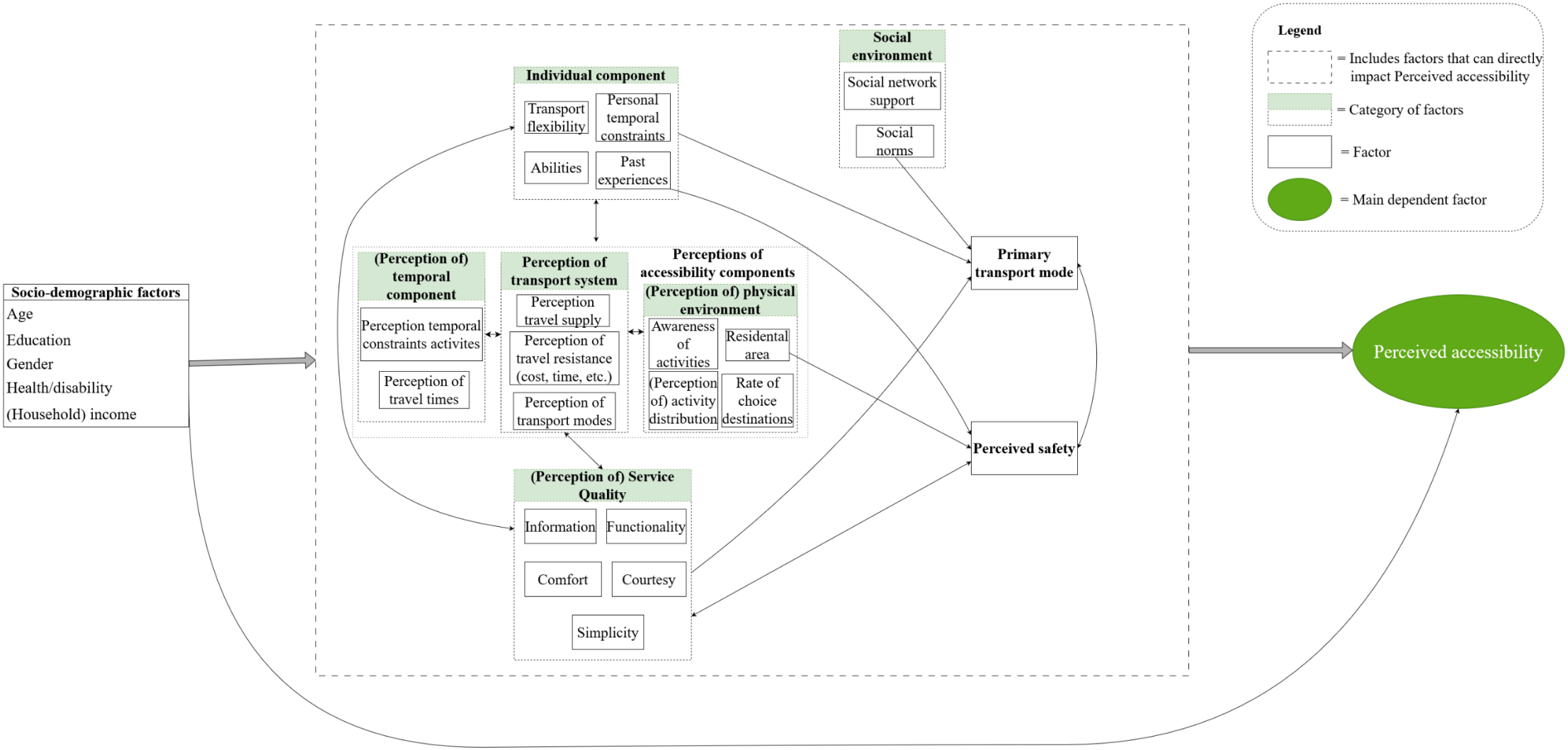

Figure 7 General conceptual model that shows how various factors affect each other and Perceived Accessibility

3.4 Relating gender and intersectional factors to transport, mobility and accessibility

The previous Sections have shown that accessibility is a broad concept and that there are various factors that can have an impact on perceived accessibility. The previous Sections also show that various papers have shown socio-demographic factors like gender, age and income to affect perceived accessibility. However, none of these papers explain how these socio-demographic factors affect perceived accessibility. In this research, gender equity is the primary subject. It is of interest how gender affects perceived accessibility. To be able to analyse this well, a gender intersectional perspective needs to be connected to the perceived accessibility conceptualisation from the previous Section.

To connect a gender perspective to the perceived accessibility conceptual model another literature review is done. First, the approach to this review can be found in Appendix C.3. Next, the main themes of the found literature are discussed, thus showing the main ways in which gender can impact transport and mobility behaviour.

To be able to get a better overview of how gender can potentially affect perceived accessibility, the effect of gender on mobility is looked further into. There are a number of ways in which gender affects mobility behaviour and therefore (potentially) accessibility. Based on categories of different travel behaviour as defined by Priya Uteng (2021) the next Section explores the gender differences with regard to experiences in the transport system.

Purpose of trips

Gender can have an impact on the purpose which people have in taking trips. While men's main purpose in travelling is often employment, women tend to be responsible to a higher level for caring for children or elderly relatives (Thynell, 2016). These purposes add to women's time and space constraints, causing them to generally work closer to home (Priya Uteng, 2021). This is also shown in research by Lo & Houston (2018) which shows that having children under 15 reduces the activity space of women, but not that of men.

Trip chaining

As shown in the purposes of trips, women tend to have multiple purposes when making trips, including employment but also caring and household activities. This results in women trip-chaining more than men (Mejía-Dorantes & Soto Villagrán, 2020; Montoya-Robledo & Escovar-Álvarez, 2020), meaning that they go to multiple activities in one trip. The consequence of this is a higher level of time poverty for women (Mejía-Dorantes & Soto Villagrán, 2020), especially given the fact that current transport provisions are not especially well suited for these multimodal trips (Bridgman et al., 2022).

Distribution and concentration of trips

Gender differences can result in different times of day to take trips. Security concerns as well as preferences mean that women take fewer trips in the late evening and night (Priya Uteng, 2021). Moreover, given the additional care responsibilities they have as mentioned before, the time they have for travel is reduced (Dobbs, 2007).

Car availability and driver's licence

The factor that has a lot of impact on mobility behaviour is whether people have a driving license and whether there is a car available to them. It is a very relevant factor as it can be very important for the needs fulfilment and independence of marginalized groups like older people (Luiu & Tight, 2021) and can give an additional sense of safety for women compared to public transport like buses (Gupta & Bhamoriya, 2021). However, traditionally, women have less access to a car and are less often in possession of a driving license (Dobbs, 2007; Gil Solá & Vilhelmson, 2022). While studies have shown that this difference in car availability and licensing has been converging in the global north in the last years, studies still show significant differences (Priya Uteng, 2021). For example, a study in Germany

showed that women still have much lower access to cars in households with only one car compared to their male partners (Priya Uteng, 2021). This supports the research from Dobbs (2007) which states that of the 87% of the women who live in a household with a car, only 29% has unlimited access to this car. In their discussion on the difference in access to cars Gil Solá & Vilhelmson (2022) mention three (possible) reasons:

1. Women are somewhat less often in possession of a driving licence
2. Women are generally more inclined to reduce car use as to spare the environment
3. Men are still dominant in the household negotiation about the use of a car and when a second car should be bought.

The first reason goes for all generations, however, it is especially relevant for older women, of whom the percentage without a driving license is much larger than that of men (Luiu & Tight, 2021). The third reason may seem somewhat old-fashioned. However, this could be a result of the status of breadwinner that the men still has in households, given that even today only 8% of the women in heterosexual relationships in The Netherlands make more money than their male counterparts, whereas in 51% of the cases the man makes more money (CBS, 2019a).

Trip durations and distances

Women tend to have averagely shorter travel times than men (Gupta & Bhamoriya, 2021; Lo & Houston, 2018), a trend which has however been converging in the last years (Priya Uteng, 2021). Yet, women still have transport needs that differ from men with regard to distance and frequency because of their unpaid roles with regard to care and the household, trips which have until recently not even been included in transport planning (Bridgman et al., 2022). The effect of care responsibilities on trip duration is also shown by Gil Solá & Vilhelmson (2022), who show that the presence of children causes a reduction in the activity space of women, but not in that of men.

Transport modes

Research shows that there is a difference in transport mode use between men and women. Generally, women use public transport and walk more than men (Montoya-Robledo & Escovar-Álvarez, 2020; Priya Uteng, 2021). A mode difference can also be seen with regard to cycling, however, it differs per country whether women cycle more or less, a factor which seems strongly connected to the culture and safety of cycling (See for example Graystone et al., 2022). Again, safety concerns can play a significant role in choosing a transport mode. Research in Sofia, Bulgaria shows that women tend to be more inclined to use taxis instead of buses due to safety concerns (Plyushteva & Boussauw, 2020). This is also interesting from an intersectional perspective as this gives additional disadvantage for low-income women who have to spend a larger percentage of their income on transport if they want to feel/be safe.

Safety and Security

It has been shown time and again that women have a lower perceived safety in transport and are more concerned with safety concerns when travelling (Busco et al., 2023; Dobbs, 2007; Mejía-Dorantes & Soto Villagrán, 2020; Montoya-Robledo & Escovar-Álvarez, 2020; Plyushteva & Boussauw, 2020; Priya Uteng, 2021). Especially travelling in the late evening and at night tends to be considered less safe by women, resulting in women restricting their mobility at night (Mejía-Dorantes & Soto Villagrán, 2020; Priya Uteng, 2021). Gender is not the only socio-demographic factor that impacts perceived safety. Weintrob et al. (2021) also show that people who are part of the LGBTQ community feel considerably less safe when travelling. Additionally, the elderly have also been shown to feel less safe in transport (Weintrob et al., 2021). Being part of multiple of these groups could thus cause additional disadvantages, which was also reported in the study by Weintrob et al. (2021) where the people who are part of the LGBTQ community who were interviewed also raised the effect of "double victimisation" if they looked like a woman to others.

3.5 Conceptual accessibility model with gender intersectional perspective

Now that it is more clear how gender can impact social exclusion and impact mobility, these factors can be related to the general conceptual accessibility model presented in Section 3.3. As noted, an important difference on account of gender is the taking up of care responsibilities. This factor can be impacted by gender, as women are still more often responsible for this, but is also impacted by income, given that it is easier for people living in a high-income household to afford external childcare. In turn, these care responsibilities can give people additional temporal constraints, a factor already represented in the general conceptual accessibility model.

The previous section has shown that access to a car and posing a driver's license are very relevant when talking about mobility and accessibility from a gender perspective. Literature shows that women in general have less access to a car and less often are in possession of a driver's license. Furthermore, household income can have a significant impact on these factors as well, given that in a high-income household it is easier to afford to have two or more cars. Having the option of taking the car gives one more option for travel which in itself can already improve perceived accessibility. Additionally, if a car is available, this will likely also result in the car being used more as a mode than if a car is not available. Next to this, age has an impact, as the gender gap in having a driver's license, and access to a car, is the biggest for elderly people.

Lastly, gender, in combination with other socio-demographic factors, can have an impact on transport modes that are used most often and on feelings of safety. Both these factors were already represented in the general conceptual accessibility model, however, given their importance the extended model shown in Figure 8 further emphasizes the effect of the socio-demographic factors on these factors.

The extended conceptual accessibility model with gender intersectional perspective is shown in Figure 8.

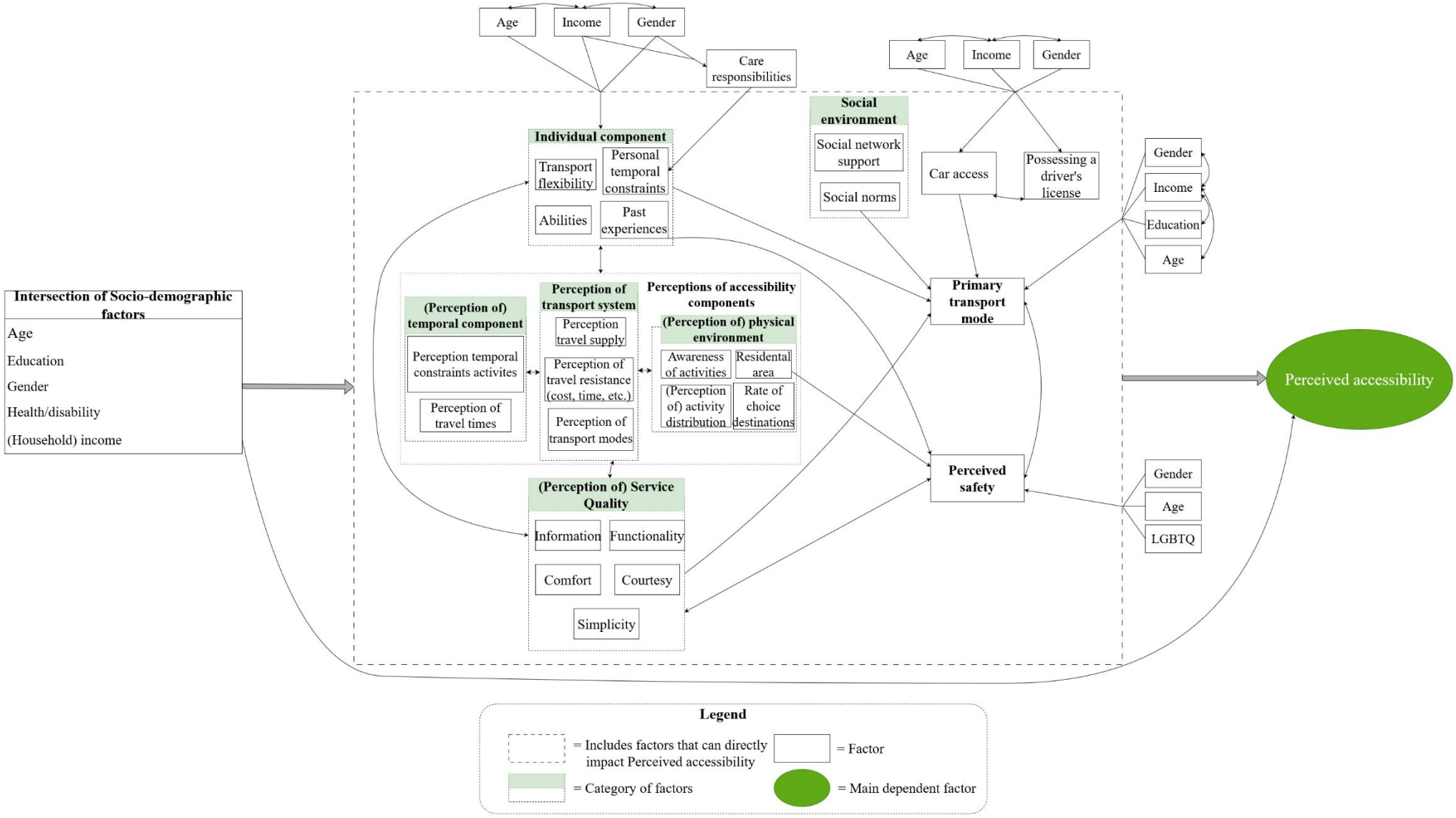

Figure 8 Conceptual accessibility model extended with gender and intersectional perspective. Socio-demographic factors are shown multiple times, outside of the dotted square, to show the gender and intersectional factors that are specifically relevant for various factors in the model.

4. Quantitative analysis

In this Chapter, the results of the Structural Equation Model are presented, as to find the answer to Sub-question 3:

Sub-question 3 (SQ3): *To what extent do the found factors impact perceived accessibility from a gender intersectional perspective in urban areas in The Netherlands?*

To answer this question, data is needed, which is gathered using surveys as described in Chapter 2. Therefore, the conceptual model presented in the previous Chapter needs to be translated into a survey. This process is described in Section 4.1. Next, the descriptives of the final data can be found in Section 4.2. In Section 4.3 an explanation is given for how the data is prepared for the models. After this, three different (groups of) models are presented, with in total 6 models. Firstly, the simple models are discussed in Section 4.4, where only the impact of the socio-demographic factors on perceived accessibility is shown. In the simple model with complete dataset, it can be seen whether any of these socio-demographic variables have a direct negative or positive relation with perceived accessibility. Additionally, a model is used for only the data from men and only the data from women to find intersectional factors that have a direct impact. Next, the general model with complete dataset is presented in Section 4.5, where relations between all factors included in the model are investigated for the total group including both men and women. Lastly, the data is split again to investigate a model with data from women and a model with data from men in Section 4.6, to potentially find further intersectional factors that are of importance.

4.1 Survey design

As for any quantitative research approach, data is needed to do the analysis. As no data is available which includes the factors that are to be investigated, surveys are used as a method to gather data. Therefore, the factors from the conceptual model have to be translated into understandable questions. The next section elaborates on this. Furthermore, the making of questions also includes scoping decisions, as investigating each factor from the model thoroughly would make the survey too long for people to feel motivated to fill them in. These decisions are therefore also elaborated on.

Perceived Accessibility

Perceived accessibility is the primary dependent factor in the conceptual model and therefore also in the statistical model. To measure perceived accessibility the choice is made to use the Perceived Accessibility Scale as developed by Lättman et al. (2016b). This Perceived Accessibility Scale uses four statements which can be answered on a Likert scale. It can be used for both testing perceived accessibility with a specific mode (Lättman et al., 2016) as well as testing perceived accessibility in the entire transport system. The scale has been tested (Lättman et al., 2016) and since used more often in research looking quantitatively into perceived accessibility (e.g. Al-Rashid et al., 2021; Friman et al., 2020b; Lukina et al., 2021). As this report looks into general equity problems with regard to perceived accessibility, and not just in one specific mode, the general Perceived Accessibility Scale as introduced by Lättman et al. (2018, p.506) will be used which uses the following statements:

1. "*Considering how I travel today it is easy to do my daily activities"*
2. *"Considering how I travel today I am able to live my life as I want to"*
3. *"Considering how I travel today I am able to do all the activities I prefer"*
4. *"Access to my preferred activities is satisfying considering how I travel today"*

This way the latent variable of perceived accessibility can be included which is measured by these four elements in the Perceived Accessibility Scale included in the survey.

Socio-demographic factors

The conceptual model includes five types of socio-demographic factors: Age, education, health/disability, (household) income and, of course, gender. For the survey, health/disability is disregarded. Although this factor is likely to have an impact on perceived accessibility, it is also a sensitive issue which means there would be additional risks when including it in a survey in which people could be re-identified. Furthermore, health/disability impacts people's physical ability to move, which will most likely reduce people's (perceived) accessibility. While an interesting subject, for this broad study the consideration is made that given the risk of including this question and the limited benefit as results are predictable, it is better to not include this factor.

Four socio-demographic factors remain which are tested. Respondents can answer multiple choice questions about their age, highest finished level of education and what gender they identify as. With regard to income, the choice has to be made whether to use household income or individual income, where household income seems to be used most often in perceived accessibility studies (see e.g. Chen et al., 2022; van der Vlugt et al., 2019). As discussed in the research into gendered factors in transport (Chapter 3), household income is very relevant as in a rich family, a woman could not be working and thus have no income while her partner has a very high income, which would give her advantages compared to a single woman with a low income. Therefore, household income is deemed important. However, some people live without a partner, making their individual income the same as their household income. Therefore to be able to make a good comparison, people living without a partner are asked for their income while people with a partner are asked for their joint income. This way, an average income per person can be determined and compared.

Individual component

The individual component in the conceptual model contains four factors: Personal temporal constraints, Past experiences, Transport flexibility, and Abilities. It is chosen to not include Past experiences in the survey and quantitative model as this is a very multi-faceted concept which would be better fitted for a qualitative study, with for example interviews with respondents. Additionally, the likely outcome would be that bad experiences in transport inhibit accessibility and vice versa, which would not add a lot of information.

Personal temporal constraints are included in two ways. Firstly, respondents are asked whether they have children and if so, in what age range. This way people with young children, who are likely to have caring responsibilities can be singled out, which, as explained in the theory, can affect people's temporal constraints. Secondly, a question is included which asks whether respondents feel restricted in their transport options because of having multiple activities in a row. This question combines temporal constraints with transport flexibility. Another question is included which purely focusses on transport flexibility and asks whether people feel they could still perform their travelling behaviour with other modes. With regard to abilities, it is chosen to focus on whether respondents have a driver's license for a car, as this factor was deemed relevant in the literature review on gender and accessibility/mobility factors. Other abilities, like for example literacy, abilities to get information on transport or physical abilities are thus not included to keep the model from becoming too complex.

Perception of accessibility components

The conceptual model also contains the Perceptions of Accessibility Components, which include, (Perception of) Temporal Constraints, (Perception of) Transport System and (Perception of) Physical Environment. Each of these three categories in turn includes multiple sub-factors. Including all these factors would make for a much too-long survey and an extremely complex model. Therefore the choice is made to exclude most of these factors. The reason that these factors are excluded and not other factors is that no indication was found in literature that these factors differ significantly based on the socio-demographic factors included in the study. Given that the main interest is to investigate differences

based on gender and other socio-demographic variables, this part is thus less relevant. However, to not exclude this part completely two questions are added to the survey based on two concepts that are central to accessibility: time and cost. By asking people to what extent they are satisfied with the time and cost of their transport, perception of travel times and travel resistance based on cost can be included in the model. Additionally, it is likely that income will closely relate to the socio-economic status of the residential area someone lives in (Jamei et al., 2022), therefore also giving an indication for the factor of the residential area.

Service Quality

As shown in the conceptual model, Service Quality contains several factors which can be taken into account. To keep the model from becoming too complex, it is chosen to ask one general question about Service Quality, with some examples of what to think about in answering the question which are the parts of Service Quality shown in the conceptual model.

Social environment

Social network support and perceived social norms are tested with one question each. For social network support a question aims to establish to what extent people feel someone in their network could take them to destinations they need to go to. Measuring social norms is more difficult and could be a study in itself. In this research, the choice is made to ask people what mode they feel is used most by people in their environment, which is one way to ask about norms as also used by, for example, Ababio-Donkor et al. (2020)

Primary transport mode

In asking for the respondents' primary transport mode there are two options which are both used in literature. Firstly, it can simply be asked what transport mode the respondent uses most in an average week, as to get one primary transport mode. (see for example Lättman et al., 2018). Another option is to ask people for the frequency with which they use the various most well-known transport modes (see for example van der Vlugt et al., 2019). In this research, the second option is chosen as it gives more information about the transport modes people use in their day-to-day lives. Respondents can indicate how often they use certain transport modes, ranging from (almost) never to multiple times a week.

Perceived safety

Perceived safety is an important factor in the model. To be able to ask good questions about this factor it is first important to understand the distinctions that can be made within the concept of perceived safety. Firstly, using different modes will cause different levels of perceived safety. For example, one could feel safer in a car than in public transport. Secondly, feelings of safety during the day and during the night can differ drastically (Mejía-Dorantes & Soto Villagrán, 2020; Priya Uteng, 2021). Therefore two latent variables are included in the model: perceived safety during the day and perceived safety during the night. For each, respondents are asked how safe they feel in different transport modes during that time of day on a 5-point Likert scale.

Additional gendered factors

Several factors have been added to the conceptual model based on a gendered view of transport. Firstly, care responsibilities. Various care responsibilities exist, however, in this research the focus is on childcare responsibilities. In this case, this is included in the survey by asking people whether they have children, and if yes, if they are below 5, between 5 and 12 or older than 12 years old. Herein it is assumed that people with children below 5 years old have the most care responsibilities, people with children between 5 and 12 still have care responsibilities but fewer as these children now go to school and people with children older than 12 have significantly fewer childcare responsibilities.

The access people have to a car is also very relevant in the conceptual model. Therefore the survey includes a question about the extent to which people are able to use a car, with a 5-point scale ranging from (almost) never being able to use a car to always being able to use a car. Lastly, another factor which was added to the conceptual model based on the research from a gender perspective is being part of the LGBTQ community. However, it was decided not to include this factor in the further analysis. Like health, asking about sexuality in a survey where there is a chance of people being re-identified is seen as very risky, and could potentially bring harm to these people if there was ever any kind of data leak. Additionally, the only factor it would impact in the model is safety. Thus while a very interesting factor and certainly interesting for further studies, for this study it is decided that the benefits of including it do not outweigh the risks.

The type of survey questions asked and scoping decisions made in establishing survey questions have now been explained. Various types of questions are used, the main ones being multiple choice questions about, for example, gender or highest level of education, and statements where people can indicate their agreement on a 5-point Likert scale. For all survey questions included in the survey see Appendix D.1.

Once the survey design is finished the survey is distributed. The online survey is distributed in various ways. Firstly, the author's own network is used for distribution, as well as that of a fellow Master's student with whom the survey was made and distributed. Secondly, social media is used to distribute the survey further, specifically Facebook and LinkedIn. Lastly, flyers with a QR code to the survey are distributed in the Author's own neighbourhood (in Leidschendam-Voorburg) as well as in Rotterdam. These ways of distributing data are very useful for getting data. However, they also have the potential to result in certain biases in the data. For example, given the network of the author, it is likely that there will be a relatively high percentage of well-educated white people in the sample, as well as a high percentage of young adults. In the next Section, the descriptives show to what extent these types of biases exist.

Some complications arose during the survey distribution, a detailed account of which can be found in Appendix D.3. Having dealt with these issues, the final data had to be cleaned, the process of which is also described in Appendix D.3. The final data set consists of 242 cases and is used in the next Sections for the quantitative analysis.

4.2 Descriptives

To get an overview of the final data, its descriptives are presented. Firstly, given that this research looks specifically at The Netherlands, it is interesting to see in what municipalities respondents in the survey live. A representation of this is shown in Figure 9. Next, the descriptives of the socio-demographic factors and perceived accessibility in the final data are shown in Table 4 and discussed. For a complete overview of the descriptives see Appendix E.

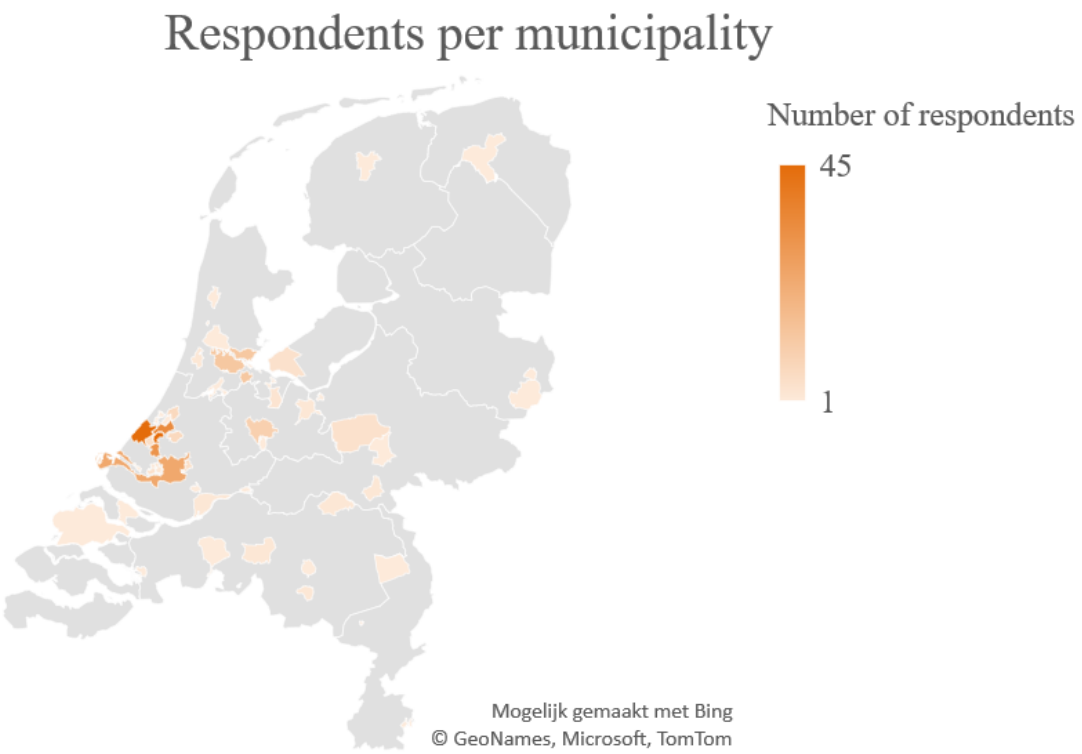

Figure 9 Graphical representation of the number of respondents per Dutch municipality

The descriptives of the socio-demographic data show that the model is not completely representative of the Dutch population. SEM is however a method that can deal with this well given that it looks at relationships between variables and not, for example, societal averages. Therefore, as long as groups of people in society are represented to some extent, this should not cause significant problems. The descriptives show that more women than men filled out the survey, this is not surprising as women tend to have more interest in gender equity subjects which could give them more incentive to fill out the survey. Furthermore, while there is a relatively large percentage of 18-25-year-olds, the other age groups are also represented in the data set. The only age group that is significantly underrepresented are the elderly (>75), which will be taken into account when discussing the results. The education level of the sample is rather high, with almost one-third having completed a WO master. However, the other education groups are represented as well. In this data, 13.2% of people have children younger than 12 years old, meaning a comparison can be made between people with young children and people without. With regard to income, there are quite some people in the lowest income groups, a large part of this group is presumed to be students given the network of the author and fellow survey distributor. The highest income groups have a rather low percentage of people, however, given that these incomes are on the high side this is not deemed unrealistic. It should also be noted that about 15% of the respondents chose the "prefer not to say" option under income. This will be included in the model as missing data, the presence of which has been taken into account when choosing the estimation method as discussed in Chapter 2.

It can be seen in Table 4 that perceived accessibility levels are overall quite high, with all items scoring at least 4 on a 5-point scale. This shows that in general, perceived accessibility is quite high in urban areas in The Netherlands. When looking at the means of the Perceived Accessibility Scale items for women and for men it can be seen that the average for women is considerably lower than that for men, as shown in Figure 10. This will be interesting to explore more in the coming Chapter.

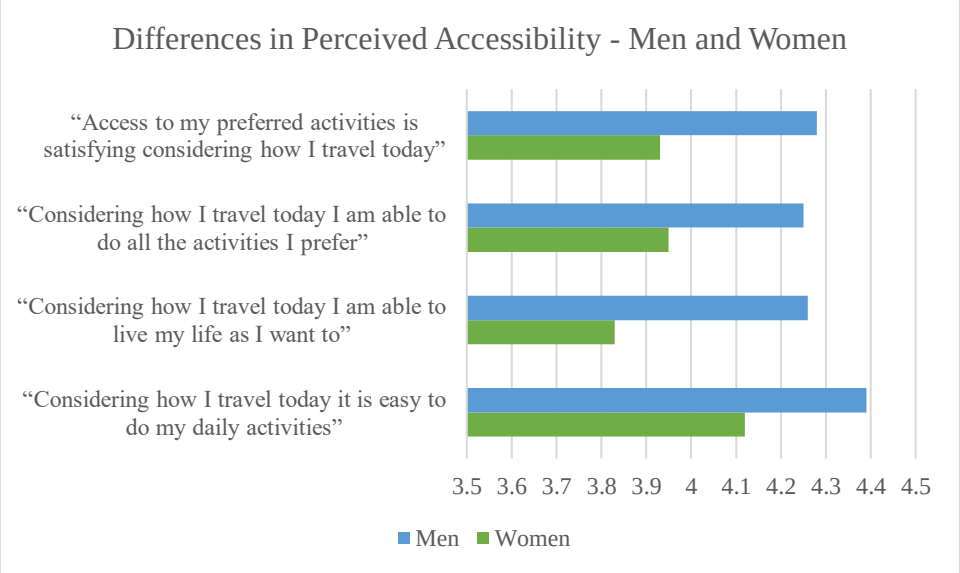

Figure 10 Differences in mean perceived accessibility levels between men (in blue) and women (in green), showing that women have an averagely lower score on all four perceived accessibility scale items.

Table 4 Descriptives of data

Variable	Questions	Mean		
		Overall	**Women**	**Men**
Perceived Accessibility *(Score on 5-point Likert scale)*	"Considering how I travel today it is easy to do my daily activities"	4.23	4.12	4.39
	"Considering how I travel today I am able to live my life as I want to"	4.00	3.83	4.26
	"Considering how I travel today I am able to do all the activities I prefer"	4.07	3.95	4.25
	"Access to my preferred activities is satisfying considering how I travel today"	4.07	3.93	4.28
	Range		**Percentage**	
Gender	Women		60.3%	
	Men		39.7%	
Age	18-25		27.3%	
	26-35		20.7%	
	36-45		16.1%	
	46-55		10.3%	
	56-65		16.1%	
	66-75		7.9%	
	> 75		1.7%	
Education level	Before secondary school		0.4%	
	Secondary School		7.0%	
	MBO		9.1%	
	HBO bachelor		23.1%	
	WO bachelor		16.1%	
	HBO master		9.5%	
	WO master		31.4%	
	PHD		3.3%	
Having Young Children (<12)	Yes		13.2%	
	No		86.8%	
Average Income	< €22,000 individual or together with partner		21.9%	
	< €22,000 average individual with partner		8.7%	
	€22,000 – €43,500		28.5%	
	€43,500 – €65,500		15.7%	
	€65,500 – €87,500		7.4%	
	€87,500 – €109,000		1.7%	
	> €109,000		0.8%	
	Prefer not to say		15.3%	

4.3 Model preparation

As discussed in the methodology section, the data needs to be prepared before the models can be implemented and tested. Thus, the survey data is inspected and prepared for modelling in the following ways. Firstly, three variables that are present in the survey are deleted upon further inspection. Feedback was received that the question about how often people use walking as a transport mode was perceived differently. Some people thought it only counted if their entire trip consisted of walking, while others thought walking to their car counted as well. As this variable also shows a much higher Skewness and Kurtosis value than the other variables (Appendix E) it is decided to exclude it from the model as it would not give insightful results and would not fit well with the model due to its non-normality. Secondly, it is noted that no people chose walking as the norm in their environment, and only less than 5% of people thought using the train was used most by people in their environment. Therefore these variables include very little information and also have a higher Skewness and Kurtosis value than the other variables. Therefore they are also not suitable for the model.

The general model will be a complex one with a lot of relations. To potentially reduce this complexity, it is tested whether the safety questions about different modes can be included into one safety sum score for the day and one safety sum score for the night. To test this, first, a Confirmatory Factor analysis is done in Amos. The resulting factor loadings are shown in Table 5.

Table 5 Factor loadings Safety Factors

Day safety			Night safety		
	Factor loading	**Factor loading after item removal**		**Factor loading**	**Factor loading after item removal**
Car safety Day	0.359	-	Car safety Night	0.182	-
Public Transport safety Day	0.744	0.721	Public Transport safety Night	0.714	0.713
Cycling safety Day	0.651	0.652	Cycling safety Night	0.845	0.846
Walking safety Day	0.750	0.773	Walking safety Night	0.906	0.906

For both day safety and night safety it can be seen that car safety has a factor loading lower than 0.5 in the initial model, a cutoff value that is common for Confirmatory Factor Analysis (Hair et al., 2009). This also makes sense when looking at the theoretical substantiation, as the question about safety was intended to capture social safety, for which it is not surprising that it would be different in the car than when using other modes. Therefore, car safety is not included in the sum score of day or night safety. The factor loadings of the remaining factors are also shown in Table 5. To further test that the resulting three factors can be made into one sum score, Cronbach's Alpha is calculated for both safety types. The Cronbach's alpha for the three Day safety factors is 0.75 and for the three Night safety factors is 0.86. Both these values are higher than 0.7 and therefore show that the variables can be combined into one sum score given the commonly used rule of thumb (Taber, 2018). Therefore, for both Day safety and Night safety the three safeties are combined into one sum score. Next, the different types of models as described in Chapter 2.2.2 are implemented.

4.4 Simple model results

Before the general model based on the conceptual accessibility model with a gender intersectional perspective is presented, a very basic model with only the socio-demographic variables and perceived accessibility is made. This way, it can be checked whether these factors have a direct significant relation with perceived accessibility by themselves. The representation of this Structural Equation Model is presented in Figure 11. It should be noted that in the model that is implemented in Amos, the exogenous factors shown are allowed to correlate. However, to keep model representation consistent and easy to read these correlations are not included in model representations.

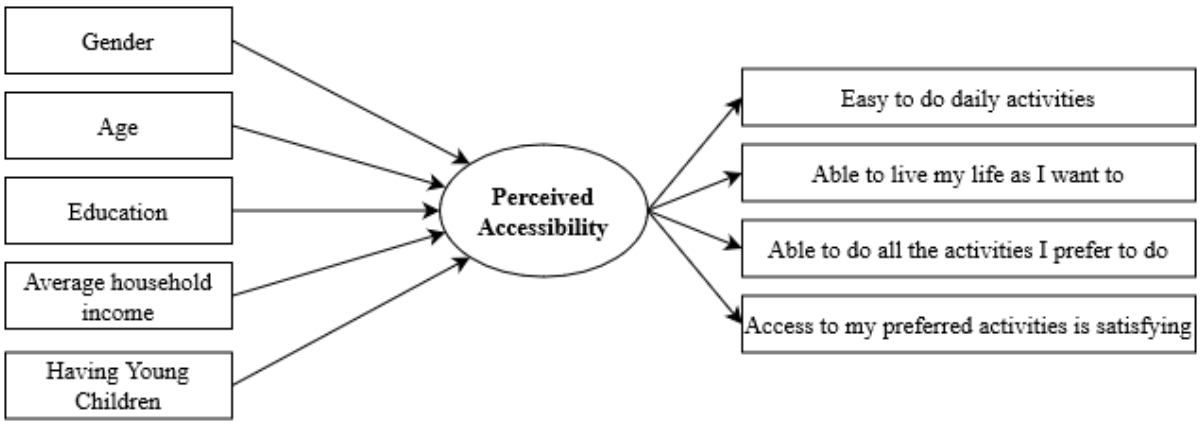

Figure 11 Graphical representation of simple model, with the socio-demographic variables included on the left side and perceived accessibility and its measuring variables on the right side.

Before the results of this model are discussed, it is first important to check the model fit to make sure that the model fits the data well enough. In this case, the model fit of this model is good by common standards (RFI = 0.991, RMSEA = 0.043, Probability level = 0.120) (see Hu & Bentler, 1999). Next, it is also relevant to investigate whether the used items on the Perceived Accessibility Scale have sufficiently high factor loadings. The factor loadings are shown in Table 6. Given that each item has a score higher than 0.5, it can be said that the scale works well (Hair et al., 2009).

Table 6 Factor loadings of items on Perceived Accessibility Scale

Perceived Accessibility Scale item	**Factor loading**
Easy to do daily activities	0.681
Able to live my life as I want to	0.801
Able to do all the activities I prefer to do	0.884
Access to my preferred activities is satisfying	0.919

The simple model gives two interesting insights, as shown in Table 7. Firstly, gender is the only one of these factors that significantly impacts perceived accessibility at a 5% confidence interval. The simple model shows that being a woman reduces the perceived accessibility of a person (-0.219, p = 0.001). Secondly, although income is not significant at the 5% level (with a p-value of 0.052) it comes very close to being significant at this level and is significant at a 10% confidence interval.

It is furthermore of interest if the relations between the socio-demographic variables and perceived accessibility are different for women and men. To analyse this further, the same model is used to analyse only the group of men and only the group of women, where the factor of gender in the model is removed. The model fit of this model is still acceptable and within the common standards (CFI = 0.994, RMSEA = 0.034, Probability Level = 0.216). Interestingly, the simple models for men and for women show that the impacts are different for men and women. For women, income is the only variable that is significant and impacts perceived accessibility positively (0.265; p = 0.021). For men, income does not significantly impact perceived accessibility, however, age does. Surprisingly, for men, age positively impacts

perceived accessibility (0.258, p = 0.039). To explain this relationship it is important to acknowledge that people older than 75 are not well represented in the data set. Therefore the positive relationship between age and perceived accessibility for men mainly indicates that middle-aged men have a higher perceived accessibility than younger men. This relationship is thus not caused by the higher income of men of older age, but could perhaps have something to do with the places they live which could be more accessible. The intersectional model in Section 4.6 may give more explanation for this relationship.

The standardized results of the simple model are shown in Table 7.

Table 7 Standardized, (almost) significant results of simple models

	Perceived accessibility	P-value
Simple model		
Gender	-0.219	0.001
Income	*0.167*	*0.052*
Simple model with data from women		
Income	0.265	0.021
Simple model with data from men		
Age	0.258	0.039

Now it is clear that certain demographics, especially gender, income and age have a direct effect on perceived accessibility. Next, it is of interest whether it can be explained how these factors affect perceived accessibility through the factors identified in the conceptual model. To do this first a model for the entire sample is created where the direct effect of gender can be investigated, as well as that of the other factors (the general model, Section 4.5). After this, the model is used to investigate the group with women and the group with men separately (the intersectional models, Section 4.6).

4.5 General model results

To investigate how the identified factors from the literature reviews impact perceived accessibility in urban areas in The Netherlands, the conceptual model is simplified and translated into a SEM model in Amos, using the data from survey questions explained in Section 4.1, which has been prepared as described in Section 4.3. The model is constructed in Amos. As the model in Amos has too many relations between factors for its graphical representation to be insightful, a representation of the model in Amos is shown in Figure 12. In this model, factors are allowed to correlate if they do so in the conceptual model. Additionally, factors on the same level are allowed to correlate. The different levels are the exogenous variables, factors impacted by exogenous variables and impacting perceived accessibility, factors impacted by exogenous variables and other endogenous variables and impacting perceived accessibility, and perceived accessibility itself, which does not impact anything else in this research. All factors in the dotted square in Figure 12, as well as the socio-demographic factors, (can) directly impact perceived accessibility (PAC) in the general model. Gender, age, education and income impact all factors within the dotted square in the general model, while having young children (12 or younger) only impacts a select number of factors shown in the model, as based on the conceptual model.

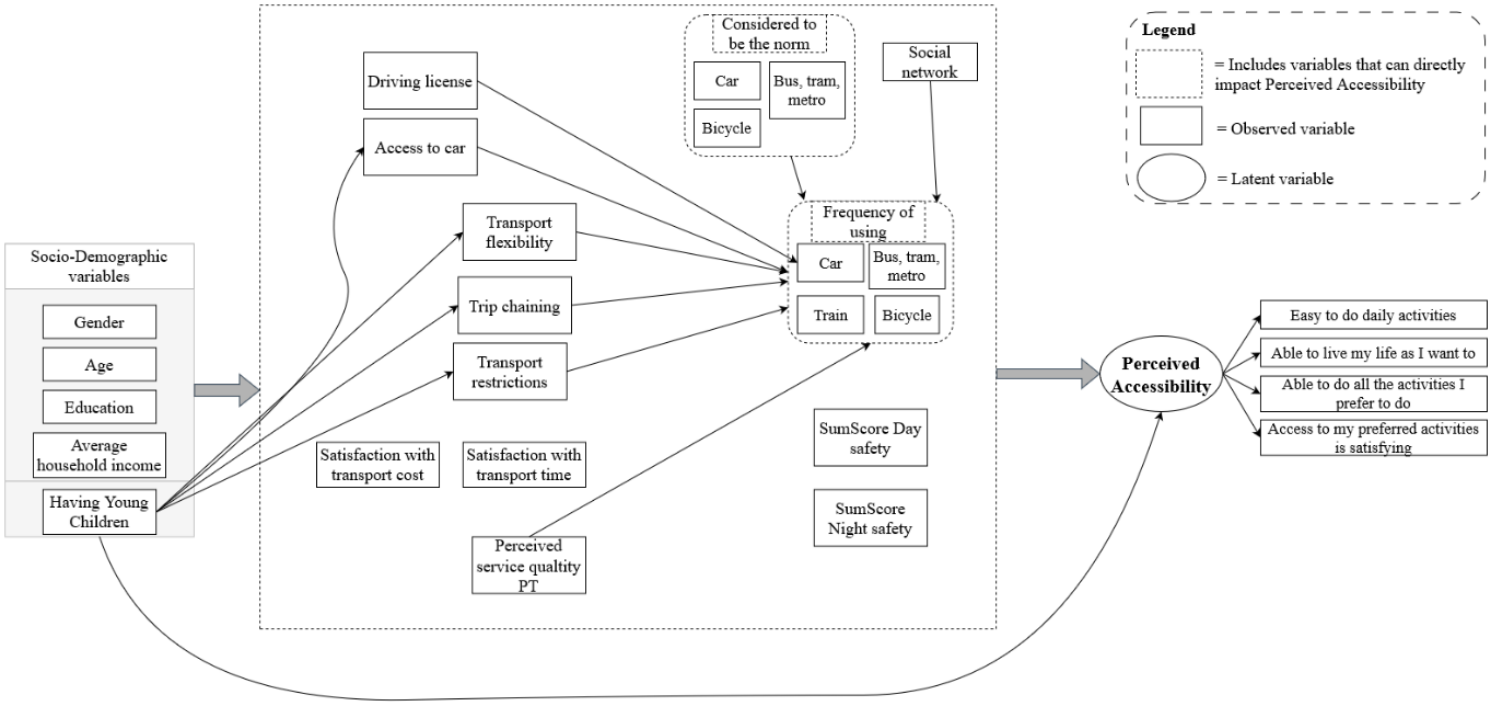

Figure 12 Representation of the general model as implemented in Amos. The socio-demographic variables on the left can affect all variables in the dotted square, which in turn can all directly affect Perceived Accessibility. Additionally, the black arrows show (potential) relationships between the various variables based on literature.

The general model as represented in Figure 12 is implemented in Amos and run. Next, non-significant relations between factors are removed incrementally to get a parsimonious model. Running the resulting model shows that the model had a good model fit, considering conventional standards (CFI = 0.995, RMSEA = 0.015, Chi-Square Probability level = 0.279) (Hu & Bentler, 1999). The standardized results of the final model are shown in Table 8 and Table 9, the two are split up to increase the readability of the Tables.

Table 8 Standardized results of general model

	Endogenous variables														
Socio-Demographics	Driving license	Car access	Car Use	Cycle Use	Train Use	BTM use	Transport in-flexibility	Transport restrictions	Day safety	Night safety	Satis - faction time transport	Satis-faction cost transport	Satis-faction SQ	Social network	PAC
Gender									-0.230	-0.391					
Age	0.184	0.431	-0.102						-0.248	-0.248	0.163	0.135			
Education		-0.158				0.120						-0.129	-0.122	-0.224	
Income					-0.230	-0.122				0.130					
Young children		0.198					-0.121	0.162							
Endogenous variables															
Driving license															0.140
Car access			0.806	-0.256	-0.436	-0.418									0.196
Transport restrictions			0.126		-0.256										-0.149
Day safety															
Night safety															0.221
Satisfaction time transport															0.255
Satisfaction cost transport															
Satisfaction service quality PT															0.267
Social network															
Trip Chaining															
Transport inflexibility			0.115		-0.138	-0.171									
BTM use															-0.171
Norm BTM					-0.243										
Norm Cycle					-0.312	-0.173									
Norm Car					-0.421	-0.215									

Table 9 Standardized results of general model: Socio-demographic impact on norms

	Norms		
Socio-demographics	Car Norm	Bicycle norm	BTM norm
Age	0.378	-0.242	-0.163
Education	-0.166	0.145	

In Tables 8 and 9, numerous relations between variables can be seen. In Table 8 the various relationships between the socio-demographic variables, the endogenous variables and perceived accessibility are shown. Table 9 presents the relationship between the socio-demographic variables age and education and car, bicycle and bus, tram or metro as the norm, which have no further relationship with perceived accessibility. For example, Table 9 shows that with higher age, people are more likely to see the car as the most used mode in their environment, as shown by the positive relationship. The next section will explore these results, where first the general significant effects are shown, after which the relationships between socio-demographic variables and perceived accessibility are zoomed in on.

To give an overview of the relevant results that were significant in the model, the input model shown in Figure 12 is changed to show significant relationships between de endogenous factors and perceived accessibility in Figure 13. In this Figure, the factors shown in green have a significant effect on perceived accessibility in the model, the strength of which is shown in the accompanying numbers. Arrows shown in grey were not shown to have a significant relationship, while arrows in black are. The impacts of the socio-demographic variables that were also included in the general model are discussed further on.

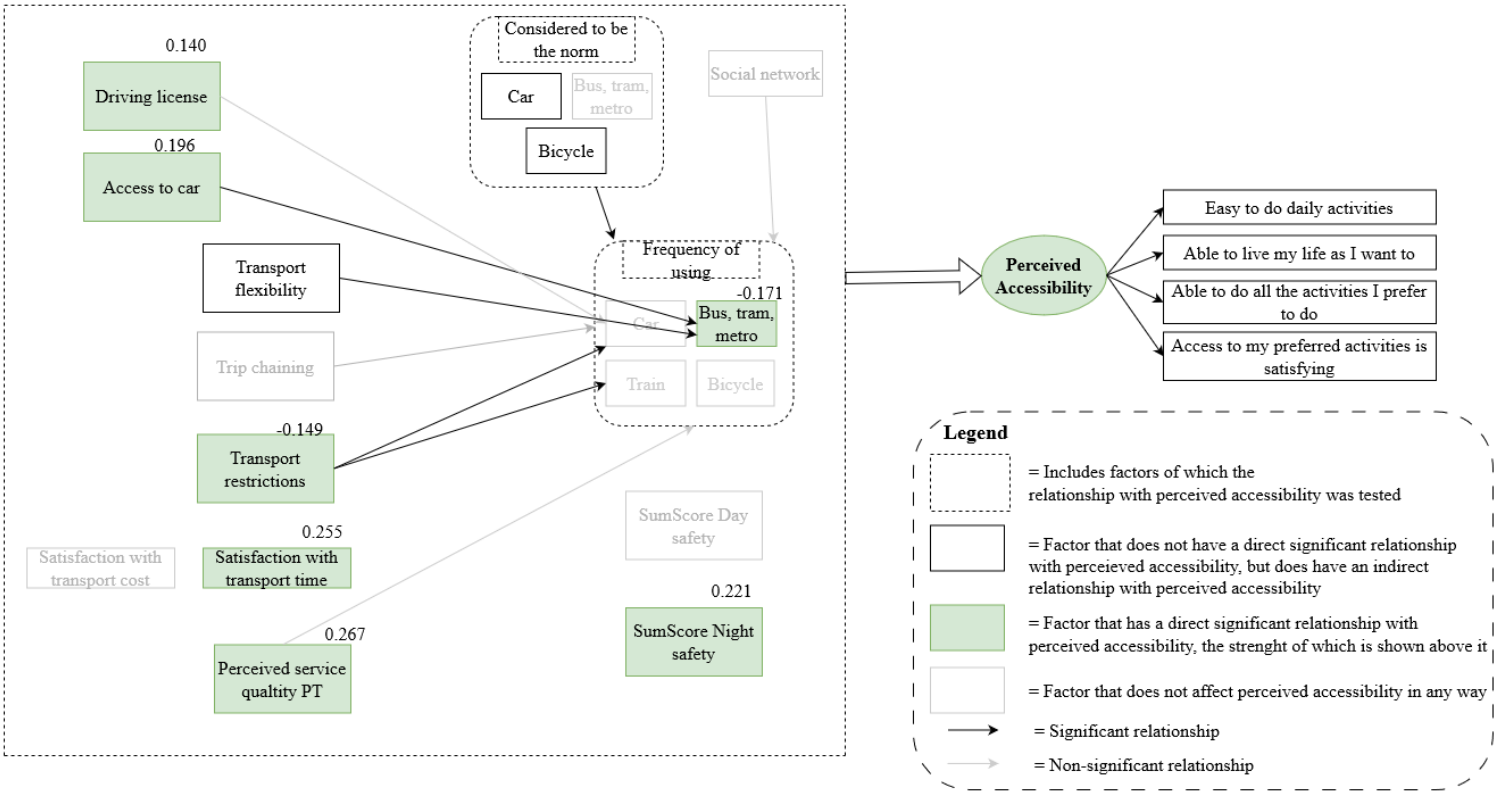

Figure 13 Representation of results general model. The Figure shows to what extent the various factors, excluding the socio-demographic variables, affect perceived accessibility as found in the general model.

As can be seen in Figure 13, four factors do not have any relationships with either perceived accessibility or any other endogenous factors: Social network, Trip Chaining, Satisfaction with transport costs and the Day safety factor. Some of these factors are impacted by certain socio-demographics. For example, education has a negative relationship with social network, which can likely be explained by the high

percentage of well-educated expats in the sample (30.3%), which will be elaborated on in the next part. However, from this model, the conclusion can be drawn that the factors shown in grey in Figure 13 do not relate significantly to people's perceived accessibility in The Netherlands.

All factors shown in green in Figure 13 have a significant relationship with perceived accessibility. The factors with the strongest effects are Perceived service quality of public transport, Satisfaction with transport time, and Perception of night safety. Other factors, like having a driver's license, have a lower impact on people's perceived accessibility. Some factors, like transport (in)flexibility, only have an indirect effect on perceived accessibility, mainly through the use of bus, tram or metro.

Each socio-demographic variable affects at least one other factor, however, to represent this in one figure would not be beneficial for its clarity. The next section discusses in depth how the different socio-demographic variables affect perceived accessibility using different Figures. It should be noted that all relationships between socio-demographic variables and perceived accessibility as presented in Figures 14 through 18 are found in the same general model as presented in Figure 12.

Gender is the factor that is the main focus of the research. The model shows that gender mainly impacts perceived safety. Both during the day and during the night, perceived safety is significantly lower for women. This impacts perceived accessibility for women in a negative way, as perceived safety at night has a positive impact on perceived accessibility. This path is shown in Figure 14.

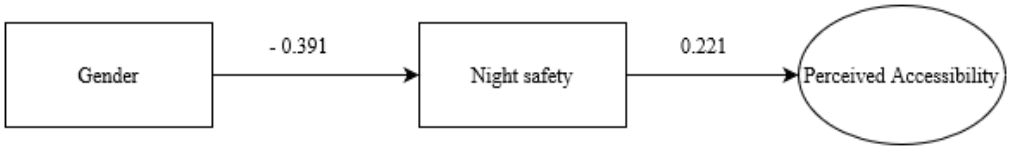

Figure 14 Indirect relationship between Gender and Perceived Accessibility found in general model. The numbers above the arrows show the strength (standardized) of the relationship.

Age affects various variables in different ways as shown in the general model. With increased age, the chance of having a driving license becomes higher, as well as having access to a car. However, the actual use of a car becomes lower with increased age, which can perhaps be explained by these people driving to work less often. Both perceived safety during the day and during the night become lower with increased age, as was also hypothesized in the conceptual model. However, counterbalancing this effect is the fact that with increasing age comes a higher satisfaction with both the cost and time of transport. Moreover, age also positively impacts seeing the car as the norm, while it reduces seeing the bicycle or the tram, bus or metro as the norm. Thus, age impacts perceived accessibility positively through the variables of driver's license, access to a car and satisfaction with time of transport. However, it impacts perceived accessibility negatively through perceived night safety. This can explain why there was no significant direct effect of age on perceived accessibility in the simple model. Figure 15 shows how age indirectly affects perceived accessibility.

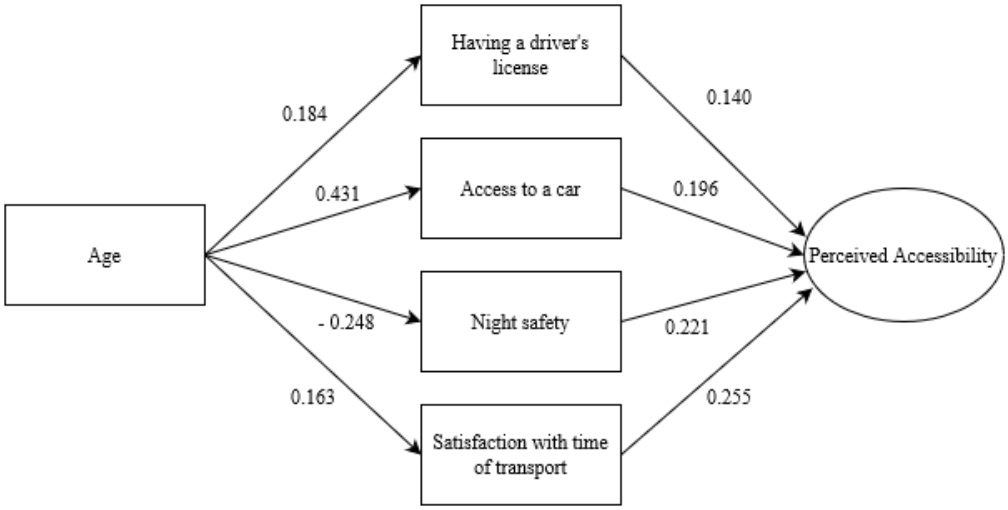

Figure 15 Indirect relationships between Age and Perceived Accessibility found in general model. The numbers above the arrows show the strength (standardized) of the relationship.

Education has various impacts in the general model. A higher education negatively relates to car access and relates positively to the use of the bus, tram or metro. The link between education and car access may be caused by people with a higher education level being more environmentally aware and therefore being less likely to buy a car of their own. Next to these relationships, a higher level of education relates negatively to satisfaction with both the cost and service quality of public transport. Lastly, it is the only variable in the model that impacts the help one can get from their network in travelling. This last factor may be related to the fact that the sample includes a significant percentage of people whose country of origin is not The Netherlands (30.3%), but who do have an averagely quite a high level of education (ex-pats) compared with people who are from The Netherlands. These people, who perhaps came to The Netherlands for work or study, are likely to have a large social network in their home country, but not as much in The Netherlands, which would explain the negative effect of education in the model. The fact that more people with a different country of origin are represented in the higher education levels, may also explain why the car is seen less as the norm in their environment, while the bicycle is more seen as the norm. Given the contrast between their home countries, where there is likely less cycling, and The Netherlands, which is famous for its cycling levels, cycling could be seen more as the norm in The Netherlands. Figure 16 shows how education impacts perceived accessibility in the model.

Figure 16 Indirect relationships between Education and Perceived Accessibility found in general model. The numbers above the arrows show the strength (standardized) of the relationship.

Income negatively influences train use and use of the bus, metro or tram, but increases the feeling of safety at night in the general model. This may be explained by the fact that people with a higher income can afford to live in neighbourhoods that are, or at least feel, safer. It however also means that people with a lower income feel less safe at night. Both being a woman and having a lower income would in

that case have a relatively larger negative impact on perceived safety at night. Figure 17 shows how income impacts perceived accessibility in the model.

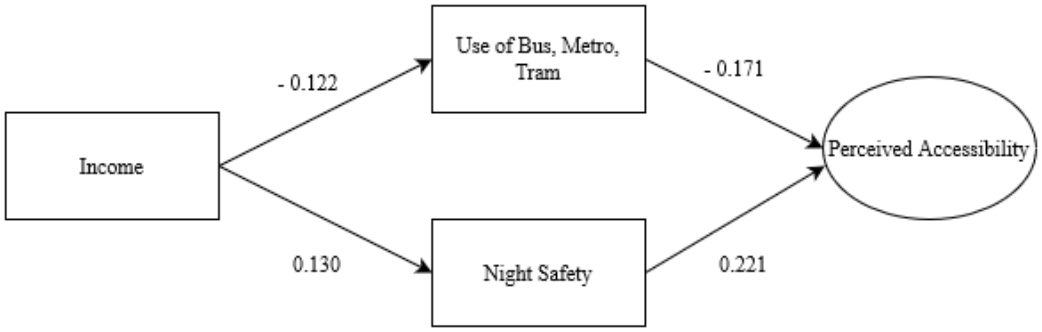

Figure 17 Indirect relationships between Income and Perceived Accessibility found in general model. The numbers above the arrows show the strength (standardized) of the relationship.

Having children aged below 12 has a significant relationship with three factors in the general model: car access, transport inflexibility and transport restrictions. The higher level of car access for people with young children can likely be explained by these families being more inclined to buy a car to bring children to various activities. Furthermore, it is not surprising that having young children will have an impact on the transport modes one can (easily) use, either in a trip chain or in general, given that people have to account for bringing their children along. The indirect relationships between having young children and perceived accessibility are shown in Figure 18.

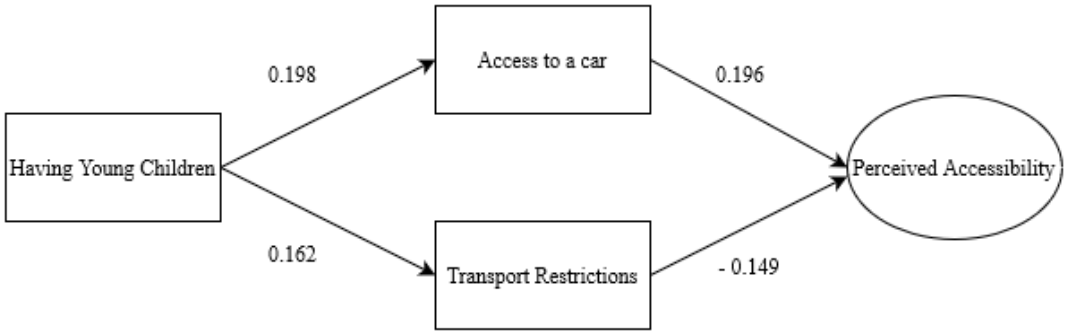

Figure 18 Indirect relationships between having young children and Perceived Accessibility found in general model. The numbers above the arrows show the strength (standardized) of the relationship.

The general model has shown numerous interesting relationships. Next, it is of interest whether the relationships differ between men and women, which is investigated in Section 4.6.

4.6 Intersectional model results

Section 4.5 shows the results of the general model, in which gender is one of the multiple socio-demographic variables included. The section showed that being a women has a negative effect on perceived accessibility through perceived safety at night. Additionally, other socio-demographic factors also had varied relationships with perceived accessibility.

In this paper intersectionality is important. However, the previous general model cannot show whether being a women gives further disadvantage on other accounts, like having a low income, compared to men. To investigate this therefore changes to the model need to be made. The same general model is used as represented in Figure 12. However, instead of performing an analysis on all data, a multigroup analysis is used to perform an analysis on only the data from women and on only the data from men as explained in Section 2.2.2.

For both the model with data from women and the model with data from men, the same process is gone through as for the general model, where non-significant relationships are removed until all relationships are significant at the 0.05 level. It should be noted that these models use split data, and therefore the sample size is smaller than for the general model. Where the general model used data with n = 242, the model with data from women has a sample of n = 146 and the model with data from men has a sample of n = 96. This will likely have an impact on the significance of the relationships between variables and will therefore cause more relationships being removed due to insignificance, compared to the general model. However, the model will still include useful information as the strongest relationships will still be significant.

Both the resulting model for men and the resulting model for women show a good model fit. With a CFI of 0.975 and a RMSEA of 0.042, the model for men shows a good fit. The probability level of the Chi-Square is somewhat low (0.075), however, given the sensitivity of this metric to sample size, the overall model fit is deemed good based on the CFI and RMSEA values. For the model for women, the CFI is 0.962 and the RMSEA is 0.045. Again these values show a good model fit according to common criteria (Hu & Bentler, 1999). The probability level of the Chi-Square statistic is low (0.009), however, given this metrics' sensitivity to sample size, the overall model fit of the model for women is deemed acceptable based on the CFI and RMSEA values.

Table 10 and Table 11 show the results of the model with data from women and the model with data from men respectively.

Table 10 Standardized results of intersectional model with data from women

	Endogenous variables														
Socio-Demographics	Driving license	Car access	Car Use	Cycle Use	Train Use	BTM use	Car Norm	Bicycle norm	BTM norm	Transport restrictions	Day safety	Night safety	Satis - faction time transport	Social network	PAC
Age		0.319					0.412	-0.263			-0.260	-0.186			
Education					0.157	0.187								-0.183	
Income					-0.309										
Young children										0.217					
Endogenous variables															
Driving license															
Car access			0.732	-0.199	-0.419	-0.406									0.325
Transport restrictions			0.168												-0.240
Day safety															
Night safety															0.188
Satisfaction time transport															0.212
Satisfaction cost transport															
Satisfaction service quality PT															0.302
Social network															
Transport inflexibility															
BTM use															
Norm BTM				-0.391		0.145									
Norm Cycle															
Norm Car															

Table 11 Standardized results of intersectional model with data from men

	Endogenous variables														
Socio-Demographics	Driving license	Car access	Car Use	Cycle Use	Train Use	BTM use	Car norm	Bicycle norm	BTM norm	Transport restrictions	Day safety	Night safety	Satis - faction time transport	Social network	PAC
Age	0.360	0.409	-0.212	0.333			0.170				-0.253	-0.204	0.200		
Education							-0.224	0.238			0.192			-0.200	
Income		0.266			-0.190		0.291	-0.347		0.226					
Young children															
Endogenous variables															
Driving license															0.186
Car access			0.887	-0.482	-0.544	-0.559									
Transport restrictions															
Day safety															
Night safety															0.152
Satisfaction time transport															0.415
Satisfaction cost transport															
Satisfaction service quality PT															0.233
Social network						-0.230									
Transport inflexibility					-0.161	-0.252									
BTM use															
Car Use															0.292
Norm BTM					-0.409										
Norm Cycle					-0.388										
Norm Car			0.137		-0.541										

Next, the most relevant relations in these Tables are elaborated on and compared between the two intersectional models, starting with differences in the mediating, endogenous, variables for men and women, after which the impact of other socio-demographic variables is discussed to get an intersectional perspective.

Before the effect of socio-demographic variables, through mediating variables, on perceived accessibility is elaborated on, it is interesting to see how the effect of the various mediating variables on perceived accessibility differ for the two groups. Although this is not especially relevant with regard to the intersectional perspective, it does further show difference in perceived accessibility experiences between men and women. Figure 19 shows the various significant mediating factors and the relationship they have with perceived accessibility for women (in orange) and for men (in green).

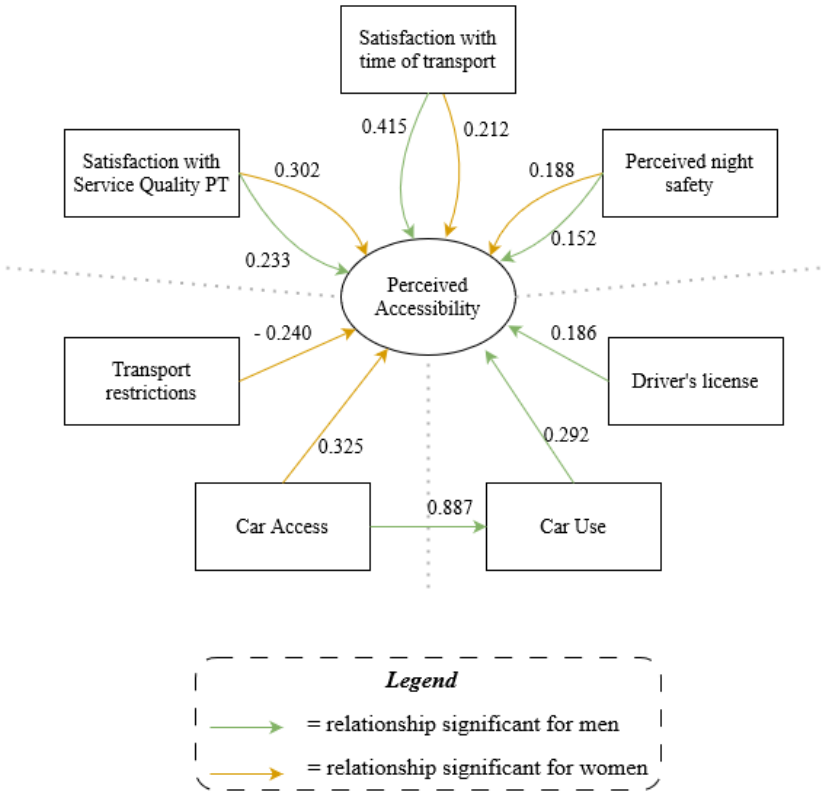

Figure 19 Effect of endogenous variables on PAC for men (green arrows, as found in the intersectional model with data from men) and for women (orange arrows, as found in the intersectional model with data from women) with the strength of relationships (standardized) shown next to the arrows.

As can be seen in Figure 19, as well as Tables 10 and 11, there are three factors that directly impact perceived accessibility for both women and men. The effect of perceived night safety is slightly higher for women than for men. The same goes for the satisfaction with the service quality of public transport. Satisfaction with time of transport however, is a much more important indicator of perceived accessibility for men than for women.

The factors that impact perceived accessibility are however not all the same for men and women. With regard to a car, car access has a direct positive effect on perceived accessibility for women. For men however, car access impacts perceived accessibility indirectly through the use of a car, which looks at how often the car is actually used. Additionally, the model for men shows that having a driver's license has a positive relationship with perceived accessibility. For women, however, there is a very different factor that impacts perceived accessibility: transport restrictions.

The relationships between mediation variables and perceived accessibility thus differ for men and women. Next, it is of interest to see how the socio-demographic effects differ between men and women.

This is elaborated on next, where all relationships shown to be significant for men have been found in the intersectional model with data from men, while all relationships shown to be significant for women have been found in the intersectional model with data from women.

In both the model for men and for women, income and education show no effect through other factors on perceived accessibility. This somewhat conflicts with the simple model which showed a significant relationship between income and perceived accessibility for the data from women. It could be that there is some mediating variable in the model which reduces this effect, but is not strong enough to be significant at the 0.05 level.

In both the model for men and for women, there are multiple mediating variables through which age affects perceived accessibility. For women, age has a significant effect on access to a car which in turn has a significant effect on perceived accessibility. Additionally, night safety lowers for women with a higher age, which in turn also affects perceived accessibility. The same effect with regard to perceived safety levels at night can be seen for men. The effect of age on night safety is somewhat stronger for men. This shows that for men, perceived levels of safety decrease more with a higher age than for women. This may not be surprising as the general model showed that women in general already have a lower perceived safety level at night than men. Interestingly, the feeling of safety at night has a stronger effect on perceived accessibility for women than for men. This indicates that for women safety at night is somewhat more important for their perceived accessibility than for men.

Where for age in the model for women access to a car is a significant mediatior for perceived accessibility, for age in the model for men the relevant mediating variable is possessing a driver's license. This could suggest that for men it is more important for their perceived accessibility to be able to drive places themselves, whereas for women the more general access to a car, perhaps with a different driver, is more important. Lastly, for men there is one more mediating variable between age and perceived accessibility: the satisfaction with the time transport takes. While for women satisfaction with the time of transport also has a significant effect on perceived accessibility, this effect is much lower than for men and also not affected by age. Figure 20 shows a graphical overview of how age affects perceived accessibility for women as found in the intersectional model with data from women (shown in orange) and men as found in the intersectional model with data from men (shown in green).

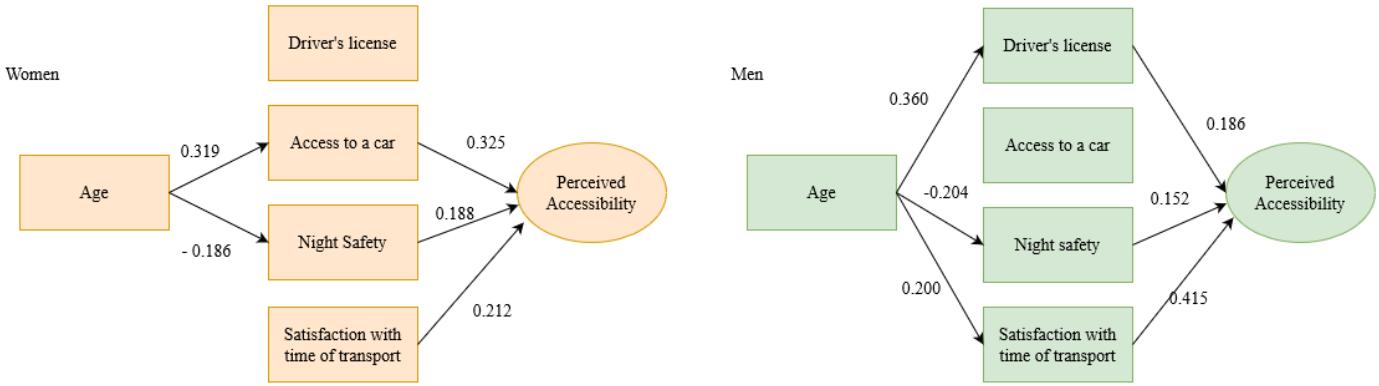

Figure 20 Effect of age on perceived accessibility for model for women and for men found in the intersectional models with data from women and with data from men. The numbers above the arrows show the strength (standardized) of the relationship.

The fact that access to a car is important for women's perceived accessibility, but not for men's in this model makes another relationship in the model relevant. In the model with data from women, car access is only influenced by age. However, in the model with data from men, income also positively impacts car access. This means that for men, a higher income in general means they get more access to a car, and vice versa. However, for women this relationship is not there at all. When comparing the means of car access it can also be seen that it is much lower for women (3.13) compared to men (3.68), both on a 5-point scale. Although this effect is not significant at the 0.05 level in the general model, it does show

a clear difference. This relationship could support the theory that men are often the primary user of a car, and therefore when a car can be afforded, this especially affects the car access of men, and not necessarily that of women. These relationships are shown in Figure 21.

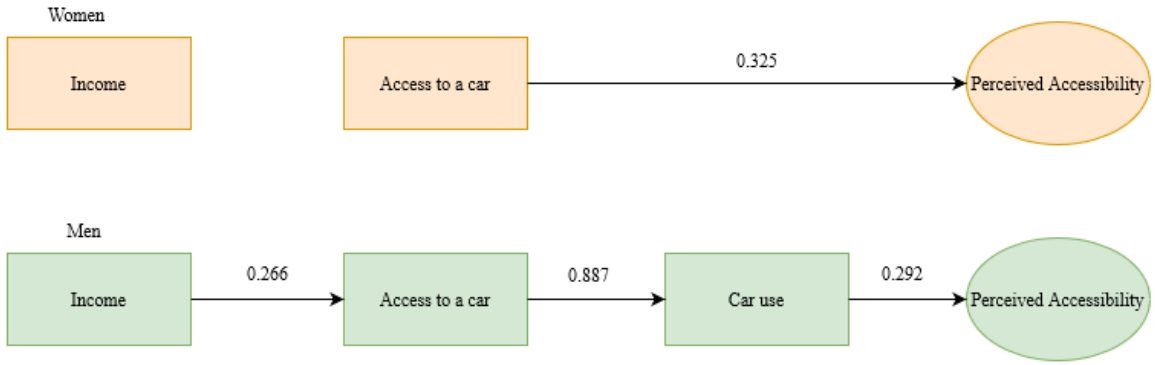

Figure 21 Differences in relationships between income, access to a car, and perceived accessibility for women and men, as found in the intersectional models with data from women and with data from men. The numbers above the arrows show the strength (standardized) of the relationship.

The other (socio-demographic) factor that has an effect on perceived accessibility, although only for women, is having young children. In the model with data from women, it can be seen that having young children causes more transport restrictions for women. Transport restrictions, as elaborated on in Section 4.2, are in this case the extent to which someone feels they could use another transport choice if they did not have to perform multiple activities in a row. For the model with data from women, this factor also negatively impacts perceived accessibility, meaning that the more someone feels they have transport restrictions, the lower their perceived accessibility. Interestingly, both the link between young children and transport restrictions, as well as the relationship between transport restriction and perceived accessibility are not present in the model with data from men. As part of the question about transport restrictions, an example was given where transport restrictions could occur when one could take their children to school by bicycle, but because one wants to go to work straight after dropping the kids off, one decides to take the car. This, in combination with the fact that women still tend to have more responsibilities with regard to childcare, could partially explain why this effect is shown for women and not for men. Although the question about trip chaining did not show any gender impacts, it seems trip chaining does cause transport restriction to a greater extent for women with young children, than for men with young children. The relationship between having young children and perceived accessibility for women and men is shown in Figure 22.

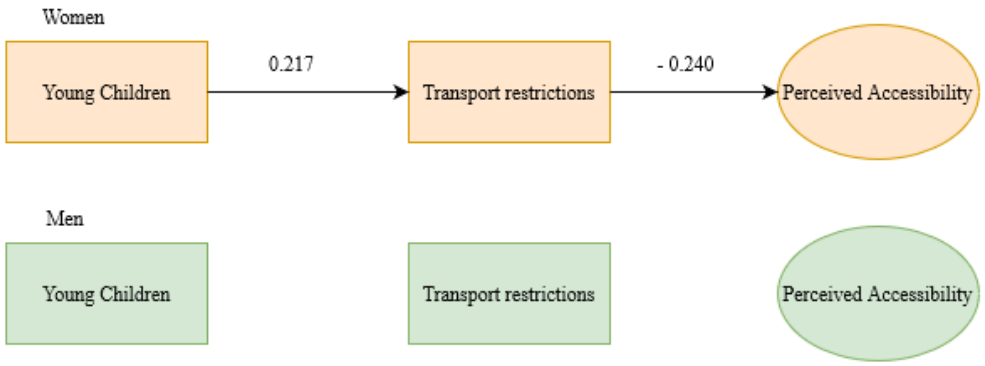

Figure 22 Relationship between having young children and perceived accessibility for women and for men, as found in the intersectional models with data from women and with data from men. The numbers above the arrows show the strength (standardized) of the relationship.

5. Qualitative analysis

The previous Chapter shows through which mediating factors gender and intersectional factors affect perceived accessibility. However, it does not show the context for these factors. To get a better understanding of where these factors come from, what is being done about them, and potentially what could be done to make these factors more equitable, the factors are investigated in the context of the transport system in The Netherlands. This way the last sub-question is answered:

SQ4: How do the main factors found to be relevant for perceived accessibility from a gender intersectional perspective relate to the past, present and future (urban) transport system in The Netherlands?

To approach this question in a systematic way, the three main factors that impact inequalities in perceived accessibility from a gender intersectional perspective are further investigated. To do this, a workshop with experts in the field of spatial planning, transport and mobility is used, as well as input from documents, papers and reports to get further information. More elaboration on the method can be found in Section 2.2.2. Next, Section 5.1 introduces the workshop design and participants, after which the analysis is presented in Section 5.2.

5.1 Workshop design and participants

Based on the previous Chapter, the factors perceived safety at night, transport restrictions and access to a car are very relevant when looking at perceived accessibility from a gender equity perspective in The Netherlands. These three factors are therefore the main subjects of the workshop. After a brief presentation (Appendix F.1) in which the research and these results are described, workshop participants are asked to reflect on these three factors and how they relate to the past, current and future transport system in a Miro board (see Appendix F.2). Lastly, a select number of items on the Miro board are discussed further to get a more complete view of the participants' perspective.

To do a workshop, participants are needed. In this case, people with different points of view are invited as this can give a balanced view of the transport system. Therefore, academics, researchers and policymakers in either the field of transport and mobility or gender equity are invited. Seventeen people were invited in total, of which five agreed to participate. Eventually, due to some scheduling issues, three people participated in the workshop (one of whom identified as a woman). A function description for each workshop participant is shown in Table 12. To protect the identities of participants, these function descriptions are kept broad.

Table 12 Description of workshop participants

Participant	Function
Workshop participant 1	Researcher in the field of transport policy
Workshop participant 2	An employee working on mobility in a national public institution
Workshop participant 3	An employee working on transport issues in a municipality

5.2 Results of qualitative analysis

This Section presents the results of the workshop, as well as some elaboration on certain subjects using documents like reports from public institutions or transport companies. As discussed in Methodology Chapter 2, data is gathered in two ways during the workshop. Firstly, a Miro board is used to get a comprehensive view of all participants' thoughts on the three main factors found to be important from a gender perspective (perceived safety at night, transport restrictions, car access). The resulting content of this Miro board can be found in Table 13.

Table 13 Workshop Miro board results

<table>
<tr><th></th><th>Past</th><th>Present</th><th>Future</th></tr>
<tr><td rowspan="4">Perceived safety</td><td>Governments and PT companies have aimed to improve things such as lighting, installed cameras, supervision</td><td>Still measures are taken such as better lighting, but it is not a top priority</td><td rowspan="2">Far more systematic attention needed from researchers, PT companies and policy-makers. The problems still tends to be underestimated.</td></tr>
<tr><td>Focus on transport provisions for the car (impacts both physical as well as social safety)</td><td>Improved lighting, wider paths, more people walking and cycling, smart location of routes [1]</td></tr>
<tr><td>Concentration of people with low income in areas with lower accessibility</td><td rowspan="2">Higher levels of urbanisation could both increase or decrease perceived safety, depending on the underlying mechanisms. Higher urbanisation means more eyes on the streets, however, it also means more anonymity</td><td>More user-oriented research needed</td></tr>
<tr><td>Lack of attention to travelling by foot or bicycle</td><td></td></tr>
<tr><td rowspan="5">Transport restrictions</td><td rowspan="2">The fact that women experience a negative effect from this intermediate factor might be a result of them having less access to a car. If you have a car, you experience fewer travel restrictions</td><td>As long as women are taking on a larger share of care tasks, this will remain. The transport system cannot solve this alone.</td><td>Policies that support a cultural shift in thinking about gender roles would help</td></tr>
<tr><td>There is still not much attention to this issue</td><td rowspan="2">Transport policies are perhaps not important. More emancipation policies especially targeted at men are needed</td></tr>
<tr><td>Male-female roles are still conservative. Cultural developments go slow and this one especially</td><td>Hub development, connecting different modes helps [2]</td></tr>
<tr><td rowspan="3">Lack of attention to differences among travellers</td><td>Improved accessibility of public transport helps</td><td rowspan="3">Space matters: if schools/ daycares are not conveniently located in relation to other destinations (work or transport opportunities), this increases the problem.</td></tr>
<tr><td>Price differentiation in public transport and shared mobility</td></tr>
<tr><td>Concept of 15-minute cities</td></tr>
<tr><td rowspan="2">Car access</td><td>Policies focussed on improving car accessibility on the main road network were more advantageous to men than women because they tend to have a longer commuting distance</td><td>Any policies that sustain or increase car dependence</td><td>Less dominance of car use in cities [3]</td></tr>
<tr><td rowspan="2">In transport policies, gender differences in car accessibility did never play a role. Emancipation policies have had influence but there are still a lot of 'traditional' families</td><td>Mobility hubs/ sharing (also cargo bikes). More working from home might have a small positive impact</td><td rowspan="2">Less car dependence in general, as well as policies for cultural changes</td></tr>
<tr><td>Car sharing solutions</td></tr>
<tr><td rowspan="2">Other</td><td>Any policies sustaining traditional gender roles</td><td></td><td>Any policies focussed on giving more accessibility to those who already have a lot of accessibility will sustain or increase gender differences</td></tr>
<tr><td colspan="2">Policies increasing the scale of amenities or facilities, thus increasing travel distances</td><td>Overall, this requires more attention from planners and policymakers (and not just with regard to gender)</td></tr>
</table>

Table 13 shows various factors mentioned which are likely to have (had) an impact on the equality issues for each factor. Next, a discussion is held where some more elaboration is given on three issues mentioned in Table 13, which are also numbered in this Table. Table 14 shows the results of this discussion, where different rows in one answer show the input of different workshop participants.

Table 14 Workshop discussion results as derived from three items in Table 13

[1]	**To what extent are improved lighting, wider paths, more people walking and cycling, and smart locations of routes implemented already?**
	It is being worked on, but not to a large enough extent. Cycling paths have been worked on for a longer time, while pedestrian routes have only recently become more important, something which has been neglected for a long time. In this, it is very important to carefully listen to the users, and not just follow the standards.
	This should also be done in Public Transport, which is more of a role for the public transport companies. You for example see fewer conductors there. This in combination with incidents seen in the news, can make women feel more unsafe, especially at night. This safety component should perhaps also be a part of the concessions for public transport companies.
	Another important thing is that in the case of a chained trip, the perceived safety of the weakest link determines the safety of the trip. Even if a lot of attention is paid to making public transport safer, if the walk to the public transport stop is still felt unsafe, the rest is useless.
	Is there any coordination between the municipality's efforts on improving safety and the efforts of public transport companies?
	No, these are completely separate.
[2]	**Could you elaborate on the note about transport restrictions, hub development and connecting different modes?**
	There need to be better connections. People should be facilitated better, and new solutions like shared mobility should be offered. Hub development is going on right now, so this should be included in the development of safety and improving the safety of transportation hubs.
	Next to this, cultural changes are very important. You can have hubs or sharing facilities, but if the man still has the traditional role of going to work while the woman takes care of the children, then these policy measures can only help to some extent.
[3]	**How do you think sustainable policies which aim to reduce car use will affect gender differences in transport?**
	What you see in the transition towards electric cars, is that they are more expensive to purchase but cheaper to use. Especially when a household has multiple cars, the second one to purchase might become too expensive. So even though they are cheaper to use, you still have a problem if you cannot do the investment. In that case, it is usually the woman in the household that is impacted because of the traditional gender roles.
	Additionally, promoting active modes and restricting cars, means women need to use more active modes in which they feel, especially in areas with insufficient lighting, more unsafe. The car, however, is for a woman a relatively safe way of transport at night. This is an important feedback loop.
	Furthermore, there can be an opposition between cities and the countryside. In cities, the policies which aim to reduce car use can be difficult for certain groups, like people with low incomes when it becomes difficult for them to have a car. It does, however, have the potential to reduce gender differences because the car is simply less important. Therefore, the shift to other modes that are potentially more accessible for women could also be an improvement. It is hard to say whether the same goes outside of the bigger cities, but the policy towards less car use could be positive for gender equality.

The next sections give a small summary of the workshop results for each factor, starting with perceived safety (5.2.1), followed by transport restrictions (5.2.2) and ending with car access (5.2.3).

5.2.1 Perceived safety

Experts in the workshop had remarks about perceived safety at night in the Dutch transport system. With regard to the past, it was agreed that not much attention has been paid to increasing safety for everyone and especially women. While some measures have been taken to improve aspects such as lighting, installing cameras and increasing supervision, this has not been, and is still not, a priority. It is also not straightforward to increase feelings of safety. As one workshop participant said: "*We thought proper*

lighting would solve a lot of issues, but we also got in return: "Don't light too much, because I feel exposed when I'm too well lit'"". In addition to this, it was noted that the focus in the past has generally been on transport provisions for the car, and not such much on other modes like travelling by foot or bicycle.

Currently, issues like proper lighting and cameras on cycling paths, have been gaining attention within local governments like municipalities. One workshop participant noted that cycling paths had gotten some attention with regard to these factors already, but that pedestrian paths had been neglected for a long time. Although noted by one workshop participant to still not be enough, it was seen as a development in a good direction to increase safety.

Where municipalities lead the charge on safety on cycling and pedestrian paths, safety in public transport is also deemed important. Quoting one workshop participant: "*If you have a chained trip, then the perceived safety of the weakest link is determining the safety of the trip. So even if you put a lot of attention into making public transport safer, if the walk to the transport stop is still felt as unsafe, then all the rest is useless*". Therefore, safety in all modes is essential to create overall safe trips.

To get some more information about safety efforts in Public Transport additional sources from these companies, as well as from municipalities and provinces were used. Public transport companies and institutions on the national and provincial levels have been working on increasing safety. This is shown in the National Covenant Social Security in Public Transport in which these parties have come to agreements with which they want to maintain current social security levels and improve them where possible (*Landelijk Convenant Sociale Veiligheid in Het OV 2020-2025*, 2020). This cooperation is very important to get a consistently safe public transport system, given the different concession areas in The Netherlands. In these concession areas, every so many years (this can be different per concession), a concession is granted to a specific Public Transport company based on their plans for how they will run Public Transport in that area. Factors like cost are very important in the offers of PT companies. However, the Law Passenger Transport in 2000 also prescribes that conditions have to be set in every concession regarding the proper (social) security levels (Weijdt & Brussen, 2016). This shows that social security has been acknowledged to be important in Public Transport. Thus, it can be said that there is a cooperation between different parties in Public Transport. However, as discussed in the workshop, there is no coordination between municipalities and public transport companies when it comes to increasing overall safety in all modes.

Another factor which was noted in the workshop to have a potential impact on gender differences in feelings of safety is the increased levels of urbanisation over the years. This increased urbanisation could be useful, as there tend to be more people on the street which can increase feelings of social safety as there is some social control. On the other hand, increased urbanisation can also lead to people feeling more anonymous when they are out on the streets, which in turn could further lower peoples' perceived safety.

The question remains: how to move forward in the next years? Firstly, more systemic attention from researchers, but also public transport companies and policy-makers was noted to be important by the workshop participants. One participant said: "*I feel the problem tends to be underestimated*". Furthermore, to be able to really increase safety, more user-orientated research was noted to be important.

5.2.2 Transport restrictions

The gender inequity with regard to transport restriction was presumed in the workshop to likely be largely explained by the traditional gender roles which in the past, but also to this day, have been slow to evolve. Women in The Netherlands are still to a larger extent than men responsible for childcare (Brakel et al., 2020). Likely these trips to schools, day-care, and afterschool activities, are still undertaken more by women, giving their trips more complexity. The noted lack of attention to

differences among travellers in policies (workshop) means that these differences between men and women have not actively been mitigated in any way.

To this day, the difficulties for women who have young children in transport are still not receiving much attention in transport (workshop). This is not just a problem for the transport system and its policies. Further cultural changes will need to take place to get a more equal division of childcare between men and women. However, what the transport system can do is further accommodate women who have to trip chain with their children. Current developments mentioned in the workshop that could do this are hub development to connect different modes, improved accessibility of public transport, and perhaps also pricing differentiation in public transport and shared mobility. In addition, developments to increase the potential for 15-minute cities were also suggested in the workshop to potentially have a positive effect on decreasing gender inequities.

In the future, further policies and other practices to support a cultural shift in thinking about gender roles are deemed very important in reducing the inequities discussed in this section. Until then, transport policies, as well as land-use policies could help mitigate difficulties experienced by women with young children. As suggested in the workshop, placing schools and daycare opportunities in convenient places with regard to further travel to work can also be very important. In short, integrated intersectional policy-making would be extremely valuable.

5.2.3 Car access

With regard to gender inequities in access to a car, it was noted in the workshop that here also the traditional gender roles that were discussed in the previous section play a large part. Meaning the conservative gender roles where the man is the main breadwinner and the woman takes care of all things concerning the household. It should however also be noted that this has not been discouraged by past transport policies, actually the opposite is true. One workshop participant also noted that past policies tended to focus on improving car accessibility on the main road network, which was more advantageous for men who tended to use this part of the network more. This is also noted by Duxfield et al. (2023), who note that urban planning often does not take the difference in travel patterns between men and women and the requirements due to those differences into account.

The dependence on cars also plays a part in gender differences. Any policy which further increases this car dependence thus has the potential to further enlarge these gender inequities. However, the current trend in policies in The Netherlands seems to be to discourage car use and increase the use of other modes. The effect of this on gender equity can be twofold, as also discussed in the workshop. One workshop participant gave the example of electric cars. These are usually cheaper to use but more expensive to purchase. To quote this participant: "*Especially when a household has multiple cars, then the second one to purchase might become too expensive. So even though they are cheaper to use if you can't do the investments, then you still have a problem, and then it is usually the woman in the household that is impacted because of these traditional roles*". To add to this, it was also noted that if women are pushed from the car to active modes and public transport, this also means that they are pushed to modes that they feel less safe in than the car. There are thus significant risks for gender equity for the policies which aim to reduce car use.

However, if in general car dependence in cities can be reduced and the link between car access and perceived accessibility no longer exists, this could also remove inequalities with regard to perceived accessibility due to car access. Thus, the ultimate goal of reducing car dependence has great potential to also reduce inequalities with regard to this factor. However, the path to this goal could have pitfalls and actually increase inequalities as explained above. To reduce these inequalities, developments like car and bike-sharing solutions could help in not increasing the gap between men and women, as the initial purchasing price is less of a problem with these developments.

6. Discussion

In this Chapter, the results of the research done in this thesis are discussed. The research results are summed up and connected to existing literature, thereby answering the main research question. Additionally, the scientific and policy implications of the research are discussed.

6.1 Interpretation of main results

The main research question in this research is: "*How do gender and intersectional factors affect the perceived accessibility of people in urban areas in The Netherlands?".* By finding the factors that can impact perceived accessibility and their connection to gender intersectional factors, the ways gender and intersectional factors impact perceived accessibility has been quantitatively tested. Finally, these results could be linked to the transport system in The Netherlands using the last qualitative strand or research. This is elaborated on next.

The quantitative part of the research showed a number of interesting findings. Firstly, a simple model showed that gender does have an effect on perceived accessibility levels in urban areas in The Netherlands, where these levels are averagely lower for women. This was not surprising based on the research done into the gender and intersectional perspective on perceived accessibility, as this research brought forward multiple aspects of travel and accessibility that could be detrimental to women's perceived accessibility. However, it was surprising when comparing this to other quantitative perceived accessibility studies, none of which had found this same effect. Some studies found no relationship between gender and accessibility (e.g. Vitman-Schorr et al., 2019; van der Vlugt et al., 2019) while other studies by Lättman et al. (2019) and Olsson et al. (2021) found a positive relationship between being a woman and perceived accessibility. In this, it should be noted that none of these studies were performed in The Netherlands, which could explain some of the differences in findings. The studies by Lättman et al. (2019) and Olsson et al. (2021) which found a positive relationship between being a woman and perceived accessibility were performed in countries in Northern Europe. These countries have been found to have a high level of gender equality compared to other countries in the European Union (López-Martínez et al., 2022), which could be an explanation for women actually having an advantage with regard to perceived accessibility. Studies that found no relationship between gender and perceived accessibility were performed in, for example, Israel (Vitman-Schorr et al., 2019) and the United Kingdom (van der Vlugt et al., 2019). An explanation for this could be that in some of these countries perceived safety at night is less reliant on gender or that there is some other factor which compensates for the negative effect(s) of being a woman. However, as none of these studies sought to explain the relationship between gender and perceived accessibility they found in more detail, an exact explanation of the differences between the studies in other countries and this study in The Netherlands is difficult to provide.

Next, the research sought to find an explanation for the found relationship between gender and perceived accessibility. The general model showed that part of this negative relationship can be explained by the perception of safety at night while using public transport, cycling or walking, which is significantly lower for women. This relates to existing research by Lynch & Atkins (1988) and Abenoza et al. (2018) which has shown in the past and more recently that perceived safety in transport is generally lower for women, especially at night. It is interesting to find that only perceived safety at night, and not perceived safety during the day, has a relationship with perceived accessibility. This connects to the study performed in the 1980s by Lynch & Atkins (1988) that shows that there is a connection between personal security fears for women and their restricted travel patterns in the United Kingdom, especially at night. Roughly 35 years later, this connection between personal safety concerns and ease of travel, especially at night, is still relevant. The quantitative model showed no other mediating factors for gender and perceived accessibility, however, it is possible that these factors do exist but were not included in this model, or could not be proven to be significant due to the sample size. One such factor that was included but could not be proven to be significantly related to gender in this research is access to a car.

However, a study by Tiikkaja & Liimatainen (2021) has shown that women in hetero relationships with children generally have less access to a car in Finland, a country where gender equity, as discussed before, is generally considered to be good. Additionally, statistics from the Netherlands show that in all age groups, more men than women have a driver's license (CBS, 2019b) and more men own a car than women (CBS, 2013). Combining this with the fact that this research shows that access to a car has a significant positive relationship with perceived accessibility, this could be proven to be an important mediating factor between gender and perceived accessibility when working with a larger sample size.

Next, the intersectional model sought to find if being a woman (or man) could cause further inequalities due to other factors such as income. One interesting outcome of this model is that for men income has a positive relationship with access to a car, while for women this relationship does not exist. However, for women, access to a car has a positive relationship with perceived accessibility, while for men car access has an indirect positive relationship with perceived accessibility through car use. The fact that income has a significant relationship with car access for men but not for women supports research by Gil Solá & Vilhelmson (2022) which states that when a car can be afforded, the man in the family is usually the main user. Secondly, the intersectional model showed that for women, having young children increases transport restrictions. Meaning that on this aggregate level, women generally feel more restrictions in their choice of transport mode when trip chaining, which in turn negatively relates to their perceived accessibility levels. These types of restrictions women feel due to trip chaining are also presented by various studies such as by Uteng (2021) and Mejia-Dorantes & Villagran (2020). However, the relationship between transport restrictions and perceived accessibility was not found for men, indicating that this is less of an issue for men.

The quantitative findings show that differences with regard to perceived accessibility based on gender and intersectional factors still exist in The Netherlands. This shows how important concepts like transport justice, transport equity and social exclusion in Dutch transport planning and policymaking still are. A concept that is especially relevant from a gender perspective in policy is 'gender mainstreaming'. This concept is defined by the Council of Europe and concerns a general approach where differences between women and men are explicitly taken into account during the collection of data, and the creation and evaluation of policies (Council of Europe, n.d.). This concept has gained more attention in recent years. From an urban mobility perspective, the importance of this is also shown in the work programme for 2021 and 2022 from the European Commission, in which the role of feminism in "promoting gender equality theoretically and practically" is specifically included (Duxfield et al., 2023), p.8). This uptake of a feminist perspective in areas like urban mobility shows a move in the right direction. This, however, has not yet resulted in complete equality in perceived accessibility from a gender perspective, which was investigated further in the last qualitative part of the research.

The quantitative analysis shows that gender negatively impacts perceived safety at night. This means that for women it is significantly lower. In turn, this lowers the perceived accessibility of women. The question is thus, why is this still a problem in the transport system and what efforts have been made to do something about this? Firstly, in the past increasing perceived social safety for everyone, and especially women, has not been a focus. The attention to this issue has been increasing but is still not a priority. Increasing feelings of safety can also be difficult. For example, increasing lighting is known as a good way to increase feelings of safety, however, this can be very context dependent, as people can also feel more exposed in places that are lit well. This point is also made by Kroon-van den Berg (2010), who notes that improved lighting does not always have the same effect, and in areas with a low intensity of traffic it can make people feel less safe due to them being in the 'spotlight'. Additionally, the focus in the past has generally been on transport provisions for the car, and not for other modes like walking or cycling. This also fits with the quantitative part where feelings of safety in the car were very different (and generally better) than for other modes.

To achieve a high level of perceived safety (at night) in transport, coordination between all institutions in charge of the transport system was noted to be important based on the workshop. While there currently

is coordination between various public transport companies, coordination between, for example, municipalities and public transport companies was found to still be lacking. The lack of coordination between municipalities opens up the potential for possible mismatches in feelings of safety across modes. Furthermore, while various documents show women to feel significantly less safe than men on Public Transport trips (Meester & van der Beek, 2021; Portegijs & van den Brakel, 2016), the various documents found on measures with regard to social security (e.g. Kroon - van den Berg, 2010; Weijdt & Brussen, 2016) do not discuss this difference in any way or seem to take it into account when designing measures. The quantitative analysis also showed that women with young children felt more restricted in their choice of transport when taking multiple trips in a row, while this effect was not found for men. This can partly be explained by the existing gender roles that exist in (Dutch) society even to this day. Additionally, given the findings in the literature that women are still to a higher degree responsible for childcare (Dobbs, 2007; Lo & Houston, 2018) and generally trip chain more (Montoya-Robledo & Escovar-Álvarez, 2020) this is thus not surprising.

The average of car access is quite a bit lower for women than for men as can be seen in the data. However, the relation between gender and car access was not significant at the 0.05 confidence level. It does not seem unlikely that with a larger dataset, this could possibly be a significant relation, especially given the differences between car ownership of men and women in The Netherlands as shown by other sources like Witte et al. (2022). However, based on the current dataset no concrete conclusions can be drawn about this relationship. What is an interesting, significant, relation from a gender perspective however, is that for men a higher income is associated with more access to a car, and a lower income is associated with less access to a car, while for women the association is not found. This could be explained by the finding in the literature, that when a car can be afforded, the man in the household is still often its primary user, making the household income for men more indicative of their access to a car (Dobbs, 2007; Gil Solá & Vilhelmson, 2022). This, again, comes from the persisting traditional gender roles. Sustainable policies which aim to reduce car use and car dependency have the potential to either positively or negatively affect this gender difference. Firstly, the high purchase cost of vehicles like electric cars could cause the relationship between income and car access even stronger, and could cause households to not be able to afford a second car anymore, something which is more likely to affect women. However, if, especially in urban areas, policies are successful in reducing car dependency this could remove the link between car access and perceived accessibility, thus making this factor no longer relevant in the discussion on gender equity in perceived accessibility.

6.2 Scientific reflection and policy implications

This research has sought to fill the knowledge gap in the literature concerning the way gender and intersectional factors affect perceived accessibility. In doing so, a conceptual model has also been created in which a comprehensive view of the factors that can impact perceived accessibility is represented. This model can also be used as a basis for future research that focuses on other factors and their relationship with perceived accessibility. Additionally, the research shows the high variety of factors that can affect people's perceived accessibility, and that a collection of non-tangible factors like perceived safety and perceived service quality of public transport can significantly affect the way people perceive the accessibility of the transport system. Lastly, the research shows the importance of taking gender and intersectional factors into account when investigating perceived accessibility.

From a policy perspective, this research shows a number of important results. Firstly, it is shown that it would be beneficial from a gender equity perspective for institutions in the transport system to focus more on increasing perceived safety across modes by coordinating their efforts to a larger extent. Additionally it is important to explicitly take gender differences into account in designing safety policies. This research shows that gender gaps still exist with regard to perceived accessibility, which could cause women to be more restricted in their mobility and thus run the risk of some level of social exclusion, especially at night. By explicitly using gender mainstreaming, where gender differences are

explicitly taken into account in policy, gender inequities in transport can likely be lessened more effectively.

Additionally, it is recommended that policymakers carefully examine the gender effects of car-restricting policies. Reducing car dependency in cities can have a positive effect on equity, as it could remove the link between car access and perceived accessibility. However, the path to reduced car dependency can have negative consequences from a gender equity perspective. The research shows that people who use the bus, tram or metro more have on average a lower perceived accessibility. By focusing on improving this first, the unequal effect of reducing car use could be mitigated. Additionally, there is a risk that women will be pushed to use active modes or public transport at night prematurely, while these modes have been shown to feel more unsafe for women, which would harm their perceived accessibility. This again highlights the importance of using gender mainstreaming on the path to lower car dependency and generally for gender equity in the transport system.

7. Conclusion

In a world where people need to travel to reach social and economic activities, the risk of social exclusion based on people's characteristics is always present. Social exclusion merely based on factors like age is undesirable in a just society. One of the potential reasons for social exclusion is reduced accessibility levels. Many definitions of accessibility exist. Accessibility can be calculated based on the characteristics of the transport and land-use system. However, one type of accessibility that is especially relevant in this case is perceived accessibility, which reflects how easy it is for people to live their lives using the existing transport system (Lättman et al., 2016b). This perception of the transport system and the opportunities within it actively impact people's mobility decisions. However, this perception can differ based on people's characteristics, which in turn could restrict their mobility.

Various characteristics, like age or income, have been found in the literature to affect perceived accessibility levels. One such factor's influence on perceived accessibility is still somewhat unclear: namely gender. In some research gender as a controlling variable is included in the analysis of perceived accessibility. Some found no effect, while others found a positive effect of being a woman on perceived accessibility. This seems counterintuitive, as from a mobility perspective various restrictions for women's mobility have been found in the literature. Yet, no research has tried to explain in what way gender and intersectional factors affect perceived accessibility. To fill this knowledge gap this research has answered the following main research question:

How do gender and intersectional factors affect the perceived accessibility of people in urban areas in The Netherlands?

To answer this question, four sub-research questions have been used. A mixed-method approach was used to answer these sub-questions. Firstly, literature reviews were used to make a conceptual model of perceived accessibility. Next, the relationships in this model were tested using quantitative analysis, more specifically Structural Equation Modelling, with data from surveys. Last, a workshop was used to gather data with which the most relevant results from the quantitative analysis could be put into context. Next, the results for each sub-question are discussed, after which a conclusion is drawn with regard to the main research question.

7.1 Sub-research questions

Sub-question 1: What factors influence perceived accessibility?
Perceived accessibility is a many-faceted concept, and can be affected by a big variety of factors which have been grouped in a number of categories. Firstly, there are various individual factors that can affect perceived accessibility. Examples are people's abilities, like being able to use digital services or being able to drive a car and people's flexibility in using various transport modes. Furthermore, (the perception of) three accessibility components which are important from a general accessibility perspective, are also relevant for perceived accessibility: the temporal component (e.g. perception of travel times), the transport system (e.g. perception of travel supply) and the physical environment (e.g. awareness of activities). Related to these components, but kept separate due to its importance in the general literature, is the perception of service quality of public transport, which can also affect perceived accessibility levels. Next to this, the social environment of a person and the norms and support within it can affect perceived accessibility. Two important factors that can affect perceived accessibility are the transport mode a person (primarily) uses and the perceived safety of the transport system and the modes within it. All these factors can correlate or affect each other in various ways. Lastly, various socio-demographic variables, like age, education, income and gender, can both affect these factors mentioned as well as perceived accessibility directly. These factors and their relationships were summed up in a conceptual model which can be found in Chapter 3.

Sub-question 2: How can perceived accessibility be conceptualized from a gender intersectional perspective?

To expand upon the previously made general conceptual accessibility model and to add a gender intersectional perspective, a second literature review was conducted. Various factors which relate to gender differences in mobility were found that connect to the general conceptual accessibility model. Firstly, women tend to have different purposes in their trips and a different distribution and concentration of trips as they are still to a larger extent responsible for care responsibilities. This relates to the individual component as these care responsibilities can impact people's transport flexibility and temporal restrictions. Another interesting factor from a gender perspective that relates to these two factors is the finding that women generally trip chain more. Furthermore, literature shows that women to this day still have less access to a car and less often have a driver's license. This relates to the abilities in the general model. Lastly, gender also relates to two main factors in the general model: the primary transport mode used and perceived safety. Literature shows that women tend to use different main modes than men, something partly caused by perceived safety of modes. Perceived safety in transport overall is also shown to be lower for women. These relationships were added to get an extended conceptual accessibility model with gender intersectional perspective to emphasize these gender effects.

Sub-question 3: To what extent do the found factors impact perceived accessibility from a gender intersectional perspective in urban areas in The Netherlands?

To find the extent to which the various factors found in literature affect each other and perceived accessibility, the conceptual model was translated into a survey and quantitative model. Firstly, it was found in a simple model that gender has a significant relationship with perceived accessibility, where women generally have a lower level of perceived accessibility. Interestingly, the other sociodemographic factors did not show a direct significant relationship with perceived accessibility. By splitting up the model into a model with data from men and with data from women, it was however found that for women income is a significant indicator for perceived accessibility, while for men age is.

Next, the general model was implemented. Various interesting paths were found through which the various socio-demographics affect perceived accessibility. For example, the various mediating factors between age and perceived accessibility are having a driver's license (positive), access to a car (positive), perceived safety at night (negative) and satisfaction with time of transport (positive). The fact that some of these relationships are positive and others negative also explains why no direct effect was found, as these factors likely compensate for each other. However, the main goal of this research is to find significant paths through which gender and intersectional factors affect perceived accessibility. It was found that the main (and only) path between gender and perceived accessibility had perceived safety at night as a mediating factor. This shows that for women, perceived safety at night for the modes of walking, cycling and public transport is generally lower, which in turn lowers their perceived accessibility levels.

Lastly, the general model was split up into a model with just data from women and a model with just data from men. Two interesting results followed from this analysis from an intersectional perspective. Firstly, the model for women showed that women with young children experience more restrictions in their transport mode choice when they trip chain, which in turn lowers their perceived accessibility. Interestingly, this effect was not found in the model for men. This shows that for women having young children gives this additional disadvantage, while for men this does not seem the case. Secondly, the amount of access to a car a person has in their daily lives has an interesting effect in both models. In the model for men, income has a significant positive relationship with access to a car. Income thus affects the frequency with which men can use a car. This in turn has a positive impact on their perceived accessibility through the mediating variable of actual car use. On the other hand, in the model for women income has no significant relationship with car access, however, car access is directly related to women's perceived accessibility. To add to this, when looking further into the data, the average access to a car is quite a bit lower for women than for men, however, in this model this direct effect was not significant.

Sub-question 4: How do the main factors found to be relevant for perceived accessibility from a gender intersectional perspective relate to the past, present and future (urban) transport system in The Netherlands?

Finally, the factors perceived safety at night, transport restrictions and access to a car which were especially relevant from a gender intersectional perspective were elaborated on using a workshop with experts as a data source. From this it became clear that with regard to perceived safety, efforts are being made by both public institutions and (public) transport companies, however, some parts, like improving the lighting of footpaths have long been neglected. Furthermore, gender differences are not taken into account to a sufficient extent to make sure that safety for women in transport improves, which explains why safety at night is still an important negative mediator for the relationship between gender and perceived accessibility. With regard to transport restrictions and access to a car, the traditional gender roles that exist to this day are seen as an important explanation for why women may have disadvantage on these points. Additionally, more attention to the travel patterns of women in transport planning and policy than is currently done could help mitigate the disadvantages women experience. Overall, further integrating this type of gender mainstreaming could be beneficial for gender equity in the future.

7.2 Main research question

By summing up the results of the discussed sub-research questions, the main research question can be answered. Firstly, gender affects perceived accessibility through one important mediating factor in The Netherlands: perceived safety at night. In The Netherlands attention to this issue has only recently been rising which makes it still an important factor of attention for the future. The intersection of gender and having young children affects perceived accessibility, as women with young children averagely feel they have more restrictions in their choice of transport mode when they are trip chaining, while for men this is not the case. This could be explained by women still having more responsibility for childcare. In this relationship, it seems traditional gender roles are playing a role in accessibility inequities. Lastly, an interesting mediating variable from an intersectional perspective is access to a car. While for men, a higher household income coincides with a higher level of access to a car, for women this relationship does not exist. This suggests that for households that have a high enough income to afford a car, its primary user is the man. Given that this factor of access to a car relates positively to perceived accessibility for both men and women, this is an important factor.

7.3 Limitations and future research

Like all research, the different stages in this research all know their own limitations which are important to keep in mind when interpreting the results. These limitations also connect to some possibilities for future research that would be of value. In this Section, these limitations and the possibilities for future research are discussed.

Firstly, the first part of the research concerned multiple literature reviews. In these reviews certain search words were selected based on their applicability, however, it is possible that given the limited time, certain papers were not found which could have offered more factors. This does not mean that the current model is not useful, however, there is a chance that it could be expanded upon in future research. For example, if paying for travel and booking tickets would become even more dependent on the smartphone, digital skills would become even more important for travel than they are now, which would in turn likely affect perceived accessibility inequalities.

The next stage of the research used surveys to gather data. Surveys in themselves come with certain technical limitations. The author's perspective was used in making the survey questions, and these can be interpreted differently by different people. For example, the survey asks people whether they live in an urban or rural area, however, different people could ascribe different meanings to these two concepts. Additionally, the survey was distributed using a digital format and included only three languages (Dutch, English, and Brazilian Portuguese), as efforts to include other languages like Turkish were not successful, given the limited time. This means that people who are not digitally skilled, like the elderly,

or able to speak one of these languages were excluded from the survey. With regard to digital skills, it was taken into account in the analysis of results that elderly people were not reached to a large extent. Furthermore, with regard to languages, the problem is not seen as too large a problem as many people in The Netherlands do speak either Dutch or English, and this particular research does not focus on how people from different (immigrant) backgrounds perceived their accessibility. If potential future research would focus on the perceived accessibility of people with an immigrant background, including more languages would of course be essential.

The difficulties with distributing surveys with a restricted budget and timeframe also show the value of performing this study with a larger data set more representative of Dutch society in the future. With a larger dataset, more relationships between various factors and perceived accessibility could likely be found, providing even more information on perceived accessibility issues. One way to be able to do larger studies on perceived accessibility is if perceived accessibility issues would be added to the Netherlands Mobility Panel. This large-scale mobility study does not currently involve general perceived accessibility questions, however, these types of questions would fit well within the study and would be of great value to get more insights into perceived accessibility in The Netherlands.

The data in this research was analysed using Structural Equation Modelling (SEM). While a very useful method, it also comes with limitations. Firstly, due to the structure of these types of models, people who neither identified as men nor women were excluded from the data set. In an ideal world, these people could have been analysed as a separate group, however, too few people who neither identified as women or men were present in the data. This does not cause a large problem for this particular research as its main focus is on the difference between men and women. However, it is important to acknowledge that in looking at just men and women, other groups could not be included. Secondly, it can be difficult in SEM to prove that the correlation found equals causation. However, by using literature as a basis and finding context for the most important results in the subsequent qualitative research part, indications for causation can be established.

Lastly, a workshop was used to gather qualitative data to give contextual explanations for the most relevant factors found in the quantitative analysis. Because of the limited time and various scheduling issues, the number of participants was not as high as it could have been, which means there were fewer perspectives on the issue. However, the participants were from varied backgrounds, making the perspectives that were given diverse. Additionally, like for the surveys, the workshop was put together based on the author's perspective and is very likely to include certain biases, something which also goes for the workshop participants.

Overall, due to the limited budget and time, various avenues of research were left unexplored. Firstly, a qualitative follow-up to this research would be of value. Using a method like interviews, more explanation could be given on why certain relationships between factors exist. This in turn could help give more precise ways with which policies can aim to reduce inequality factors. This leads us to the following potential future research subject, as it would be interesting to see how effective past and current policies are in increasing equality for women in accessibility. It would for example be interesting to see to what extent improving lighting in the streets would improve perceived accessibility levels for women. For this, however, extensive data would be needed. For the third potential venue for future research, the difference in perceived safety at night and during the day is important. This research showed that perceived safety at night is significantly related to perceived accessibility while perceived safety during the day is not. A factor of interest that this brings forward is whether this factor also only affects perceived accessibility during the night, which seems likely. To this author's awareness, no research had been done that shows differences between perceived accessibility during the day and during the night. However, this could be very relevant as it is likely that factors like safety, but also travel times and primary modes used are very different between the day and the night.

Last but not least, in scoping this study it was decided to only look at perceived accessibility and the factors that influence it. However, higher or lower levels of perceived accessibility have larger implications on people's lives. As discussed in the theoretical part of this study, lower perceived accessibility levels can lead to social exclusion and other types of exclusion, e.g. from employment. However, these larger implications were not explicitly included in this study due to time and budget limitations. Future research on these larger implications of perceived accessibility levels would be very valuable, as this can determine to what extent (lower) perceived accessibility levels actively lead to problems and inequalities in society.

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Appendix

Appendix A: Extended Summary

Introduction

The transport system is essential for all people to do the various spatially distributed activities they need and want to do. This access to activities is thus very important from a social and economic perspective. However, this also means that when inequalities exist in access to activities, there is a risk of social exclusion of certain groups of people. Poor access to transport, and thus low levels of accessibility, can be the cause of people's social exclusion (Dixit & Sivakumar, 2020; Social Exclusion Unit, 2003). Social exclusion can have a far-reaching impact on people's lives, as socially excluded people have a higher probability to be unemployed, have higher rates of bad health and on average have higher rates of bad health and on average have fewer years of education (Mackett & Thoreau, 2015).

To avoid the social exclusion of certain groups, it is thus important to have equal accessibility levels across groups. However, measuring accessibility levels is not straightforward as these can be measured in various ways, ranging from calculated (objective) accessibility metrics to perceived (subjective) accessibility measures (Ryan & Pereira, 2021). In the context of social exclusion, perceived accessibility is a very relevant concept. This concept can be defined as "*how easy it is to live a satisfactory live using the transport system"* (Lättman et al., 2016b, p.2), and thus looks at people's perception of their accessibility levels. These perceptions will be used for decisions with regard to people's own mobility behaviour, and can thus relate closely to social exclusion.

People's perceived accessibility can be related to various individual factors like gender, income or age. Gender has been shown to have a significant effect on mobility behaviour and perceived accessibility due to various factors, such as women traditionally having more childcare responsibilities (Carboni et al., 2022; Miralles-Guasch et al., 2016). When looking at accessibility issues from a gender perspective, the feminist concept of intersectionality is very relevant, as this looks at the interconnected nature of disadvantage due to being a part of multiple disadvantaged groups (Bridgman et al., 2022), which is likely to also affect disadvantage in perceived accessibility.

Gender equity is strived for around the world and also in The Netherlands (Rijksoverheid, n.d.). To achieve gender equity knowledge is needed on areas of gender inequity. One of these areas of gender inequity could be the perceived accessibility of the transport system. However, a literature review shows that little research has been done into how gender and intersectional factors can affect perceived accessibility. Some perceived accessibility studies, for example by Calvert et al. (2022) or van der Vlugt et al. (2019), include gender as one of many factors investigated. Interestingly, some studies find that being a woman has a positive relationship with perceived accessibility levels (e.g. Lättman et al., 2019). This seems counterintuitive given certain restrictions women can face in transport with regard to, for example, perceived safety (Jamei et al., 2022). However, none of the literature found seeks to explain the relationship between gender and perceived accessibility. Additionally, none of this found literature includes the concept of intersectionality in a meaningful way to explain certain disadvantages with regard to perceived accessibility.

Thus, a knowledge gap exists with regard to the way gender and intersectional factors affect perceived accessibility. This thesis seeks to fill this knowledge gap in the context of The Netherlands by answering the following main research question: ***How do gender and intersectional factors affect the perceived accessibility of people in urban areas in The Netherlands?*** To answer this research question, a mixed research approach is used, which is elaborated on next.

Research approach and methods

To answer the main research question in this thesis a mixed-method approach is used. A strength of this method is that the quantitative and qualitative approaches can complement each other, which makes for

more robust research (Ivankova et al., 2006). In the case of this research, the first part of the research will consist of two literature reviews to achieve a theoretical basis for the research in which the various factors through which gender intersectional factors could impact perceived accessibility according to literature can be represented in one conceptual model.

Next, this conceptual model can be used as a basis for the quantitative stage of the research. In this stage, the strength of relationships between the factors represented in the conceptual model is tested using the method of Structural Equation Modelling (SEM). SEM is a useful statistical tool and can, based on theory, test the strength and statistical significance of relationships between factors simultaneously in one model that includes multiple equations (Thakkar, 2020). Using SEM, three categories of models are made. Firstly, a simple model which only includes the socio-demographic variables and perceived accessibility, is used for all data and for just the data from women and from men. Secondly, a general model based on the made conceptual accessibility model is implemented using the complete dataset. Lastly, two intersectional models are implemented, which use the same model structure as the general model but only with data from women and with data from men, using a multigroup analysis. To perform this analysis, data is needed, which is gathered using surveys for which the questions are made based on the theoretical conceptual model.

Lastly, the results of the quantitative analysis will be related to the transport system in The Netherlands to find potential areas of improvement for which a qualitative method is used: a workshop with experts. In this workshop, experts in the transport (policy) field are introduced to the results of the quantitative research and are asked to relate this back to the transport past, current and future transport systems. Thus, using the mixed-methods approach and the various methods explained a complete picture of the way gender and intersectional factors affect people's perceived accessibility can be gained.

Conceptualisation

To get an overview of the factors that have a relationship with perceived accessibility and the gender intersectional perspective that can be connected to them, literature reviews are done. In the first literature review, papers that include research into factors influencing perceived accessibility are selected to get a complete overview of general factors that can affect perceived accessibility. In doing so, the following (categories of) factors are found to be relevant for perceived accessibility:

- *Perceived safety* (e.g. Lättman et al., 2016; van der Vlugt et al., 2019)
- *Primary transport mode* (e.g. Lättman et al., 2018; Tanimoto & Hanibuchi, 2021)
- *Socio-demographic factors*: Age (e.g. Lukina et al., 2021), Education (e.g. Jamei et al., 2022), Gender (e.g. Friman et al., 2020a), Disability/health (e.g. Márquez et al., 2019) and (Household) income (e.g. van der Vlugt et al., 2019)
- *(Perception of) service quality*: consists of Information, Functionality, Comfort, Courtesy and Simplicity (Jamei et al., 2022; Lättman et al., 2016a)
- *Individual component*: Personal temporal constraints (Pot et al., 2021), Transport flexibility (van Wee, 2022) and Abilities like the ability to drive a car (Curl, 2018)
- *Social environment*: Social network support (van Wee, 2022) and Social norms (Pot et al., 2020)
- *(Perception of) physical environment*: Residential area (e.g. Jamei et al., 2022), Rate of choice destinations (e.g. Pot et al., 2021), (Perception of) activity distribution (e.g. van Wee, 2022) and Awareness of activities (Chen et al., 2022)
- *(Perception of) temporal component*: Perception of travel times (Jamei et al., 2022) and Perception of temporal constraints of activities (van Wee, 2022)
- *(Perception of) transport system*: Perceptions of travel supply (Pot et al., 2021), Perceptions of travel resistance (Pot et al., 2021) and Perception of transport modes (Chen et al., 2022)

The (categories of) factors above all have the potential to influence perceived accessibility, and can also influence each other. To connect a gender intersectional perspective to these findings a second literature

review is done using papers on gender (equity) and mobility. Based on the selected literature seven categories of travel behaviour are found in which gender differences are especially relevant, being:

1. *Purpose of trips*: women's purposes of travel generally involve more care responsibilities than men's (Thynell, 2016), which also adds to women's time and space constraints (Priya Uteng, 2021)
2. *Trip chaining*: women more often have multiple purposes when making trips, resulting in them generally trip-chaining more than men (Montoya-Robledo & Escovar-Álvarez, 2020), resulting in a higher level of time poverty (Mejía-Dorantes & Soto Villagrán, 2020)
3. *Distribution and concentration of trips*: security concerns and preferences generally result in women taking fewer trips in the late evening and night (Priya Uteng, 2021)
4. *Car availability and driver's license*: traditionally, women have less access to a car and are less often in possession of a driver's license than men (Dobss, 2007; Gil Solá & Vilhelmson, 2022). This difference has become smaller over the years but still exists (Priya Uteng, 2021)
5. *Trip durations and distances*: women tend to on average have shorter travel times than men (Gupta & Bhamoriya, 2021; Lo & Houston, 2018)
6. *Transport modes*: differences exist in the modes used by women and by men, where generally women use public transport more and walk more than men (Montoya-Robledo & Escovar-Álvarez, 2020; Priya Uteng, 2021)
7. *Safety and Security*: women generally have a lower perceived safety in transport and are more concerned with safety concerns when travelling, especially in the late evening and at night (Busco et al., 2023; Dobbs, 2007; Mejía-Dorantes & Soto Villagrán, 2020)

The above points of difference in mobility based on gender and accompanying intersectional factors can be connected to the general factors presented which affect perceived accessibility to make an accessibility conceptual model with gender intersectional perspective as shown in Figure A.1.

Quantitative part: Structural Equation Modelling

To test the strength of relationships between various factors found in literature in the context of The Netherlands, a survey is used to gather data with which the Structural Equation Models can be made. In constructing the survey various scoping decisions need to be made to reduce the length of the survey and the complexity of the model. Some factors are excluded from the survey due to the privacy risk, which is for example the case for the factor of disability/health. Others are excluded as their value in finding gender differences in perceived accessibility is deemed limited, which is for example the case for a number of the perception of accessibility components. Figure A.2 shows all the factors finally included in the general model.

To distribute the survey, the author's own network and that of a fellow student are used, as well as social media and flyers. After cleaning the data this results in 242 cases. Due to the method of distribution, some biases exist in the data. For example, the elderly, people older than 75 in this case, are not well represented in the data. Additionally, the education level of the respondents is average rather high. This is something to keep in mind when interpreting the model results.

The first model made is a simple model with only the socio-demographic variables and perceived accessibility. This model, with a good model fit (CFI = 0.994, RMSEA = 0.034, Probability Level = 0.216) (Hu & Bentler, 1999), shows that gender has a significant negative relationship with perceived accessibility (-0.219, standardized). This means that for women perceived accessibility is generally lower. Additionally, by using the simple model separately for data from women and for data from men it is found that for women income has a significant positive relationship with perceived accessibility (0.265, standardized), while for men age has a significant positive relationship with perceived accessibility (0.258, standardized).

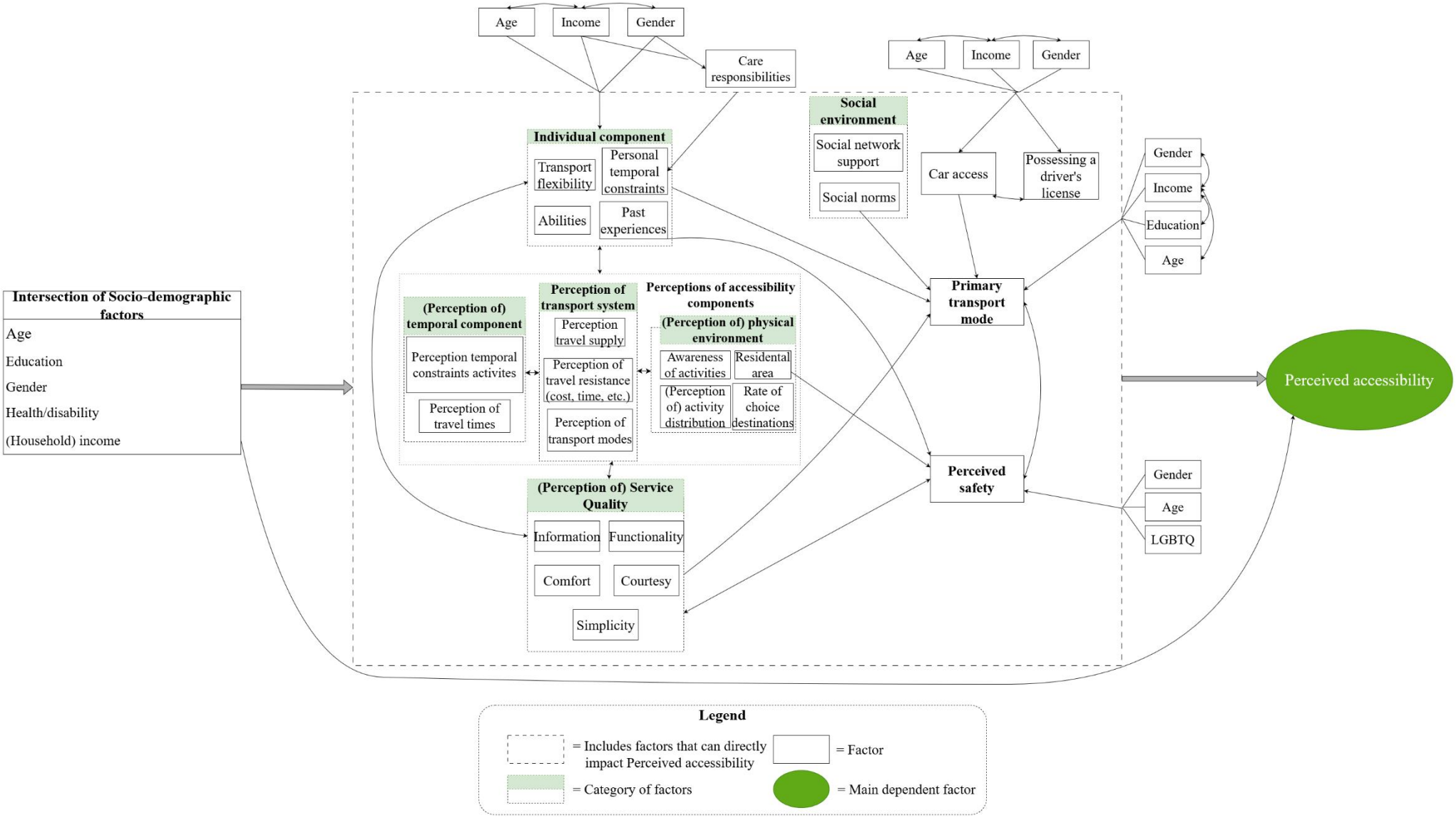


Figure A.1 Accessibility conceptual model with gender intersectional perspective. Socio-demographic factors are shown multiple times, outside of the dotted square, to show the gender and intersectional factors that are specifically relevant for various factors in the model.

To explain these relationships further the general model is made, based on the conceptual accessibility model and the scoping decisions as discussed before. A graphical representation of the general model is shown in Figure S.2.

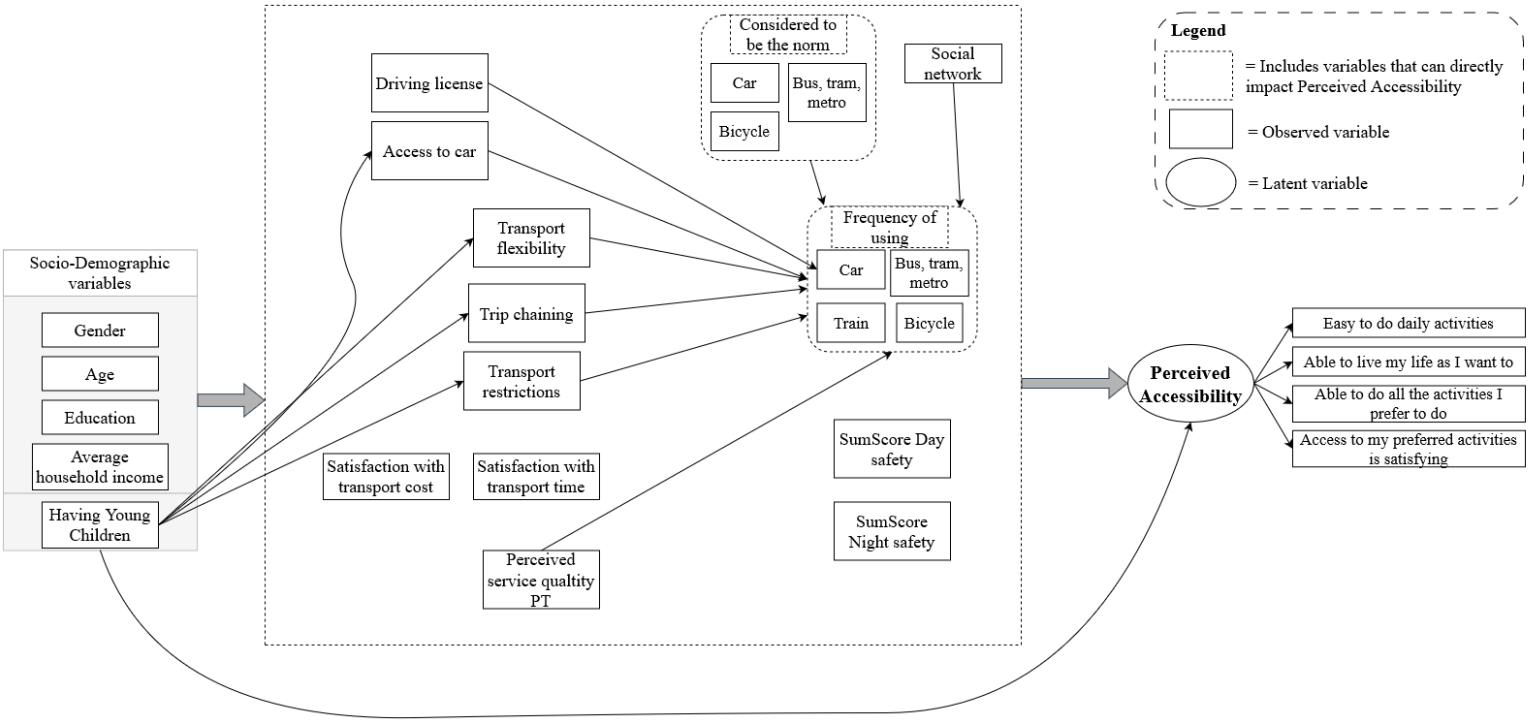


Figure A.2 Representation of the general model as implemented in Amos. The socio-demographic variables on the left can affect all variables in the dotted square, which in turn can all directly affect Perceived Accessibility (PAC). Additionally, the black arrows show (potential) relationships between the various variables based on literature.

The general model shows a good model fit (CFI = 0.995, RMSEA = 0.015, Chi-Square Probability level = 0.279) (Hu & Bentler, 1999) and contains various interesting results, the complete overview of which can be found in the full report. Results show that the socio-demographic variables impact perceived accessibility (PAC) in various ways. For example, age impacts perceived accessibility positively through having a driver's license, access to a car and satisfaction with time of transport. However, age impacts perceived accessibility negatively through perceived safety at night. These different impacts may explain why certain socio-demographics like age showed no direct impact on perceived accessibility in the simple model. The main path of interest in this model is the path between gender and perceived accessibility. Gender (or being a woman) has a significant relationship with two mediating factors in the model: perceived safety during the day (-0.230, standardized) and perceived safety during the night (-0.391, standardized). In the general model, gender only affects perceived accessibility through perceived safety at night, as perceived safety during the day does not have a significant relationship with perceived accessibility in this model.

In the next part of the modelling process, the general model is used to make two intersectional models, one with data from men and one with data from women. From a gender intersectional perspective, these models show two especially interesting results. Firstly, for men, income relates positively to access to a car, which in turn positively impacts their perceived accessibility through the use of a car. For women, access to a car directly positively relates to perceived accessibility, however, income has no significant relationship with access to a car. This supports the theory that when a car can be afforded when there is a higher average household income, the primary user of this car is the man. Secondly, the intersectional model shows that for women, having young children adds to the transport mode choice restrictions they face when trip-chaining, which in turn is negatively related to their perceived accessibility. However, in the model with data from men, this relationship is not significant. Thus, it seems that women's caring responsibilities indeed restrict their perceived accessibility in this way.

Qualitative part: Workshops

To connect the quantitative results to the existing transport system in The Netherlands a workshop with three experts in the field of transport (policy) is done. From this workshop, it is clear that limited attention has been given to increasing feelings of safety in the transport system in The Netherlands. Currently, issues like increasing safety on cycling and pedestrian paths are gaining attention, but are still not a focus on a policy level. Additionally, public transport companies are working together in their efforts to increase safety. However, no cooperation seems to exist between municipalities, responsible for many cycling and pedestrian paths, and the public transport companies. Thus it is not surprising that perceived safety is still an area of gender inequity in the transport system. Additionally, the traditional gender roles that exist in The Netherlands to this day also play an important part in the gender inequities found in access to a car and the additional transport restrictions women feel they have when they have young children compared to men. However, transport policies could aim to mitigate the differences between men and women by actively taking differences between travellers into account when designing policies, which up till now has not been done to a large extent.

Discussion and Conclusion

A number of conclusions can be drawn from the research. Firstly, the concept of perceived accessibility is very broad and can be influenced by a large variety of factors as found in the literature. Secondly, it was found in the quantitative part that being a woman has a negative relationship with perceived accessibility in The Netherlands. Based on the found literature on gender differences in mobility this result was not surprising. However, it is surprising when it is compared to other quantitative studies on perceived accessibility which included gender, as none of these studies found this effect (e.g. Vitman-Schorr et al., 2019; Lättman et al., 2019). This may be due to the context of the research as these studies were performed in different countries. Additionally, it was found in the quantitative part that a relevant explaining factor for the relationship between gender and perceived accessibility is perceived safety at night. The fact that perceived safety levels in transport are lower for women is not surprising as this has been shown before by, for example, Abenoza et al. (2018). However, a new interesting finding is that only the lower perceived safety at night, and not during the day, results in lower perceived accessibility in this model for The Netherlands. Next to these results, the intersectional models also showed two interesting results from a gender perspective. The first is that for men, income has a positive significant relationship with access to a car, while for women this effect does not exist. Furthermore, women are shown to feel more restrictions in their transport mode choice when trip chaining when they have young children which in turn relates negatively to their perceived accessibility, while these relationships do not exist for men. The qualitative part of the research resulted in some explanations for these quantitative findings. Firstly, it was found that increasing (perceived) social safety in transport has had little attention in past transport policies, and has only recently become a somewhat more important subject. With regard to transport restrictions and access to a car, traditional gender roles which exist to this day still seem to play a role. However, transport policies have also not focused sufficiently on differences between travellers meaning that the gender differences found have also not been mitigated to a large extent.

There are various potential subjects for future research following this thesis. Future research could go further into these quantitative results using qualitative methods to find further explanations for these relationships and especially what type of policy could help to reduce gender inequalities in perceived accessibility. Additionally, the impact of perceived safety at night could be investigated more by specifically looking at differences in perceived accessibility at night and during the day. Lastly, it would be of value for future research to expand upon this research and also look into the effects of (low) perceived accessibility levels on factors like well-being and social exclusion.

Appendix B: Ethics Committee forms

In this Appendix, the Ethics forms submitted to and approved by the HREC are shown.

Appendix B.1 Ethics checklist

Applicant Information

PROJECT TITLE:	**Accessibility and Gender: an intersectional approach**
Research period: *Over what period of time will this specific part of the research take place*	**March 2023 – July 2023**
Faculty:	**Technology, Policy and Management (TPM)**
Department:	**CoSEM**
Type of the research project: *(Bachelor's, Master's, DreamTeam, PhD, PostDoc, Senior Researcher, Organisational etc.)*	**Master's thesis**
Funder of research: *(EU, NWO, TUD, other – in which case please elaborate)*	**None**
Name of Corresponding Researcher: *(If different from the Responsible Researcher)*	**Iris Roeleven**
E-mail Corresponding Researcher: *(If different from the Responsible Researcher)*	
Position of Corresponding Researcher: *(Masters, DreamTeam, PhD, PostDoc, Assistant/ Associate/ Full Professor)*	**Master student**
Name of Responsible Researcher: ***Note:*** *all student work must have a named Responsible Researcher to approve, sign and submit this application*	**Maarten Kroesen**
E-mail of Responsible Researcher: *Please ensure that an institutional email address (**no Gmail, Yahoo, etc.**) is used for all project documentation/ communications including Informed Consent materials*	
Position of Responsible Researcher : *(PhD, PostDoc, Associate/ Assistant/ Full Professor)*	**Associate Professor**

I.

II. Research Overview

Please summarise your research very briefly (100-200 words)

What are you looking into, who is involved, how many participants there will be, how they will be recruited and what are they expected to do?

Add your text here – (please avoid jargon and abbrevations)

In my research, I will look into the effect of gender and intersectionality on perceived accessibility. Perceived accessibility in this context is defined as how easy people feel it is to live a satisfactory life using the existing transport system. The main research question is the following: "*How do gender and intersectionality factors affect the perceived accessibility of people in The Netherlands?".*

To answer this question a mixed research approach will be used. Based on literature reviews, a conceptual framework will be made which shows how gender and intersectionality can theoretically impact perceived accessibility. Consequently, a survey will be made to test the relationships in the conceptual model, where a sample of people living in The Netherlands (approx. 150 – 500 people) will be asked to fill it out. These people are recruited through the author's own network and by distributing flyers. This data will be analysed. The results will then be given more meaning by performing a workshop (plan A) (approx. 5 people) or multiple interviews (approx. 5 people) with experts in the field (plan B). As the decision on whether to do a workshop or multiple interviews has not yet been made, both options are included in all submitted HREC forms.

It should be noted that for the surveys, this research study is combined with the work of fellow CoSEM master student Luisa de La Vega Bayma de Oliveira, who has the same supervising team. This means that one survey will be used to gather data for both studies.

a) **If your application is an additional project** related to an existing approved HREC submission, please provide a brief explanation including the existing relevant HREC submission number/s.

Add your text here – (please avoid jargon and abbrevations)

b) **If your application is a simple extension of, or amendment to,** an existing approved HREC submission, you can simply submit an HREC Amendment Form as a submission through LabServant.

Risk Assessment and Mitigation Plan

Please complete the following table in full for all points to which your answer is "yes". Bear in mind that the vast majority of projects involving human participants as Research Subjects also involve the collection of **Personally Identifiable Information (PII)** and/or **Personally Identifiable Research Data (PIRD)** which may pose potential risks to participants as detailed in Section G: Data Processing and Privacy below.

To ensure alighment between your risk assessment, data management and what you agree with your Research Subjects you can use the last two columns in the table below to refer to specific points in your Data Management Plan (DMP) and Informed Consent Form (ICF) – **but this is not compulsory**.

It's worth noting that **you're much more likely to need to resubmit your application if you neglect to identify potential risks**, than if you identify a potential risk and demonstrate how you will mitigate it. If necessary, the HREC will always work with you and colleagues in the Privacy Team and Data Management Services to see how, if at all possible, your research can be conducted.

			If YES please complete the Risk Assessment and Mitigation Plan columns below.		*Please provide the relevant reference #*	
ISSUE	**Yes**	**No**	**RISK ASSESSMENT – what risks could arise?** *Please ensure that you list ALL of the actual risks that could potentially arise – do not simply state whether you consider any such risks are important!*	**MITIGATION PLAN – what mitigating steps will you take?** *Please ensure that you summarise what actual mitigation measures you will take for each potential risk identified – do not simply state that you will e.g. comply with regulations.*	**DMP**	**ICF**
A: Partners and collaboration						
1. Will the research be carried out in collaboration with additional organisational partners such as: • One or more collaborating research and/or commercial organisations • Either a research, or a work experience internship provider[1] *[1] If yes, please include the graduation agreement in this application*		**x**				
2. Is this research dependent on a Data Transfer or Processing Agreement with a collaborating partner or third party supplier? *If yes please provide a copy of the signed DTA/DPA*		**x**				
3. Has this research been approved by another (external) research ethics committee (e.g.: HREC and/or MREC/METC)? *If yes, please provide a copy of the approval (if possible) and summarise any key points in your Risk Management section below*		**x**				
B: Location						

			If YES please complete the Risk Assessment and Mitigation Plan columns below.		*Please provide the relevant reference #*	
ISSUE	**Yes**	**No**	**RISK ASSESSMENT – what risks could arise?** *Please ensure that you list ALL of the actual risks that could potentially arise – do not simply state whether you consider any such risks are important!*	**MITIGATION PLAN – what mitigating steps will you take?** *Please ensure that you summarise what actual mitigation measures you will take for each potential risk identified – do not simply state that you will e.g. comply with regulations.*	**DMP**	**ICF**
4. Will the research take place in a country or countries, other than the Netherlands, within the EU?		**x**				
5. Will the research take place in a country or countries outside the EU?		**x**				
6. Will the research take place in a place/region or of higher risk – including known dangerous locations (in any country) or locations with non-democratic regimes?		**x**				
C: Participants						
7. Will the study involve participants who **may** be vulnerable and possibly (legally) unable to give informed consent? (e.g., children below the legal age for giving consent, people with learning difficulties, people living in care or nursing homes,).		**x**				
8. Will the study involve participants who **may** be vulnerable under specific circumstances and in specific contexts, such as victims and witnesses of violence, including domestic violence; sex workers; members of minority groups, refugees, irregular migrants or dissidents?	**x**		Survey: As the survey is conducted voluntarily by a sample of Dutch citizens, there may be vulnerable people amongst the people who decide to participate in the survey. These people might feel emotional or mental discomfort while filling out the survey. Workshop: not a risk Interviews: not a risk	Survey: No directly identifiable data will be gathered in the survey. Furthermore, the survey will not be designed to collect data about the vulnerabilities of respondents. Moreover,, it will be made clear to respondents on the first page of the survey that they can quit at any time. Lastly, only adults (people older than 18) will be asked to fill out the survey. Workshop: not a risk Interviews: not a risk		
9. Are the participants, outside the context of the research, in a dependent or subordinate position to the investigator (such as own children, own students or employees of either TU Delft and/or a collaborating partner organisation)? *It is essential that you safeguard against possible adverse consequences of this situation (such as allowing a student's failure to participate to your satisfaction to affect your evaluation of their coursework).*		**x**				
10. Is there a high possibility of re-identification for your participants? (e.g., do they have a very specialist job of which there are only a small number in a given country, are they members of a small community, or employees from a partner company collaborating in the research? Or are they one of only a handful of (expert) participants in the study?	**x**		Survey: For the research of fellow master student Luisa de La Vega Bayma de Oliveira, the postcode of peole will be asked. Combining the postcode of people with the other socio-demographic data that will be asked (like gender, age range) there is a risk that people could be re-identified. Workshop: not a risk	Survey: Individual data will not be published in any way, only aggregated data, so re-identification from published data is impossible. In addition, the survey data will be stored securely in the TU Delft OneDrive and only be privately available in the TU Delft OneDrive for the author, collaborator and supervisors. Workshop: not a risk		

			If YES please complete the Risk Assessment and Mitigation Plan columns below.		*Please provide the relevant reference #*	
ISSUE	**Yes**	**No**	**RISK ASSESSMENT – what risks could arise?** *Please ensure that you list ALL of the actual risks that could potentially arise – do not simply state whether you consider any such risks are important!*	**MITIGATION PLAN – what mitigating steps will you take?** *Please ensure that you summarise what actual mitigation measures you will take for each potential risk identified – do not simply state that you will e.g. comply with regulations.*	**DMP**	**ICF**
			Interview: not a risk	Interview: not a risk		
D: Recruiting Participants						
11. Will your participants be recruited through your own, professional, channels such as conference attendance lists, or through specific network/s such as self-help groups		**x**				
12. Will the participants be recruited or accessed in the longer term by a (legal or customary) gatekeeper? (e.g., an adult professional working with children; a community leader or family member who has this customary role – within or outside the EU; the data producer of a long-term cohort study)		**x**				
13. Will you be recruiting your participants through a crowd-sourcing service and/or involve a third party data-gathering service, such as a survey platform?	**x**		Survey: Qualtrics will be used as a survey platform. As this is a platform from the US, there is a risk of personal data breach, which could lead to (reputational) damage to participants. Workshop: not a risk Interviews: not a risk	Survey: Qualtrics has been approved by the TU Delft and therefore is aligned with the regulations. To still minimize the potential damage of a data breach, no directly identifiable personal data will be asked for in the main survey. Additionally, questions regarding personal data will be made as broad as possible, for example, by asking for an age range and income range instead of specific numbers. This way the potential damage of a data breach is lessened. To minimize the risk of data breach itself the guidance from the TU Delft with regard to Qualtrics will be followed, where survey and answers will be downloaded from Qualtrics once sufficient people have filled out the survey, after which the survey and data will be deleted from Qualtrics. To be able to give away a gift card to one or two of the participant, email addresses will need to be collected. However, by linking to a different survey to collect email addresses and turning off the registration of Ip-addresses etc., these email addresses will not be linked to survey answers. This also limits the damage of a data breach. Workshop: not a risk Interviews: not a risk		

			If YES please complete the Risk Assessment and Mitigation Plan columns below.		*Please provide the relevant reference #*	
ISSUE	**Yes**	**No**	**RISK ASSESSMENT – what risks could arise?** *Please ensure that you list ALL of the actual risks that could potentially arise – do not simply state whether you consider any such risks are important!*	**MITIGATION PLAN – what mitigating steps will you take?** *Please ensure that you summarise what actual mitigation measures you will take for each potential risk identified – do not simply state that you will e.g. comply with regulations.*	**DMP**	**ICF**
14. Will you be offering any financial, or other, remuneration to participants, and might this induce or bias participation?	**x**		Survey: participants of the survey will be given the opportunity to enter a lottery to win a Bol.com gift voucher. To be able to do this email addresses of those people who want to enter the lottery will need to be collected. This could enlarge the risk of re-identification of participants and their survey answers. Additionally, it could cause a bias for people who are more responsive to a monetary incentive. Workshop: not a risk Interviews: not a risk	Survey: to minimize the risk of re-identification, the email addresses of participants will not be gathered in the same survey as the one in which participants have to answer questions. Instead at the end of this survey, there will be a link to another survey which has the sole purpose of gathering email addresses for a lottery draw. By also turning on the anonymise data option in Qualtrics, IP-addresses will not be gathered making the risk of linking the survey answers to the email address minimal and therefore making the survey anonymous By using this method participants will only be able to participate in the lottery draw at the end of the survey. As they have to fill in their email address, this will minimize the risk of people doing the survey multiple times as they would either have to put the same email address multiple times, in which case they will be disqualified, or putting in additional effort by making more email addresses, which would be disproportional for the limited chance of reward. Workshop: not a risk Interviews: not a risk		
E: Subject Matter *Research related to medical questions/health may require special attention. See also the website of the CCMO before contacting the HREC.*						
15. Will your research involve any of the following: • Medical research and/or clinical trials • Invasive sampling and/or medical imaging • Medical and *In Vitro Diagnostic Medical* Devices Research		**x**				
16. Will drugs, placebos, or other substances (e.g., drinks, foods, food or drink constituents, dietary supplements) be administered to the study participants? If yes see here to determine whether medical ethical approval is required		**x**				
17. Will blood or tissue samples be obtained from participants? If yes see here to determine whether medical ethical approval is required		**x**				

			If YES please complete the Risk Assessment and Mitigation Plan columns below.		*Please provide the relevant reference #*	
ISSUE	**Yes**	**No**	**RISK ASSESSMENT – what risks could arise?** *Please ensure that you list ALL of the actual risks that could potentially arise – do not simply state whether you consider any such risks are important!*	**MITIGATION PLAN – what mitigating steps will you take?** *Please ensure that you summarise what actual mitigation measures you will take for each potential risk identified – do not simply state that you will e.g. comply with regulations.*	**DMP**	**ICF**
18. Does the study risk causing psychological stress or anxiety beyond that normally encountered by the participants in their life outside research?		x				
19. Will the study involve discussion of personal sensitive data which could put participants at increased legal, financial, reputational, security or other risk? (e.g., financial data, location data, data relating to children or other vulnerable groups) *Definitions of sensitive personal data, and special cases are provided on the TUD Privacy Team website.*		x				
20. Will the study involve disclosing commercially or professionally sensitive, or confidential information? (e.g., relating to decision-making processes or business strategies which might, for example, be of interest to competitors)		x				
21. Has your study been identified by the TU Delft Privacy Team as requiring a Data Processing Impact Assessment (DPIA)? *If yes please attach the advice/ approval from the Privacy Team to this application*		x				
22. Does your research investigate causes or areas of conflict? *If yes please confirm that your fieldwork has been discussed with the appropriate safety/security advisors and approved by your Department/Faculty.*		x				
23. Does your research involve observing illegal activities or data processed or provided by authorities responsible for preventing, investigating, detecting or prosecuting criminal offences *If so please confirm that your work has been discussed with the appropriate legal advisors and approved by your Department/Faculty.*		x				
F: Research Methods						
24. Will it be necessary for participants to take part in the study without their knowledge and consent at the time? (e.g., covert observation of people in non-public places).		x				
25. Will the study involve actively deceiving the participants? (For example, will participants be deliberately falsely informed, will information be withheld from them or will they be misled in such a way that they are likely to object or show unease when debriefed about the study).		x				
26. Is pain or more than mild discomfort likely to result from the study? And/or could your research activity cause an accident involving (non-) participants?		x				
27. Will the experiment involve the use of devices that are not 'CE' certified? *Only, if 'yes': continue with the following questions:*		x				

			If YES please complete the Risk Assessment and Mitigation Plan columns below.		*Please provide the relevant reference #*	
ISSUE	**Yes**	**No**	**RISK ASSESSMENT – what risks could arise?** *Please ensure that you list ALL of the actual risks that could potentially arise – do not simply state whether you consider any such risks are important!*	**MITIGATION PLAN – what mitigating steps will you take?** *Please ensure that you summarise what actual mitigation measures you will take for each potential risk identified – do not simply state that you will e.g. comply with regulations.*	**DMP**	**ICF**
• Was the device built in-house?						
• Was it inspected by a safety expert at TU Delft? *If yes, please provide a signed* device report						
• If it was not built in-house and not CE-certified, was it inspected by some other, qualified authority in safety and approved? *If yes, please provide records of the inspection*						
28. Will your research involve face-to-face encounters with your participants and if so how will you assess and address Covid considerations?	**x**		Survey: not a risk Workshop: The workshop can be held either face-to-face or online, but preferably face-to-face. If held face-to-face, there is a chance of Covid being transmitted There is also a chance of participants being vulnerable with regard to their health, making their participation more uncomfortable for them. Interview: The interviews can be held either face-to-face or online. If held face-to-face, there is a chance of Covid being transmitted There is also a chance of participants being vulnerable with regard to their health, making their participation more uncomfortable for them.	Survey: not a risk Workshop: Currently, the Covid restrictions are very limited. However, to reduce risk, participants will be asked to test for Covid if they are feeling sick but still want to participate. Additionally, face-to-face meetings with participants will not be held in too small spaces where people are forced to be close together. It will be made clear to participants that if they feel uncomfortable meeting in person, they will be given the opportunity to attend the workshop online. Interviews: Currently, the Covid restrictions are very limited. However, to reduce risk, participants will be asked to test for Covid if they are feeling sick but still want to participate. Additionally, face-to-face meetings with participants will not be held in too small spaces where people are forced to be close together. It will be made clear to participants that if they feel uncomfortable meeting in person, they will be given the opportunity to meet online.		
29. Will your research involve **either:** **a)** "big data", combined datasets, new data-gathering or new data-merging techniques which might lead to re-identification of your participants**and/or** b) artificial intelligence or algorithm training where, forexample biased datasets could lead to biased outcomes?		**x**				
G: Data Processing and Privacy						

			If YES please complete the Risk Assessment and Mitigation Plan columns below.		*Please provide the relevant reference #*	
ISSUE	**Yes**	**No**	**RISK ASSESSMENT – what risks could arise?** *Please ensure that you list ALL of the actual risks that could potentially arise – do not simply state whether you consider any such risks are important!*	**MITIGATION PLAN – what mitigating steps will you take?** *Please ensure that you summarise what actual mitigation measures you will take for each potential risk identified – do not simply state that you will e.g. comply with regulations.*	**DMP**	**ICF**
30. Will the research involve collecting, processing and/or storing any directly identifiable PII (Personally Identifiable Information) including name or email address that will be used for administrative purposes only? (eg: obtaining Informed Consent or disbursing remuneration)	**x**		Survey: email addresses of participants who want to participate In the lottery draw will be gathered, which can cause a risk of re-identification. Workshop: For the workshop, personal data will be collected for administrative purposes (the informed consent form), therefore there is a risk of re-identification of the participants. Interviews: For the interviews, personal data will be collected for administrative purposes (the informed consent form), therefore there is a risk of re-identification of the participants.	Survey: Only the email addresses of those wanting to participate in the lottery draw will be gathered. To still make the answers anonymous, email addresses will be gathered in a separate survey, to which a link is posted on the final page of the first survey. This way the email addresses will not be linked to survey answers. Additionally, email addresses will be deleted immediately after the gift card winners have been selected. Workshop: Personal data will only be gathered in the Informed Consent Form, which will be securely stored in the TU Delft OneDrive, and which will be destroyed after the project is done. Moreover, no personal questions will be asked during the workshop or interview, and any transcripts and audio recordings will be stored securely and deleted once they have been used. Only summaries from the workshop or interviews will be published. Interviews: Personal data will only be gathered in the Informed Consent Form, which will be securely stored in the TU Delft OneDrive, and which will be destroyed after the project is done. Moreover, no personal questions will be asked during the workshop or interview, and any transcripts and audio recordings will be stored securely and deleted once they have been used. Only summaries from the workshop or interviews will be published.		
31. Will the research involve collecting, processing and/or storing any directly or indirectly identifiable PIRD (Personally Identifiable Research Data) including videos, pictures, IP address, gender, age etc and **what other Personal Research Data** (including personal or professional views) will you be collecting?	**x**		Survey: In the survey data will be collected on participant's gender, age range, income range, highest finished education level, whether they are living together with a partner and whether they have children (adult or minor) and additionally, they will be asked for their postal code. Additionally, people will be asked about their perception of the transport	Survey: The risk of re-identification will be minimized as much as possible by keeping questions as broad as possible, while still being useful for the research. By asking for an age range and income range the risk of re-identification is less than when one would ask for precise age or income. Additionally, it is only asked whether people have children and whether those		

			If YES please complete the Risk Assessment and Mitigation Plan columns below.		*Please provide the relevant reference #*	
ISSUE	**Yes**	**No**	**RISK ASSESSMENT – what risks could arise?** *Please ensure that you list ALL of the actual risks that could potentially arise – do not simply state whether you consider any such risks are important!*	**MITIGATION PLAN – what mitigating steps will you take?** *Please ensure that you summarise what actual mitigation measures you will take for each potential risk identified – do not simply state that you will e.g. comply with regulations.*	**DMP**	**ICF**
			system and how easily it is for them to live a satisfactory life using this transport system. The combination of postal code and certain socio-demographic characteristics, means there is a risk of re-identification of participants, which could mean that participants' answers can be linked back to them. This in turn could cause (reputational) damage to participants. Workshop: the workshop will be audio-recorded, which could cause a risk of re-identification of participants of the workshop. Participants in the workshop will also be asked about their professional views on the transport system and gender (equity) factors within the transport system. Thus there is a risk that if they are re-identified, it will be known who has what professional perceptions. Interviews: the interviews will be audio-recorded, which could cause a risk of re-identification of participants of the interview. Participants in the workshop will also be asked about their professional views on the transport system and gender (equity) factors within the transport system. Thus there is a risk that if they are re-identified, it will be known who has what professional perceptions.	children are still minors, not their exact ages. By keeping answers broad, the risk of re-identification is thus minimized as much as possible. However, because of the question about people's postal codes it is difficult to completely rule out the potential for re-identification and it is therefore especially important to keep the data private. Therefore, only aggregated data will be published. The specific survey answers will be safely stored in TU Delft OneDrive where it is only available to the author, collaborator and supervisors. By not sharing the data publically risk of re-identification is thus further minimized. Lastly, no especially sensitive data like race or sexual orientation will be asked for, minimizing the damage of potential re-identification. Workshop: To keep data anonymized, audio-recordings and transcripts will be deleted once the project is done. Additionally, they will be moved to safe storage in OneDrive as soon as possible after the workshop. As discussed with the privacy team via email, talking about gender and transport from a professional perspective is not considered sensitive. By not asking potentially sensitive information about people's own personal lives in the workshop, the harm caused by potential re-identification is also minimized. Workshop: To keep data anonymized, audio-recordings and transcripts will be deleted once the project is done. Additionally, they will be moved to safe storage in OneDrive as soon as possible after the interviews. As discussed with the privacy team via email, talking about gender and transport from a professional perspective is not considered very sensitive. By not asking potentially sensitive information about people's own personal lives in the interview, the harm caused by potential re-identification is also minimized.		

			If YES please complete the Risk Assessment and Mitigation Plan columns below.		*Please provide the relevant reference #*	
ISSUE	**Yes**	**No**	**RISK ASSESSMENT – what risks could arise?** *Please ensure that you list ALL of the actual risks that could potentially arise – do not simply state whether you consider any such risks are important!*	**MITIGATION PLAN – what mitigating steps will you take?** *Please ensure that you summarise what actual mitigation measures you will take for each potential risk identified – do not simply state that you will e.g. comply with regulations.*	**DMP**	**ICF**
32. Will this research involve collecting data from the internet, social media and/or publicly available datasets which have been originally contributed by human participants		x				
33. Will your research findings be published in one or more forms in the public domain, as e.g., Masters thesis, journal publication, conference presentation or wider public dissemination?	**x**		Surveys and workshop/interviews: The research findings will be published as part of a Master's thesis. This could mean that respondents could be identified based on findings. This could cause further problems for respondents such as reputational issues.	Surveys: Personal information will not be published in the master thesis, and results will only be shown in an aggregated way. Thus, the exact personal survey answers will not be published in any way. Furthermore, email addresses gathered for the survey lottery draw will also not be published in any way and be deleted once the winner(s) of the gift cards have been selected, and moreover, the email addresses cannot be linked to the survey answers of a respondent Workshop: Any personal data gathered in the informed consent form, will be deleted once the project is finished and will be saved in a secure environment until their deletion. This will make the published data anonymous and thus make the risk of reputational harm minimal. The published paper or article will not talk about the identifiable data of participants in any way. Interviews: Any personal data gathered in the informed consent form, will be deleted once the project is finished and will be saved in a secure environment until their deletion. This will make the published data anonymous and thus make the risk of reputational harm minimal. The published paper or article will not talk about the identifiable data of participants in any way.		
34. Will your research data be archived for re-use and/or teaching in an open, private or semi-open archive?		**x**				

III. Signature/s

Please note that by signing this checklist list as the sole, or Responsible, researcher you are providing approval of the completeness and quality of the submission, as well as confirming alignment between GDPR, Data Management and Informed Consent requirements.

Iris Roeleven

Signature of Corresponding Researcher: 

Date: 29/03/2023

Name of Responsible Researcher: Maarten Kroesen

Signature (or upload consent by mail) Responsible Researcher: 

Date: 29-03-2023

Appendix B.2 Data management plan

0. Administrative questions

1. Name of data management support staff consulted during the preparation of this plan.

My faculty data steward, Nicolas Dintzner, has been consulted about this DMP on 22/03/23

Ymkje Koster, member of the TU Delft privacy team, was consulted on the sensitivity of discussing gender in a professional capacity in a workshop or interview on 22/03/2023.

2. Date of consultation with support staff.

2023-03-22

I. Data description and collection or re-use of existing data

3. Provide a general description of the type of data you will be working with, including any re-used data:

Type of data	File format(s)	How will data be collected (for re-used data: source and terms of use)?	Purpose of processing	Storage location	Who will have access to the data
Survey questions on the socio-demographic factors of respondents including gender, age range, income range, education level and household composition (specifically whether respondents live together with a partner and have children (who are minors)) , their postal codes, furthermore on factors found to be related to perceived accessibility in literature and questions on their perceived accessibility	.csv files	Factors found in literature review to impact perceived accessibility are translated into questions for the online survey	Collecting the demographic profile of respondents, how they view the transport system and how they perceive their accessibility	Qualtrics and OneDrive	The Msc. student and the graduation committee consisting of Trivik Verma, Maarten Kroesen and Juliana Goncalves and colllaborator: fellow TU Delft Msc. student Luisa de La Vega Bayma de Oliveira
Data on demographic factors gender, age range, income range, highest level of education and household composition (specifically whether they live together with a partner and whether they have children (who are minors)) of respondents and respondent's postal codes	.csv files	Online survey	To understand the relationship between gender and intersectional factors and (the factors influencing) perceived accessibility	Qualtrics and OneDrive	The Msc. student and the graduation committee consisting of Trivik Verma, Maarten Kroesen and Juliana Goncalves and fellow TU Delft Msc. student Luisa de La Vega Bayma de Oliveira

Data on (the factors influencing) perceived accessibility from respondents	.csv files	Online survey	To understand the relationship between gender and intersectional factors and (the factors influencing) perceived accessibility	Qualtrics and OneDrive	The Msc. student and the graduation committee consisting of Trivik Verma, Maarten Kroesen and Juliana Goncalves and fellow TU Delft Msc. student Luisa de La Vega Bayma de Oliveira
List of workshop participants	.doc	Academic and professional networks of project team, internet search	To find suitable people for a workshop	OneDrive	The Msc. student and the graduation committee consisting of Trivik Verma, Maarten Kroesen and Juliana Goncalves
List of interview participants	.doc	Academic and professional networks of project team, internet search	To find suitable people for interviews	OneDrive	The Msc. student and the graduation committee consisting of Trivik Verma, Maarten Kroesen and Juliana Goncalves
Workshop recording data and transcript	.mp3 .doc	Recording from the organised workshop(either online or face- to-face)	To collect information on how the quantitative results relate to the existing transport system in The Netherlands	OneDrive and Microsoft Teams	The Msc. student and the graduation committee consisting of Trivik Verma, Maarten Kroesen and Juliana Goncalves
Interview recording data and transcript	.mp3 .doc	Recording from the organised interviews (either online or face-to-face)	To collect information on how the quantitative results relate to the existing transport system in The Netherlands	OneDrive and Microsoft Teams	The Msc. student and the graduation committee consisting of Trivik Verma, Maarten Kroesen and Juliana Goncalves
Workshop summary (anonymized)	.doc	Recording data and transcript from the workshop	To have an overview of key findings from the workshop	OneDrive	The Msc. student and the graduation committee consisting of Trivik Verma, Maarten Kroesen and Juliana Goncalves
Summary of interviews (anonymized)	.doc	Recording data and transcripts from the interviews	To have an overview of finding from the interviews	OneDrive	The Msc. student and the graduation committee consisting of Trivik Verma, Maarten Kroesen and Juliana Goncalves

4. How much data storage will you require during the project lifetime?

< 250 GB

II. Documentation and data quality

5. What documentation will accompany data?

- README file or other documentation explaining how data is organised
- Data dictionary explaining the variables used
- Methodology of data collection

III. Storage and backup during research process

6. Where will the data (and code, if applicable) be stored and backed-up during the project lifetime?

- Another storage system - please explain below, including provided security measures
- OneDrive

As Qualtrics will be used for the online surveys, it will store the results of this survey until the period for answering the survey is finished. As this is a US based company, there is a risk of data breach. However, guidance from the TU Delft with regard to Qualtrics will be followed and socio-demographic questions will be as broad as possible to minimize risk of re-identification. Moreover, the email adresses of respondents (used for a gift voucher lottery draw), will be collected in a different survey so that email adresses cannot be linked to survey answers. Additionally, once the data has been collected it will be downloaded to OneDrive and deleted from Qualtrics.

IV. Legal and ethical requirements, codes of conduct

7. Does your research involve human subjects or 3rd party datasets collected from human participants?

- Yes

8A. Will you work with personal data? (information about an identified or identifiable natural person)

If you are not sure which option to select, ask your Faculty Data Steward for advice. You can also check with the privacy website or contact the privacy team: privacy-tud@tudelft.nl

- Yes

8B. Will you work with any other types of confidential or classified data or code as listed below? (tick all that apply)

If you are not sure which option to select, ask your Faculty Data Steward for advice.

No, I will not work with any confidential or classified data/code

9. How will ownership of the data and intellectual property rights to the data be managed?

This is an internal TU Delft master thesis project, where no third parties are involved. The data gathered will be stored to a OneDrive folder owned by the author. Access to this data will only be open to the author and the graduation committee. The author will have the right to control access and be the data owner.

10. Which personal data will you process? Tick all that apply

- Photographs, video materials, performance appraisals or student results
- Email addresses and/or other addresses for digital communication
- Names and addresses
- Data collected in Informed Consent form (names and email addresses)
- Signed consent forms
- Gender, date of birth and/or age

The specific categories of personal data that will be processed are:

For workshop: names, emails (in informed consent forms)

For interviews: names, emails (in informed consent forms)

For surveys:

- gender (woman, man, other),
- age range (18-25, 26-35, etc.),
- income range (Gross income with categories that vary by 10000 at least),
- level of education finished (e.g. middle school, HBO Bachelor etc.),
- whether someone lives with a partner
- whether someone has children aged below 5, aged between 5 and 12, aged older than 12 (multiple answers possible)
- Country of origin (Netherlands, other European country, country outside of Europe)
- One open question which asks for people's postal code

11. Please list the categories of data subjects

Survey:

Dutch Citizens, older than 18, that are willing to fill out the survey.

Workshops:

Experts in the transport and/or gender equality field. These can be people who work in policy or in organisations or interest groups which work in transport or gender equality.

Interviews:

Experts in the transport and/or gender equality field. These can be people who work in policy or in organisations or interest groups which work in transport or gender equality.

12. Will you be sharing personal data with individuals/organisations outside of the EEA (European Economic Area)?

- No

15. What is the legal ground for personal data processing?

- Informed consent

16. Please describe the informed consent procedure you will follow:

Survey:

At the start of the survey the informed consent form is shown so (potential) participants can read it. The informed consent form will include that by clicking to the next page of the survey, participants have given their consent.

Workshop:

Participants will be asked to read and, if they agree, sign the informed consent form before the workshop they participate in.

Interviews:

Participants will be asked to read and, if they agree, sign the informed consent form or explicitly confirm their consent via email before they participate in an interview.

17. Where will you store the signed consent forms?

- Same storage solutions as explained in question 6

18. Does the processing of the personal data result in a high risk to the data subjects?

- None of the above applies

It was checked with the privacy team whether discussing gender in a workshop or interview is considered sensitive. The response was that as participants are asked for their professional opinion about the topic and not their personal life, it is not considered sensitive.

22. What will happen with personal research data after the end of the research project?

- Personal research data will be destroyed after the end of the research project
- Anonymised or aggregated data will be shared with others

Anonymized statements and assessments from the workshop or interviews will be part of the resulting Master Thesis. Furthermore, the data from surveys will be aggregated in the form of statistical summaries and be part of the resulting Master Thesis. The precise data, like exact answers to questions in the survey, will be destroyed once the project is done, at the latest after 2 years, and not publicly published in any way.

23. How long will (pseudonymised) personal data be stored for?

- Other - please state the duration and explain the rationale below

As there is a possibility for the data to be used in further publications after the master thesis, it will be stored for 2 years at the most in the TU Delft OneDrive.

24. What is the purpose of sharing personal data?

- Other - please explain below

Personal data is not shared.

25. Will your study participants be asked for their consent for data sharing?

- Yes, in consent form - please explain below what you will do with data from participants who did not consent to data sharing

If consent is given, the anonymized data of participants will be used and aggregated data will be published. If consent is not given, their data will not be used in any way for the research.

V. Data sharing and long-term preservation

27. Apart from personal data mentioned in question 22, will any other data be publicly shared?

- All other non-personal data (and code) underlying published articles / reports / theses

Survey questions (but not answers) and method of analysing data will be shared.

29. How will you share research data (and code), including the one mentioned in question 22?

- All anonymised or aggregated data, and/or all other non-personal data will be uploaded to 4TU.ResearchData with public access

30. How much of your data will be shared in a research data repository?

- < 100 GB

31. When will the data (or code) be shared?

- At the end of the research project

32. Under what licence will be the data/code released?

- CC BY-NC-ND

VI. Data management responsibilities and resources

33. Is TU Delft the lead institution for this project?

- Yes, the only institution involved

34. If you leave TU Delft (or are unavailable), who is going to be responsible for the data resulting from this project?

Juliana Goncalves

Assistant professor at the Faculty of Architecture

35. What resources (for example financial and time) will be dedicated to data management and ensuring that data will be FAIR (Findable, Accessible, Interoperable, Re-usable)?

4TU.ResearchData is able to archive 1TB of data per researcher per year free of charge for all TU Delft researchers. We do not expect to exceed this and therefore there are no additional costs of long term preservation.

Appendix B.3 Informed consent forms

Appendix B.3.1 Informed consent form survey

Delft University of Technology
Informed consent form survey

English

You are being invited to participate in a research study titled *Accessibility and Gender: An intersectional approach*. This study is being done by Iris Roeleven from the TU Delft.

The purpose of this research study is to find out how gender and intersectional factors impact perceived accessibility. Perceived accessibility in this context is defined as how easy people feel it is to live a satisfactory life using the existing transport system.

The survey will take you approximately 10 minutes to complete. The data from this survey will be used for research purposes, as a part of a Master's thesis which looks into the effect of gender and intersectionality on perceived accessibility to find potential equity problems in the current transport system. We will be asking you for certain information such as:

- Some socio-cultural traits such as your gender, your age range, your (household) income range, whether you live together with a partner and whether you have children (who are minors).
- The transport modes you have access to and your most used transport modes, whether your transport choices are limited due to temporal constraints and whether you feel safe while travelling
- How easy you find it to reach the activities you want to participate in using available transport
- If you wish to participate in a draw to win a voucher from bol.com, your email address (which can be entered in a link to a separate survey shown once you have submitted the main survey)

As with any online activity the risk of breach is always possible. To the best of our ability your answers in this study will remain confidential. We will minimize any risks by anonymizing the data, separating email addresses from survey answers, only analysing aggregated data and deleting the personal data after two years at the most. Only anonymized survey answers will be published at the end of the study. Content of open questions will not be shared in any way.

Your participation in this study is entirely voluntary and you can withdraw at any time. As the survey is completely anonymous, it will not be possible to remove answers to questions once the survey form has been completed and sent.

You can reach the research team through the following contact information:

- Iris Roeleven (corresponding researcher)
- Maarten Kroesen (responsible researcher)

By clicking through to the anonymous online survey and completing all its mandatory questions, you are agreeing to this Opening Statement and providing your informed consent to participate in this study.

Appendix B.3.2 Informed consent form workshop

Delft University of Technology
Informed consent form workshop on gender equity in the transport system

You are being invited to participate in a research study titled *Accessibility and Gender: An intersectional approach*. This study is being done by Iris Roeleven from the TU Delft.

The purpose of this research study is to find out how gender and intersectional factors impact perceived accessibility. Perceived accessibility in this context is defined as how easy people feel it is to live a satisfactory life using the existing transport system. The goal for this part of the study is to better understand the way gender and intersectionality impact perceived accessibility.

The workshop is expected to last one hour. Data generated will be used for research purposes, as part of a Master's thesis which looks into the effect of gender and intersectionality on perceived accessibility to find potential equity problems in the current transport system. We will be discussing a conceptual model and the results from the quantitative research with you and will discuss these results in the context of the (current) transport system and gender equity problems.

As with any online activity, the risk of a breach is always possible. To the best of our ability, your answers in this study will remain confidential. We will minimize any risks by deleting transcripts and (audio) recordings once the study is completed (after two years at the most), and only publishing anonymized summaries of the workshop. None of the personal individual answers or personal information will be made publicly available or published in any form.

Your participation in this study is entirely voluntary and you can withdraw at any time.

You can reach out to the researchers asking for data to be removed up to one week after the workshop. You can reach the research team through the following contact information:

- Iris Roeleven (corresponding researcher)
- Maarten Kroesen (responsible researcher)

By checking yes to the questions below and signing the form, you are agreeing to this opening statement and providing informed consent to participate in this study.

PLEASE TICK THE APPROPRIATE BOXES	Yes	No
A: GENERAL AGREEMENT – RESEARCH GOALS, PARTICIPANT TASKS AND VOLUNTARY PARTICIPATION		
1. I have read and understood the study information above, or it has been read to me. I have been able to ask questions about the study and my questions have been answered to my satisfaction.	☐	☐
2. I consent voluntarily to be a participant in this study and understand that I can refuse to answer questions and I can withdraw from the study at any time, without having to give a reason.	☐	☐
3. I understand that taking part in the study involves: Participating in an audio-recorded workshop, from which notes and transcripts will be generated. The audio file and the transcription will be deleted after two years at the most or earlier once the study is done, and only an anonymized summary of transcript contents will be made (publicly) available when the study is expected to be published in August 2023.	☐	☐

PLEASE TICK THE APPROPRIATE BOXES	Yes	No
B: POTENTIAL RISKS OF PARTICIPATING (INCLUDING DATA PROTECTION)		
4. I understand that taking part in the study involves the risk of mental or emotional discomfort. I understand that these will be mitigated by my ability to leave the workshop at any point and to ask for any data gathered up to that point to be deleted.	☐	☐
5. I understand that taking part in the study also involves collecting specific personally identifiable information (PII) such as name and email address, and associated personally identifiable research data (PIRD) such as my insights on the current transport system or gender equity problems with the potential risk of my identity being revealed.	☐	☐
6.. I understand that the following steps will be taken to minimise the threat of a data breach, and protect my identity in the event of such a breach: • Only the personal data needed for this consent form is collected, keeping any personal data collected to a minimum. • Recordings will be saved in secure data storage. • Only an anonymized summary of the workshop will be published, not the audio files or full transcripts themselves. • Audio recordings and transcripts are deleted after two years.	☐	☐
9. I understand that personal information collected about me that can identify me, such as my name and email address, will not be shared beyond the study team.	☐	☐
10. I understand that the (identifiable) personal data I provide will be destroyed once the study is complete and is suitable for publication. The publication is expected to happen in August 2023.	☐	☐
C: RESEARCH PUBLICATION, DISSEMINATION AND APPLICATION		
11. I understand that after the research study the anonymous summary will be used for a Master's thesis and could help identify equity problems in the current transport system.	☐	☐
D: (LONGTERM) DATA STORAGE, ACCESS AND REUSE		
12. I give permission for the de-identified (anonymous) summary of the workshop to be archived in 4TU.ResearchData repository, to which access is open to all, so it can be used for future research and learning.	☐	☐

Signatures

_____ _____ _____

Name of participant Signature Date

Study contact details for further information:

Iris Roeleven

Appendix C: Literature reviews: Article selection processes

In this Appendix the article selection processes for the literature reviews can be found.

Appendix C.1 Approach knowledge gap literature review

This Appendix section shows the process that was used to find literature with which to identify a knowledge gap. Figure C.1 shows an overview of the process of finding literature. Firstly, Scopus was used to find articles. The search term that was used can be found in the Figure. To find even more articles, a similar search term was used in Google Scholar, where the first two pages of results were investigated to find papers that had not yet been found using Scopus. This resulted in 14 papers. However, two were discarded due to them being too general and not suitable to compare to the others. Four additional articles were also found using snowballing from the found articles. This resulted in 16 articles being selected for the literature review.

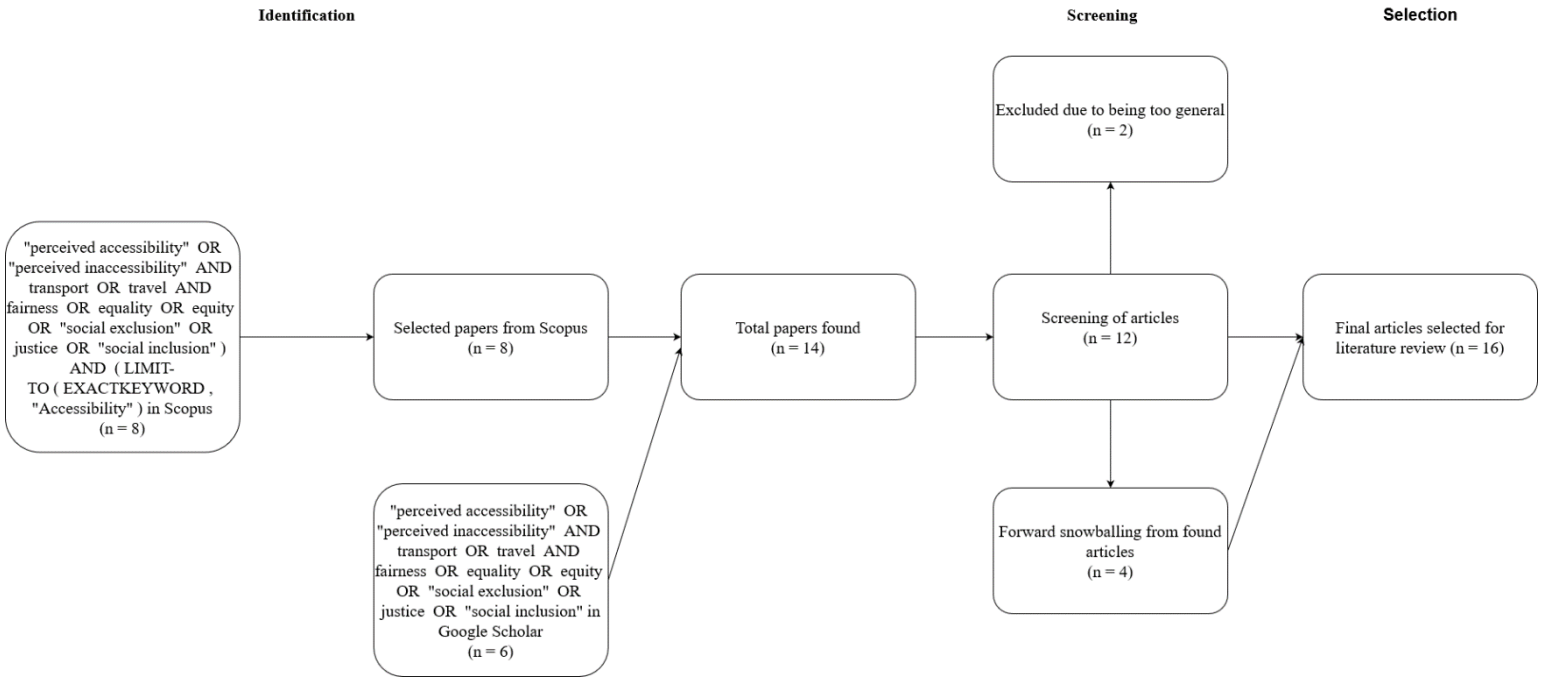


Figure C.1 Literature search process

Appendix C.2 Approach literature review: factors impacting perceived accessibility

To find factors that influence perceived accessibility Scopus and Google Scholar were used. In Scopus the search term "{perceived accessibility} AND transport OR mobility OR travel" were used. This yielded N results in Scopus. By looking through these results it was seen that some of these papers were actually from the field of medicine and computer science. These were not relevant for this research and therefore these fields were excluded from the research results. This resulted in 47 papers. Based on titles and abstracts, 19 were excluded as they were irrelevant for the research. Upon close inspection 9 more were excluded as they used perceived accessibility as an independent explaining variable instead of looking at what factors influence it. The same search term was used in Google Scholar to ensure that no papers were missed through Scopus. This resulted in 1 additional paper. Furthermore, 2 additional papers were found through forward snowballing from the found papers. This resulted in 22 papers. The entire literature search approach is summarized in Figure C.2.

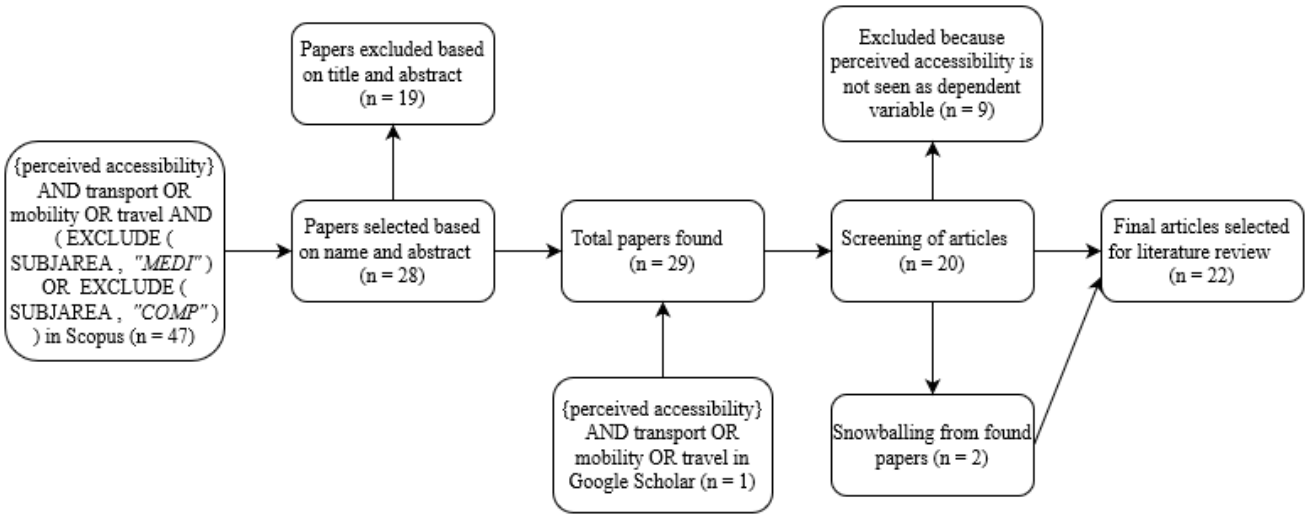


Figure C.2 Literature review process SQ1

An overview of the found papers is given in Table C.1.

Table C.1 Selected articles for literature review SQ1

Authors and year	Title	Type of transport mode discussed
Al-Rashid et al., 2021	Psychosocial factors of public transport users and social inclusion implications among older women in Pakistan	Public Transport
Chen et al., 2022	Perceived accessibility: How access to dockless bike-sharing impact activity participation	Bicycles
Curl, 2018	The importance of understanding perceptions of accessibility when addressing transport equity: A case study in Greater Nottingham, UK	General
Friman et al., 2020a	Carpooler's perceived accessibility of carpooling	Carpooling
Jamei et al., 2022	Perceived accessibility and key influencing factors in transportation	General
Lättman et al., 2016	Perceived accessibility of public transport as a potential indicator of social inclusion	Public Transport
Lättman et al., 2018	A new approach to accessibility – Examining perceived accessibility in contrast to objectively measures accessibility in daily travel	General
Lättman et al., 2019	Perceived accessibility, satisfaction with daily travel, and life satisfaction among the elderly	General
Lättman et al., 2020	Restricted car use and perceived accessibility	General
Friman et al., 2020b	Public transport quality, safety and perceived accessibility	Public Transport
Liu et al., 2022	A modal shift due to a free within-destination tourist bus scheme	Public Transport

Liu et al., 2021	Smartphone based services: Perceived accessibility and transport inequity during the COVID-19 pandemic	Public Transport
Lukina et al., 2021	Study of perceived accessibility in daily travel within the metropolis	General
Márquez et al., 2019	Factors affecting personal autonomy and perceived accessibility of people with mobility impairments in an urban transportation choice context	General
Pot et al., 2020	Linking experiences barriers during the daily travel and transport poverty in peripheral rural areas: The case of Zeeland, The Netherlands	General
Pot et al., 2021	Perceived accessibility: What it is and why it differs from calculated accessibility measures based on spatial data	General
Radisya Pratiwi et al., 2015	Quantifying the relationship between visitor satisfaction and perceived accessibility to pedestrian spaces on festival days	Walking
Sukwadi et al., 2022	The study of travel satisfaction in MRT Jakarta during the pandemic of Covid-19	Mass Rapid Transport
Tanimoto & Hanibuchi, 2021	Associations between the sense of accessibility, accessibility to specific destinations, and personal factors	General
van der Vlugt et al., 2019	What about the people? Developing measures of perceived accessibility from case studies in Germany and the UK	General, walking
van der Vlugt et al., 2022	The influence of travel attitudes in perceived walking accessibility and walking behaviour	Walking
van Wee, 2022	Accessibility and equity: A conceptual framework and research agenda	General

Appendix C.3 Approach literature review: gender, transport and mobility

This part of the research aims to connect a gender intersectional perspective to the perceived accessibility framework. However, part of the reason that this research is done is that there is still a significant knowledge gap on how gender impacts perceived accessibility. Therefore, the search for literature used the broader concepts of transport and mobility. Additionally, including the terms social exclusion/inclusion and equity to the search term results in papers which discuss this aspect of gender and transport, which is helpful in connecting it to perceived accessibility factors. The main search term that was used in Scopus and Google Scholar is "*{social inclusion}* OR *{social exclusion}* AND *transport* OR *mobility* AND *gender* OR *female"*. To remove non-relevant papers from the search results additional restrictions were added, which can be seen in Figure C.3.

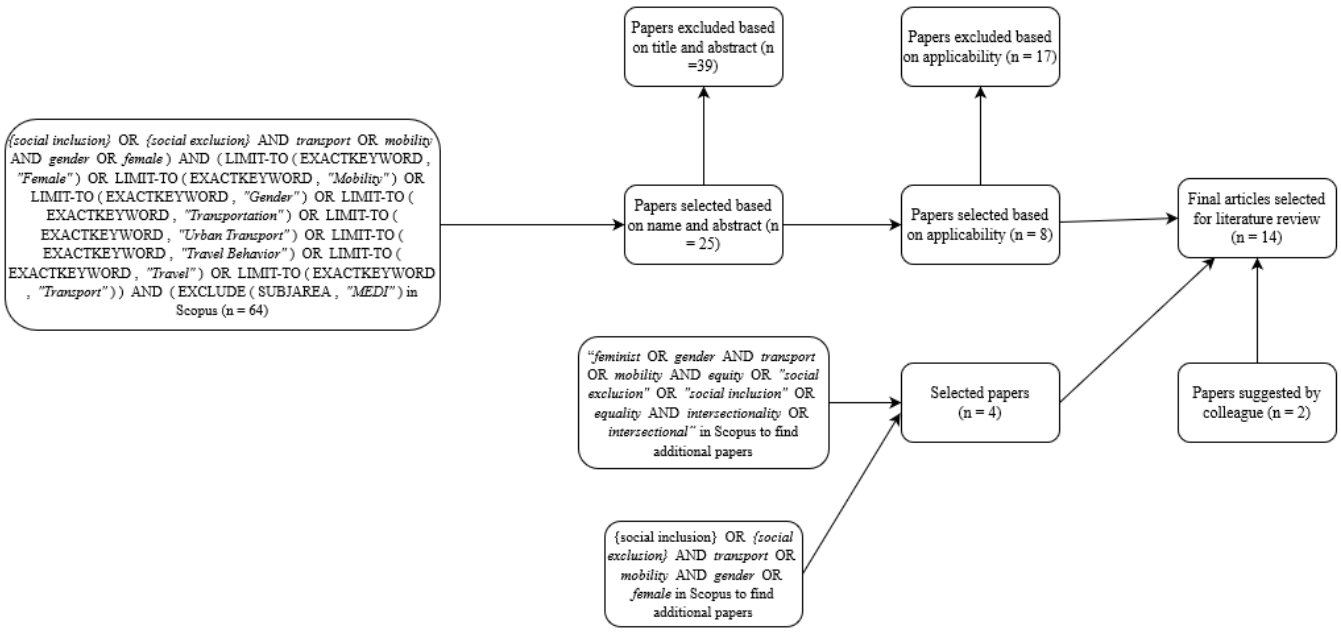


Figure C.3 Literature review process SQ3

An overview of the search process is presented in Figure C.3, and an overview of the resulting papers can be found in Table C.2.

Table C.2 Selected articles for literature review SQ2

Author(s) and year	Title
Bridgman et al., 2022	How can Gender Smart Mobility become a more intersectional form of mobility justice
Busco et al., 2023	Social Exclusion and the public bus system in Santiago, Chile
Dobbs, 2007	Stuck in the slow lane: Reconceptualizing the Links between Gender, Transport and Employment
Gil Sola & Vilhelmson, 2022	To choose, or not a choose, a nearby activity option: Understanding the gendered role of proximity in urban settings
Gupta & Bhamoriya, 2021	'Give me some rail': An enquiry into puzzle of declining female labour force participation rate
Lo & Houston, 2018	How do compact, accessible, and walkable communities provide gender equity in spatial behaviour?
Luiu & Tight, 2021	Travel difficulties and barriers during later life: Evidence from the travel survey in England
Mejía-Dorantes & Villagran, 2020	A review on the influence of barriers on gender equality across the city: A synthesis approach of Mexico city and its Metropolitan Area

Montoya-Robledo & Escovar-Alvarez, 2020	Domestic worker's commutes in Bogota: Transportation, gender and social exclusion
Plyushteva & Boussauw, 2020	Does night-time public transport contribute to inclusive night mobility? Exploring Sofia's night bus network from a gender perspective
Ryan & Wretstrand, 2018	What's mode got to do with it? Exploring the links between public transport and car access and opportunities for everyday activities among older people
Thynell, 2016	The quest for gender-sensitive and inclusive transport policies in growing Asian cities
Uteng, 2021	Gender gaps in urban mobility and transport planning
Weintrob et al., 2021	Queer mobilities: Critical LGBTQ perspectives of public transport spaces

Appendix D: Survey

Appendix D.1 Survey questions

In this Appendix chapter, the survey questions used for gathering data are presented. Questions that were added after the infiltration of bots are coloured blue.

Perceived accessibility survey

Start of Block: Informed consent form

You are invited to participate in a research study about accessibility. This study is being done by Iris Roeleven and Luisa de La Vega from the Technical University of Delft (TU Delft). The purpose of this survey is to understand how accessibility differs from person to person. Accessibility means how easy it is to go to specific places using the existing transport system. For example, we want to understand how convenient it is for you to reach places such as grocery stores using different transport modes and/or during specific times of the day. We are particularly interested in the differences between people who identify as women and men. The survey will take you approximately 10 minutes to complete. The data from this survey will be used for research purposes, as a part of a Master's thesis, which looks into the effect of gender on accessibility to propose improvements to the current transport system. We will ask you for certain information, such as:

- Country of residence and postcode
- Socio-demographic information such as gender, age range, household income range, whether you live together with a partner, and whether you have children
- Your preferences and impressions about the transport modes (safety, quality, cost, availability)
- How convenient it is for you to use different transport modes to reach specific places

To the best of our ability, your answers in this study will remain confidential. The data will be used exclusively for research purposes about Accessibility in Transport, aiming to contribute to a more equitable transport system. As with any online activity, the risk of a breach is always possible and there is a risk of re-identification for the participants, partly due to the survey asking for postal codes. We will minimize any risks by separating email addresses from survey answers, only analysing aggregated data, and saving personal data is a safe environment, where it is deleted after two years. Only aggregated survey answers will be published at the end of the study, which means that your answers will not be traced back to you. Content of open questions will not be shared in any way.

Your participation in this study is entirely voluntary and you can withdraw at any time. It will not be possible to remove answers to questions once the survey form has been completed and sent. You can reach the research team through the following contact information:

- Iris Roeleven (corresponding researcher)
- Luisa de La Vega (corresponding researcher)
- Maarten Kroesen (responsible researcher)
- Juliana Goncalves (responsible researcher)

By clicking through to this online survey and completing all its mandatory questions, you are agreeing to this Opening Statement and providing your informed consent to participate in this study.

Start of Block: Captcha

Before you proceed to the survey, please complete the captcha below

End of Block: Captcha

Start of Block: Geographic questions

Where do you currently live?

- ○ The Netherlands
- ○ Another country, inside of Europe
- ○ Another country, outside of Europe

What type of area would you say your home is in?

- ○ An urban area
- ○ A rural area
- ○ Other

Are you 18 or above (years old)?

- ○ Yes
- ○ No

Skip To: End of Survey If Are you 18 or above (years old)? = No

Display This Question:

If Where do you currently live? = The Netherlands

What is your postal code?

_____

End of Block: Geographic questions

Start of Block: Main mode and capabilities

Do you have a driver's license for a car?

- ○ No
- ○ Yes

To what extent do you have access to a car?

- ○ I do not have access to a car
- ○ I can sometimes use a car
- ○ I sometimes can, and sometimes can not make use of a car
- ○ I can usually make use of a car
- ○ I can always make use of a/my car

How often do you use the following transport modes?

	(Almost) never	1 to 5 days a year	6 to 11 days a year	1 to 3 days a month	1 to 3 days a week	4 or more days per week
Car	○	○	○	○	○	○
Train	○	○	○	○	○	○
Bus, tram or metro	○	○	○	○	○	○
Bicycle	○	○	○	○	○	○
Walking	○	○	○	○	○	○

End of Block: Main mode and capabilities

Start of Block: Modes used for specific activities

What is the main transport mode you use to grocery stores on a daily basis?

- ○ Car
- ○ Bus, Tram or Metro
- ○ Cycling
- ○ Walking

What is the main transport mode you use to go to leisure activities in the evening or at night? It can be activities for leisure, such as restaurants, bars, nightclubs or others.

- ○ Car
- ○ Bus, Tram, Metro or Train
- ○ Cycling
- ○ Walking

End of Block: Modes used for specific activities

Start of Block: Care and mode

Do you have children? (You can select multiple options)

- ☐ No
- ☐ Yes, one child younger than 5 years old
- ☐ Yes, two or more children younger than 5 years old
- ☐ Yes, one child or more between 5 and 12 years old
- ☐ Yes, one child or more older than 12 years old

Display This Question:

If Do you have children? (You can select multiple options) = Yes, one child younger than 5 years old

Or Do you have children? (You can select multiple options) = Yes, two or more children younger than 5 years old

Or Do you have children? (You can select multiple options) = Yes, one child or more between 5 and 12 years old

What is the main transport mode you use to go to school, daycare, or a similar place on a daily basis?

- ○ Car
- ○ Bus, Tram, Metro or Train
- ○ Cycling
- ○ Walking

End of Block: Care and mode

Start of Block: Transport flexibility

This section is about your possibilities to use different modes of transport. It means whether you can/could or cannot/could not travel using such modes of transport, regardless of whether you actually choose to use them or not.

Please indicate to what extent you agree with the following statement.

Looking at my current travel behaviour, I could also do this travelling using other transport modes

- ○ Strongly agree
- ○ Agree
- ○ Neither agree nor disagree
- ○ Disagree
- ○ Strongly disagree

The following questions ask you to categorize your use of transport modes to specific locations. Please consider four categories:

- Convenient: I find this transport mode easy to use and it fits well my personal needs;
- Neutral: I find this transport mode acceptable to use;
- Inconvenient: I have significant restriction(s) to use this transport mode.
- Not possible: I cannot use this transport mode (ex: driving a car without access to a car).

Please categorize the use of transport modes for going to grocery stores from your house.

	Convenient	Neutral	Inconvenient	Not possible
Car	○	○	○	○
Public Transport	○	○	○	○
Walking	○	○	○	○
Cycling	○	○	○	○

Please categorize the use of transport modes for going to entertainment facilities in the evening or at night from your house.

	Convenient	Neutral	Inconvenient	Not possible
Car	○	○	○	○
Public Transport	○	○	○	○
Walking	○	○	○	○
Cycling	○	○	○	○

Display This Question:

If Do you have children? (You can select multiple options) = Yes, one child younger than 5 years old

Or Do you have children? (You can select multiple options) = Yes, two or more children younger than 5 years old

Or Do you have children? (You can select multiple options) = Yes, one child or more between 5 and 12 years old

Please categorize the use of transport modes for going to school, daycare or a similar place from your house.

	Convenient	Neutral	Inconvenient	Not possible
Car	○	○	○	○
Public Transport	○	○	○	○
Walking	○	○	○	○
Cycling	○	○	○	○

Please rank the aspects you value when considering a transport mode convenient or not. Please put the factors shown into the right order (you can drag them to the right place). Here 1 means you find this factor most important and 5 means you find this factor least important.

_____ Time
_____ Safety
_____ Comfort
_____ Money
_____ Sustainability

This is a brief attention check, please answer 'strongly disagree' to this question, instead of other answers like 'agree'

- ○ Strongly disagree
- ○ Disagree
- ○ Neither agree nor disagree
- ○ Agree
- ○ Strongly agree

End of Block: Transport flexibility

Start of Block: Service quality and time restrictions

Next, a number of statements are presented. Please indicate to what extent you agree with these statements.

I am satisfied with the time my daily transport takes

- ○ Strongly disagree
- ○ Disagree
- ○ Neither agree nor disagree
- ○ Agree
- ○ Strongly agree

I am satisfied with the cost of my daily transport

- ○ Strongly disagree
- ○ Disagree
- ○ Neither agree nor disagree
- ○ Agree
- ○ Strongly agree

I think the service quality (e.g. the information given to me, comfort, simplicity) of Public Transport from my house is good

- ○ Strongly disagree
- ○ Disagree
- ○ Neither agree nor disagree
- ○ Agree
- ○ Strongly agree

Page Break

The term 'trip chain' means that you travel to multiple places, one after another, without going back to the place you started, usually your home. For example, If you leave home, go to work and do groceries immediately after before going back home, this is called trip chaining.

How often do you trip chain?

- ○ Never
- ○ Seldom
- ○ Sometimes
- ○ Often

Statement:

There are some transport modes that I currently do not use, but could use if I had fewer consecutive activities in a day. For example, it could be that you currently use a car instead of a bicycle to bring your kids to school, because you have to go to work straight after dropping the kids of, for which you have to use your car.

- ○ Strongly disagree
- ○ Disagree
- ○ Neither agree nor disagree
- ○ Agree
- ○ Strongly agree

End of Block: Service quality and time restrictions

Start of Block: Social environment

Please indicate to what extent you agree with the following statement.

If I cannot travel somewhere (important) myself, I think someone in my social network (e.g. a friend, a family member) would be available to help me

- ○ Strongly disagree
- ○ Disagree
- ○ Neither agree nor disagree
- ○ Agree
- ○ Strongly agree

What transport mode do you feel is used most by people in your environment?

- ○ Car
- ○ Tram, bus or metro
- ○ Train
- ○ Bicycle
- ○ Walking

End of Block: Social environment

Start of Block: Safety

How safe do you feel while travelling with the following transport modes during the day?

	Very unsafe	Unsafe	Neither unsafe or safe	Safe	Very safe
Car	○	○	○	○	○
Public transport	○	○	○	○	○
Cycling	○	○	○	○	○
Walking	○	○	○	○	○

How safe do you feel while travelling with the following transport modes during the night (after dark)?

	Very unsafe	Unsafe	Neither unsafe nor safe	Safe	Very safe
Car	○	○	○	○	○
Public transport	○	○	○	○	○
Cycling	○	○	○	○	○
Walking	○	○	○	○	○

End of Block: Safety

Start of Block: Perceived accessibility

Please indicate to what extent you agree with the following statements.

Considering how I travel today it is easy to do my daily activities

- ○ Strongly disagree
- ○ Disagree
- ○ Neither agree nor disagree
- ○ Agree
- ○ Strongly agree

Considering how I travel today I am able to live my life as I want to

- ○ Strongly disagree
- ○ Disagree
- ○ Neither agree nor disagree
- ○ Agree
- ○ Strongly agree

Considering how I travel today I am able to do all the activities I prefer

- ○ Strongly disagree
- ○ Disagree
- ○ Neither agree nor disagree
- ○ Agree
- ○ Strongly agree

Access to my preferred activities is satisfying considering how I travel today

- ○ Strongly disagree
- ○ Disagree
- ○ Neither agree nor disagree
- ○ Agree
- ○ Strongly agree

End of Block: Perceived accessibility

Start of Block: Socio-demographic

What gender do you identify as?

- ○ Male
- ○ Female
- ○ Other

What is your age?

- ○ Between 18 - 25
- ○ 26-35
- ○ 36-45
- ○ 46-55
- ○ 56-65
- ○ 66-75
- ○ Older than 75

What is the highest education level you have completed?

- ○ Level before middle school
- ○ Middle school
- ○ MBO (Secondary vocational education)
- ○ HBO (higher professional education) bachelor
- ○ WO (research-oriented higher education) bachelor
- ○ HBO (higher professional education) master
- ○ WO (research-oriented higher education) master
- ○ PHD

Are you living together with a partner?

- ○ No
- ○ Yes

What/where is your country of origin? (if you are uncertain, choose the region where you have spent most of your childhood)

- ○ The Netherlands
- ○ Another European country
- ○ Africa
- ○ North America
- ○ Central America
- ○ Caribbean
- ○ South America
- ○ Oceania
- ○ South Asia
- ○ Central Asia
- ○ South Eastern Asia
- ○ East Asia
- ○ Western Asia

Display This Question:

If Are you living together with a partner? = Yes

What was approximately the net income of you and your partner together in the last year?

- ○ Less than €22.000
- ○ €22.000 - €43.500
- ○ €43.500 - €87.000
- ○ €87.000 - €131.000
- ○ €131.000 - €175.000
- ○ €175.000 - €218.000
- ○ More than €218.000
- ○ Prefer not to say

Display This Question:

If Are you living together with a partner? != Yes

What was approximately your net income in the last year?

- ○ Less than €22.000
- ○ €22.000 - €43.500
- ○ €43.500 - €65.500
- ○ €65.500 - €87.500
- ○ €87.500 - €109.000
- ○ €109.000 - €131.000
- ○ More than €131.000
- ○ Prefer not to say

In what Dutch province do you live?

- ○ I do not live in The Netherlands
- ○ Zuid-Holland
- ○ Noord-Holland
- ○ Zeeland
- ○ Noord-Brabant
- ○ Limburg
- ○ Gelderland
- ○ Flevoland
- ○ Utrecht
- ○ Drenthe
- ○ Overijssel
- ○ Friesland
- ○ Groningen

End of Block: Socio-demographic

Appendix D.2 Flyer used for survey distribution

The English and Dutch flyer used for the distribution of the survey are shown in this Appendix. These were made together with fellow student Luisa de la Vega Bayma de Oliveira.

Figure D.1 English survey flyer

Figure D.2 English survey flyer

Appendix D.3 Survey distribution and data cleaning

To distribute the survey and get a large enough sample for the Structural Equation Modelling, multiple channels were used. Firstly, the survey was sent to the network of the author as well as of a fellow Master student with whom the surveys were distributed together. Secondly, the link to the survey was posted on social media, specifically LinkedIn and Facebook. Lastly, flyers were distributed in the neighbourhood of the author, the advisor and flyers were distributed in Rotterdam by the fellow Master student.

Appendix D.3.1 Complications during distribution

The distribution of surveys did not go without complications. The distribution started on the afternoon of April 11th, 2023. The amount of respondents gradually grew during this day. However, the next morning there were suddenly more than 500 respondents. This increase was unexpected and therefore more closely investigated. It became clear that bots were filling in the survey. This could be seen in some cases as they were putting in impossible postal codes in the survey, or filling in the survey much too quickly. Therefore, the same morning the bot detection function was turned on in Qualtrics. This showed that indeed bots had, and still were, filling in the survey. A captcha was implemented at the start of the survey to try to stop the bots, however, this did not have a clear effect and bots kept filling in the survey. As both bot detection and the implemented captcha did not flag all bots, additional "trap questions" were added. These showed that still more bots were filling in the survey. One note with regard to the bots is that all bots detected filled in the survey in English, no instances were found in suspected bots in the surveys that were filled in in Dutch or Portuguese. However, due to the remaining infiltration of bots the decision was made to pause the survey and copy it to make a new one with a new link. Griffin et al. (2022) show three ways to reduce the influence of bots and protect data quality: Bot detection and protection, Changes to recruitment and Data cleaning. One the bots were detected in the first survey and in making the new survey, the first two categories were used to implement the following changes:

- **Bot detection and protection** (Survey 1 and new surveys)
    - A reCAPTCHA test is included in the start of the survey
    - The bot detection function of Qualtrics was turned on
    - "Trap questions" were included, being:
        - "Are you 18 years or older?" -> If a bot, or a human, answered no they could not fill in the survey further.
        - "In what province do you live?" -> Using this question, it could be checked whether the postal code or the country a respondent said they live in matched with the province they said they live in.
        - "This is a brief attention check: Please answer "completely disagree" to this question" -> This question could be used for bots who answer randomly as well as for humans who are not paying attention to their answers
- **Changes to recruitment** (new surveys)
    - The incentive of a lottery for a gift card of 40 euros is removed from the survey and the messages with surveys on social media. This way the potential monetary incentive for the bots is removed.
    - In the posts on social media about the survey, the fact that the study concerns gender differences was removed. This was done as, aside from the monetary incentive, there could be an incentive to put bots on a survey about gender topics, as this can be a sensitive issue. Therefore, this incentive is removed.
    - Multiple survey links were used for the different ways in which the surveys were distributed. This way, if one source of distribution showed bot answers, it would be easier to identify. Thus, four different survey links were used:
        - A link for posts on social media

- A link to send to people in own social network directly
- A link to put on folders used for survey distribution
- A link for different channels, for example, SurveySwap, where surveys are exchanged.

These strategies were implemented. This resulted in no more bots being detected in the new survey. However, the data from survey one still included a lot of bots as well as useable answers from real people. Therefore the third category for data integrity mentioned by Griffin et al. (2022) became important: data cleaning, which is described in the next section.

Appendix D.3.2 Data cleaning of survey one

The final dataset of survey one includes 1097 responses. However a large part of these respondents were suspected to be bots. Therefore a code in Python was written to filter out (potential) bots answers, after which an additional manual check was performed. Based on the huge bot infiltration, it was decided to focus the study on The Netherlands and not use the data from respondents saying they live in another country. Additionally, respondents who did not fill in their postal code were not included, as it was deemed too hard to check whether these respondents were real. The following criteria were used to filter the remaining data:

1. ***Completion rate***: All entries which has not been 100% completed were removed from the dataset. This means that respondents who did not reach the end of the survey were removed from the dataset.
2. ***Time of day***: From the moment of the first day that the first suspicious answers came in to the time the reCAPTCHA was turned on (16:30 pm 11/04 – 09:30 am 12/04), all English answers were removed. Moreover, the answers given in the middle of the night the next night (23:40 pm 12/04 – 08:00 am 13/04) were also removed as it was deemed unlikely that humans were filling in surveys at this time of night.
3. ***Postal code***: All respondents that answered they lived in The Netherlands, but filled in an impossible postal code (e.g. 5 numbers, where the Dutch postal code is always 4 numbers and 2 letters) were removed from the dataset.
4. ***Recaptcha score***: Respondents with a reCAPTCHA score lower than 0.5 were flagged as bots by Qualtrics, however, it was also noted that some bots had higher scores than this. Because of the extent of problems with the bots, it was chosen to only keep answers with a reCAPTCHA score higher than 0.7.
5. ***Trap question 1***: All respondents who failed to put ‘strongly disagree” to the attention check question were removed from the dataset
6. ***Trap question 2***: All respondents who failed to answer the right Dutch province for the postal code they put in were removed. Additionally, respondents who put they did not live in The Netherlands, but did put a province in the Netherlands as the place where they lived were removed.
7. ***Duration of survey***: to filter out further bots, as well as humans who could not have paid attention to the questions, respondents who took the survey too quickly were filtered out. A sample of real answers shows that the average time to fill in the survey was between 9.5 and 10 minutes. Based on this and the survey maker’s own experience with the survey, 4 minutes was deemed the threshold for the respondent of the survey to have taken it seriously. Therefore, all respondents who had finished the survey in less than 4 minutes were removed from the dataset.
8. ***Duplicate starting times of survey***: It was noted that in some instances, (suspected) bots were starting and finishing the survey at the exact, or closely related time. Therefore respondents that started at the exact same minute were removed from the survey. This may have removed some real people from the survey, however, it was deemed an important step to get a good data quality.

9. ***A final manual check***: The resulting data file was manually checked by both survey makers to find logical inconsistencies, which resulted in a select number of further exclusions, based on, for example:
    a. Several similar four-number postal codes in the centre of Amsterdam were used by multiple respondents, of which some responded that it was an rural area. This seemed illogical as the centre of Amsterdam is one of the most urban areas in The Netherlands. Therefore, the respondents who used these centre of Amsterdam postal codes were removed.
    b. An additional answer was removed due to a combination of a suspicious postal code and illogical answers. This respondent claimed to feel extremely unsafe while using Public transport, cycling of walking during the day, while feeling extremely safe while using these same modes during the night. This was deemed illogical based on all other responses to this question and therefore removed.

Using these filtering strategies, the dataset with 1097 responses was reduced to a data file with 147 responses which were deemed real.

Appendix D.3.3 Data cleaning of second survey and combining the data into one data set

The surveys that were distributed after having taken the measures described against bots showed now further (suspected) bot answers. Therefore, the data cleaning of these surveys focussed on filtering out humans who could not have paid sufficient attention to their answers. Therefore responses were removed that:

- Answered the survey in less than 4 minutes;
- Did not answer “strongly disagree” to the test question.

Additionally, the choice was made to only focus on The Netherlands as an area, responses from people living in other countries were filtered out.

Appendix D.2.4 Putting the final data together

After the data cleaning, three separate files with data existed, data from survey one, data from the second survey distributed via social media and data from distributed flyers. These files were compiled into one data file. For this final data file, the choice was made to only focus on people living in Urban areas. This way the areas where people live are more comparable, and Perceived Accessibility differences are not caused by the differences in accessibility when living in an urban area compared to living in a rural area.

The process of putting together the final data set is shown in Figure D.3.

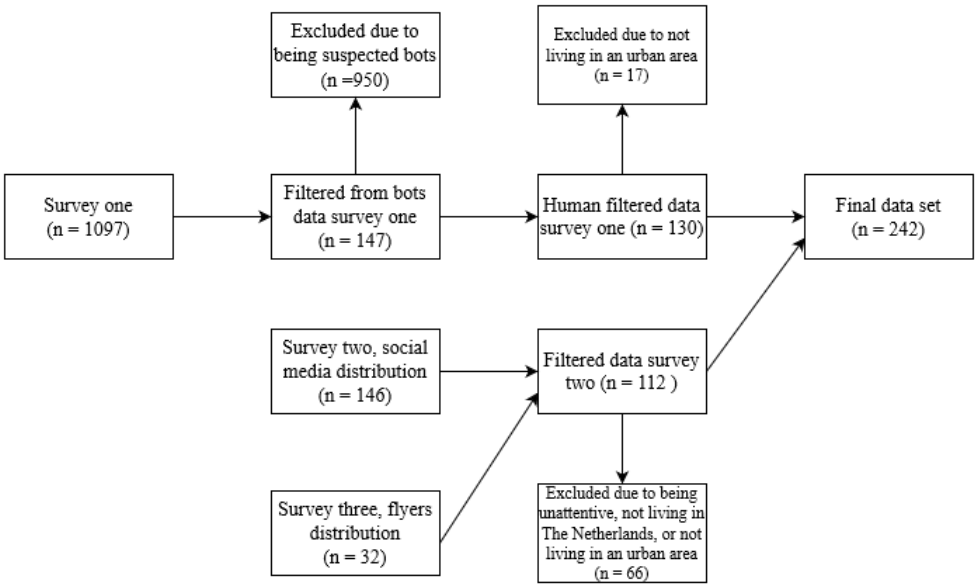


Figure D.3 Data flow surveys

Appendix E: Descriptives

In this Appendix chapter, the complete descriptives of the used data can be found.

Table E.1 Complete descriptives survey data

Variable	Mean	Std. Deviation	Skewness	Kurtosis	Variable	Choice	Percentage
PAC Q1 (1-5 scale)	4.23	0.633	-0.522	0.762	Gender	Women	60.3%
PAC Q2 (1-5 scale)	4.00	0.924	-0.934	0.358		Men	39.7%
PAC Q3 (1-5 scale)	4.07	0.806	-0.804	0.496	Age	18-25	27.3%
PAC Q4 (1-5 scale)	4.07	0.783	-1.065	1.701		26-35	20.7%
Driver's License (1 = "No", 2 = "Yes")	1.79	0.406	-1.458	0.128		36-45	16.1%
Norm Car (0 = Not norm, 1 = Norm)	0.53	0.500	-0.117	-2.003		46-55	10.3%
Norm Bus, Tram, Metro (0 = Not norm, 1 = Norm)	0.10	0.305	2.623	4.921		56-65	16.1%
Norm Bicycle (0 = Not norm, 1 = Norm)	0.32	0.468	0.765	-1.426		66-75	7.9%
Norm Walk (0 = Not norm, 1 = Norm)	0.00	0.000	.	.		> 75	1.7%
Norm Train (0 = Not norm, 1 = Norm)	0.05	0.209	4.392	17.430	Education level	Before secondary school	0.4%
Car Access (1-5 scale)	3.35	1.643	-0.312	-1.578		Secondary School	7.0%
Car Use (1-6 scale)	3.90	1.843	-0.511	-1.197		MBO	9.1%
Train Use (1-6 scale)	3.44	1.669	-0.177	-1.345		HBO bachelor	23.1%
Bus, Tram, Metro Use (1-6 scale)	3.67	1.600	-0.403	-0.969		WO bachelor	16.1%
Bicycle Use (1-6 scale)	4.70	1.721	-1.270	0.272		HBO master	9.5%
Walking Use (1-6 scale)	5.46	1.118	-2.775	7.870		WO master	31.4%
Transport Inflexibility (1-5 scale)	2.46	1.181	0.542	-0.743		PHD	3.3%
Satisfied Time (1-5 scale)	3.83	0.913	-0.882	0.673	Having Young Children	Yes	13.2%
Satisfied Cost (1-5 scale)	3.62	1.131	-0.776	-0.225		No	86.8%
Good Service Quality (1-5 scale)	3.63	0.998	-0.647	-0.148	Average Income	< €22,000 individual or together with partner	21.9%
Trip Chain (1-5 scale)	3.36	1.644	0.793	-0.954		< €22,000 average individual with partner	8.7%
Transport Restrictions (1-5 scale)	2.58	1.125	0.234	-0.951		€22,000 – €43,500	28.5%
Network Help (1-5 scale)	3.48	1.124	-0.716	-0.319		€43,500 – €65,500	15.7%
Safety Car Day (1-5 scale)	4.26	0.771	-0.863	0.377		€65,500 – €87,500	7.4%
Safety Public Transport Day (1-5 scale)	4.15	0.687	-0.752	1.686		€87,500 – €109,000	1.7%
Safety Cycling Day (1-5 scale)	4.05	0.840	-1.115	1.960		> €109,000	0.8%
Safety Walking Day (1-5 scale)	4.29	0.734	-1.400	3.954		Prefer not to say	15.3%
Safety Car Night	4.15	0.833	-1.245	2.600	Country of origin	The Netherlands	69.7%

(1-5 scale)							
Safety Public Transport Night (1-5 scale)	3.35	1.000	-0.403	-0.338		Another European country	5.4%
Safety Cycling Night (1-5 scale)	3.34	1.039	-0.246	-0.619		Africa	0.4%
Safety Walking Night (1-5 scale)	3.14	1.141	-0.067	-0.828		North America	1.2%
						Central America	0.8%
						Caribbean	0.8%
						South America	17.8%
						South Asia	1.2%
						South Eastern Asia	1.2%
						East Asia	0.8%
						Western Asia	0.4%
					Mode norm	Car	52.9%
						Tram, bus or metro	10.3%
						Train	4.5%
						Bicycle	32.2%
						Walking	0.0%

Appendix F: Workshop

Appendix F.1 Workshop slides

In this Appendix, the PowerPoint slides used for the workshop are shown.

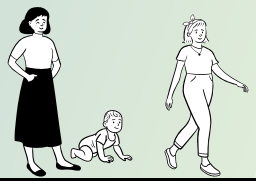
Introduction to research

- **In my research, I look into how Perceived Accessibility differs from person to person, with a focus on differences between people who identify as women and people who identify as men.**
- **Furthermore, differences also exist within the groups of women and men, which are taken into account by using an intersectional perspective.**
- Steps taken are:
  - Conceptual model based on literature
  - Statistical analysis using survey data
  - Workshop to validate relevant results and relate them to the transport system

Differences in mobility between people can take various forms, and are not just based on gender, as shown in literature

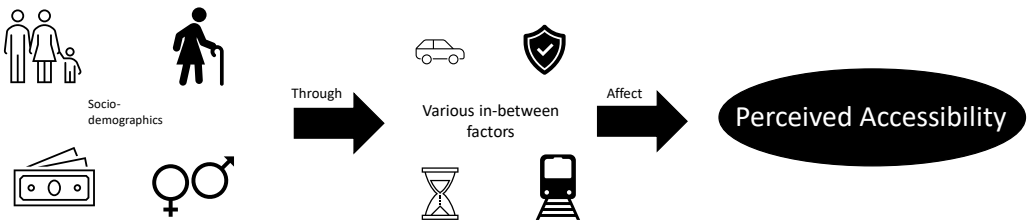
A younger man will likely feel much more safe using Public Transport modes or while walking or cycling, than an older woman

Older men often use different transport modes in their daily lives than young men

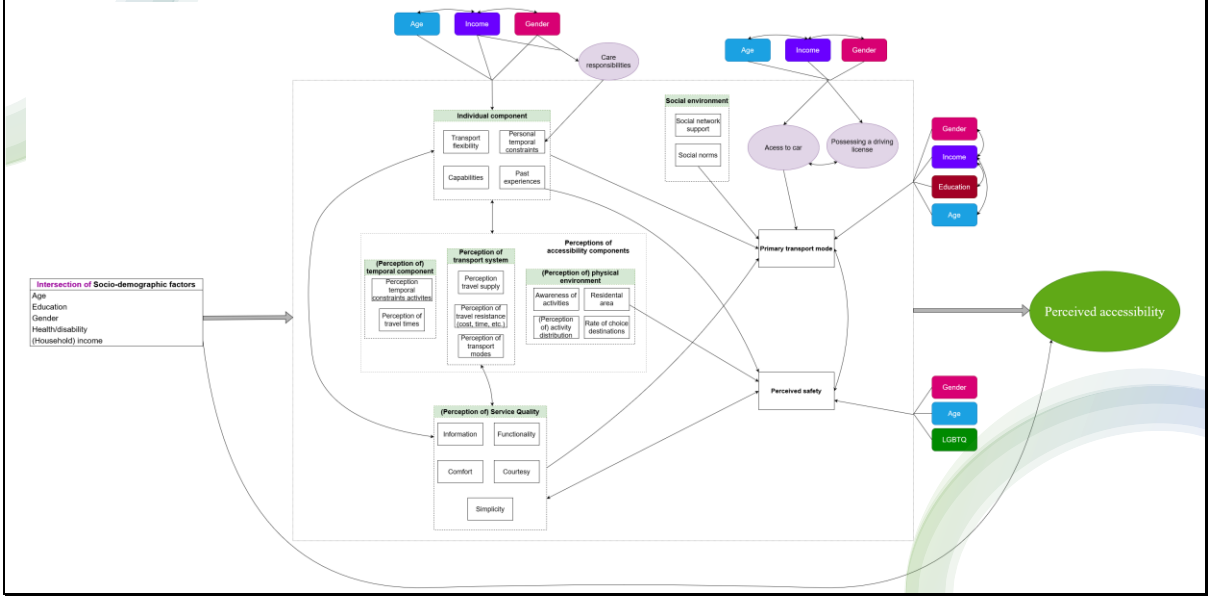


Women with childcare responsibilities are likely to have more time restrictions and more limited transport options compared to women without children

Overview of the model used

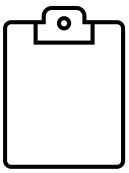


Conceptual model



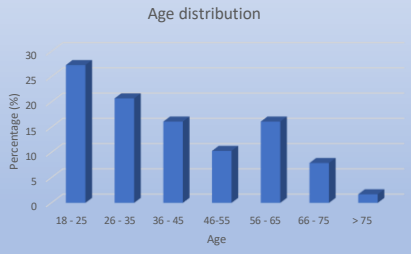
Survey Distribution

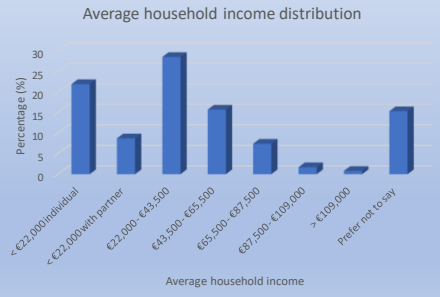
- To test relationships between factors, a survey was distributed to collect data for a statistical analysis
- Resulting dataset consisted of 242 people from urban areas in The Netherlands



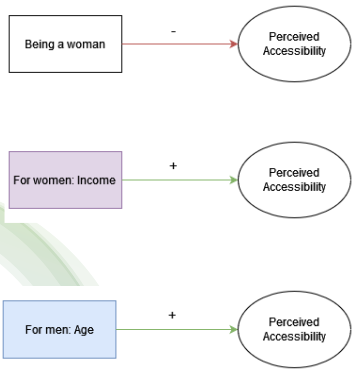
Some descriptives of the data

Female	Male
60.3%	39.7%





Results simple model

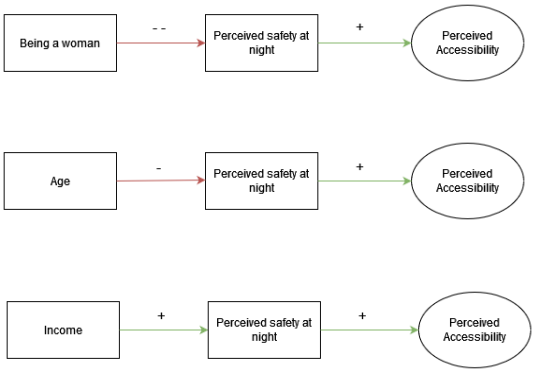


Being a woman reduces Perceived Accessibility

For women a higher income gives a higher Perceived Accessibility -> Also means that women with lower income have lower Perceived Accessibility

For men a higher age results in better Perceived Accessibility

Most relevant results complete model: Perceived safety

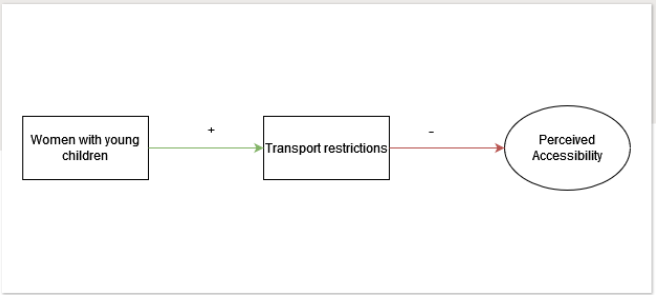


Being a woman significantly reduces perceived safety at night compared to being a man, which in turn lowers women's perceived accessibility

The older people are, the lower their perceived safety at night is, which in turn also reduces their perceived accessibility. On the other hand, younger people feel safer at night giving them a higher perceived accessibility

People with a higher income feel more safe while travelling at night, increasing their perceived accessibility. However, for low-income people the opposite goes, where they feel less safe and thus also have a lower perceived accessibility

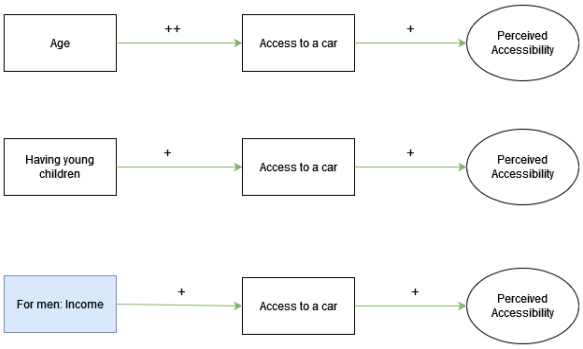
Most relevant results: Transport restrictions



Women with children experience more transport (mode) restrictions due to having multiple activities in a row. This in turn lowers their perceived accessibility. For men with young children, this effect does not exist.

**The question about transport restrictions related to the extent to which people felt they were restricted in their transport choices due to them having multiple places they needed to go to in a row*

Most relevant results: access to a car



With increased age, comes significantly higher access to a car, which increases perceived accessibility. On the other hand, younger people have less access to a car which causes lower perceived accessibility.

People with children younger than 12 years old have more access to a car compared to people who do not, which in turn increases their perceived accessibility.

For men, income has a significant effect on access to a car. This means that men with a higher household income have more access to a car, while men with a lower household income have less access to a car. This effect does not exist for women.

**Access to a car: how often can respondents use a car, on a scale from 1 (never) to 5 (always)*

Question so far?

Miro Board

Please use the next 20 minutes to write down your thoughts on the subjects in the Miro Board

Link:
https://miro.com/app/board/uXjVMIMl8QI=/?share_link_id=395102115537

Questions before we start?

Discussing the Miro Board

Closing off

Thank you for participating!

Appendix F.2 Miro board

In this Appendix, a picture of the Miro board used in the workshop can be found.

Figure F.1 Miro board used for workshop