Accessibility of Public Transport for People with a Disability

Jelmer Nederhof – Thesis
MSc Transport, Infrastructure and Logistics

TU Delft

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Delft University of Technology

MSc Transport, Infrastructure and Logistics

Accessibility of Public Transport for People with a Disability

Final Thesis

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Preface

This thesis marks the end of my five-year academic journey at the TU Delft. It was crafted with great effort, joy, hopelessness, inspiration, curiosity and eagerness. Before you lies the result: a simple pdf document, albeit very long. I hope you like reading it. But more than anything else, I wish that you learn something new. In the words of my father and his father before him: *Even if there is only one sentence in the whole book that appeals to you, it's worth reading.*

This thesis would not have been here without the support of a number of people. First, I would like to thank Rosa for her continued guidance of the project. Thank you for all our pleasant meetings, for providing a listening ear if needed and a push in the right direction if necessary. Thank you Niek, for your trust in me since the beginning. Thank you for the opportunity of doing this thesis at Populytics. And thanks for all the constructive feedback throughout the project. Thank you Niels, for always providing a reality check, by saying *yes it can be difficult and that's ok!* Thanks for having your door open for me to walk through and ask away. Thank you Alexandra for your hospitality and thank you for being part of the assessment committee.

I would like to thank all interviewed experts for their time and considerations. Your dedication steered me in the right directions. Thanks to all the people that, even after the interviews, gave input and provided feedback. A special thanks to both Freek and Peter. Your patience and eye for detail made this thesis much better. Thanks again!

This thesis was only possible thanks to all respondents who took the time to fill out the PVE. Thank you for writing your life stories in there, or just completing it in between everything else in life. Thank you all who burned my PVE to the ground with negative reactions. It made me learn that you'll always get criticism, no matter what you do.

Thank you, beloved colleagues at Populytics. The first day I received a warm welcome from you guys and since then I always looked forward to go to the office on Wednesdays. Thanks for all the support during my thesis, all the inspiring discussions during the lunch and all *Mokkamaster* coffees.

I would like to thank all my friends. Thank you for always being there, even if I am not. Thank you for the support, enjoyable distractions and summer plans to look forward to. For all the friends that I met in the past few years at the TU Deft: it was a pleasure! I am grateful to know so many inspiring, fun and unique people: from the debate club, Dispuut Verkeer or from class. Above all, thank you fellow inmates of the Thesis room. Thanks for being part of this journey. I enjoyed all the coffees, conversations and random chats we had and still have together.

Now, more than ever, I would like to thank my parents. Without you I would not be on this world, but without you I also would not have chosen this subject. In the beginning, I was afraid it might be too personal. But, I am very, very glad I did it. Thank you for all your support, both mental and on so many other fronts, now and throughout the years.

Jelmer Nederhof
Rhoon, June 2025

Summary

Across the globe, public transport accessibility for people with a disability falls short on a multitude of levels (Mwaka et al., 2024), risking social exclusion (Bruno et al., 2024) and reduced quality of life (Aarhaug & Elvebakk, 2015). The Netherlands was recently urged by the UN to adopt urgent measures on this issue (UN CRPD [United Nations Committee on the Rights of Persons with Disabilities], 2024). To increase accessibility as effective as possible, an efficient allocation of resources is crucial.

Multiple studies consulted People with a Disability (PwD) regarding the accessibility of public transport (PT). However, it is good practise to not just consult minority groups like PwD about their experiences, but include them in the design of accessibility solutions as well (Del Hoyo et al., 2021). J. Park & Chowdhury (2021) recommend scholars to ask PwD what improvements could have the biggest effect on their mobility. Generally, policymakers make decisions based on what they *think* PwD need. However, the studied literature has not yet asked PwD what policy measures *they* would prefer. Hence, a knowledge gap is identified in the accessibility policies that people with a disability and citizens in general would prefer.

Filling this knowledge gap can better inform policymakers, practitioners and planners when prioritising projects that focus on inclusiveness (J. Park & Chowdhury, 2021). Moreover, including PwD in the decision-making process generates vital insights (Chiscano, 2021; Del Hoyo et al., 2021), that could improve the social inclusion and quality of life of PwD (Aarhaug & Elvebakk, 2015). Specifically, the study tries to identify the policies that policymakers should strive for to improve the accessibility of PT for PwD.

Methodology

Recognizing this gap, our study proposes a Participatory Value Evaluation (Mouter et al., 2021) to be conducted. In the literature, common methods to assess the PwD user's perspective are interviews and surveys. Interviews allow for detailed feedback, but lack in number of responses. Surveys support large response rates but miss detailed insights on how objectives are traded off. The method has successfully been used to let a large group of respondents prioritise their preferred policies, motivate their choices, all while considering monetary and resource constraints (Bahamonde-Birke et al., 2024; Mouter et al., 2021; Mulderij et al., 2021). However, a Participatory Value Evaluation (PVE) is a novel method when applied to accessibility research in the transport environment. Therefore, part of this research is dedicated to explore the strengths and weaknesses of PVE in the appraisal of accessibility policies.

The PVE was designed with the help of a desk research, literature research and expert interviews. The desk research and literature research delivered an overview of policies that *could* be proposed to the respondents. The results were analysed quantitively, by means of a Latent Cluster Class Analysis (LCCA) and qualitatively by exploring the open-answer responses.

Main findings

In the PVE, participants could indicate which policies should get more priority. In total, 1835 respondents accessed the PVE, 1254 completed the policy trade-off, of which 328 have a disability. The study identified seven different subgroups of PwD: people with a walking, vision, hearing, cognitive or speaking impairment, as well as people with low energy levels and people sensitive to stimuli.

Participants gave most priority to the repair of broken elevators, as presented in figure 1. All subgroups of PwD, as well as citizens in general prioritised this policy most. The main way to increase the uptime of elevators is to spend more money on maintenance contracts. Additionally, preventing vandalism was proposed. Similarly, wheelchair accessible vehicles is considered important. Participants prioritised these policy measures *despite* the high costs. These results show that participants prefer more expensive, long-term policies that facilitate independent travel for most PwD, over less expensive measures that do not improve independence in the long term.

However, some subgroups of PwD also prioritised the training of personnel and travel assistance, two short-term measures that enable *dependent* PT usage. These subgroups are people with cognitive impairments, people sensitive to stimuli and people who have difficulties standing or have low energy levels in general. For them, physical assistance remains a necessity, in line with previous research (Risser et al., 2015; Durand, 2025).

A novel measure was identified to be possibly beneficial: automatic check-in and check-out. Transdev (n.d.) offers this service already in buses in Brabant. This is mostly relevant for people with a visual impairment, because for them it can be hard to find the check-in poles. But, the policy measure can also help people with cognitive impairments, people sensitivity to stimuli and travellers in general.

Participants gave policies priority because of their perceived *necessity* and *effectiveness*. Necessity means that participants considered the status quo to be unacceptable. Effectiveness means that a policy measure could help PwD to use PT. In the PVE, respondents show altruistic and moral considerations, in line with previous findings in other fields (Mouter et al., 2021). For example, the different subgroups of PwD also select policies that do not benefit them directly. Surprisingly, the cost of a measure or the interest of another group than PwD was cited little as a reason to (not) choose a policy.

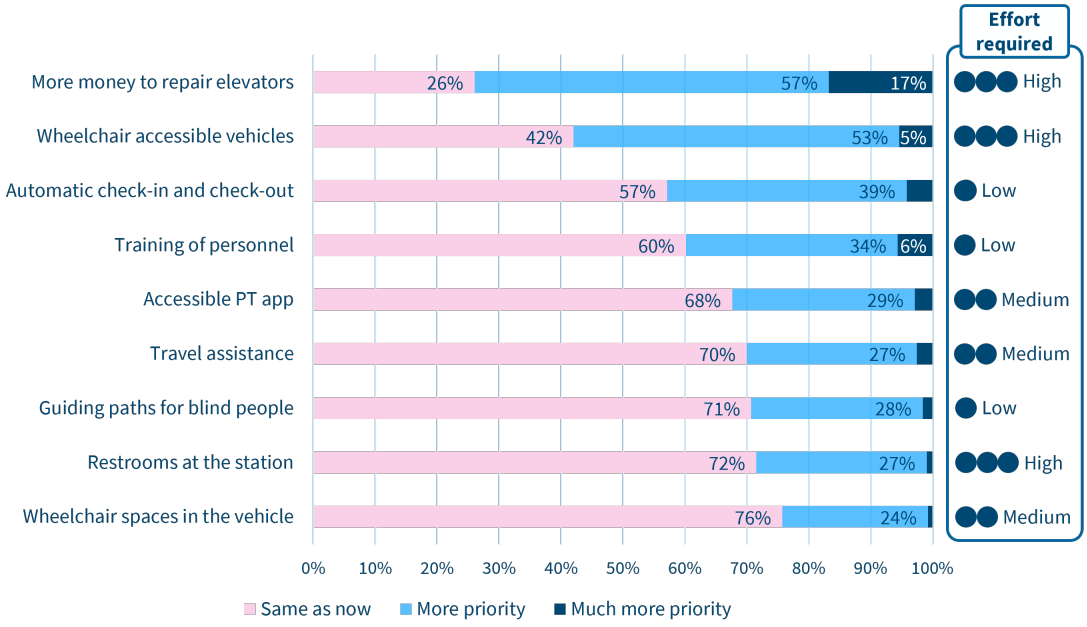

Figure 1: The elicited preferences of participants in the choice task. Participants could give a policy *more priority* and *much more priority*. *Same as now* is the default option, indicating that enough is done already regarding this policy.

The results of the Latent Cluster Class Analysis (LCCA) are shown in figure 2. The LCCA can find heterogeneity among respondents, based on their elicited preferences and any significant personal characteristics. Note that the clusters are never black and white. Nevertheless, the clusters provide insights into the types of answers people gave in the PVE survey.

Cluster 1, nicknamed *caregivers*, mostly gives priority to wheelchair accessible vehicles and broken elevators. Almost nobody of this cluster gave priority to wheelchair accessible toilets. The cluster consists of relatively few PwD, but relatively many people that know somebody with a disability. Furthermore, the cluster consists of relatively few older people.

Cluster 2, nicknamed *young travellers*, opted for elevators and not for wheelchair accessible vehicles. This cluster did not strive to make PT 'fully accessible'. Instead, it prioritised a set of measures that can quickly help PwD to use PT, such as reliable elevators, the training of personnel and automatic check-in and check-out. This cluster consists of relatively many PwD, frequent PT users and young people.

Cluster 3, nicknamed *altruistic unfamiliar*, did not dedicate effort to elevators. Instead, they distributed it relatively evenly over all other policies. They think it is important that all issues are addressed. The cluster consists of many sporadic PT users and relatively many older people, males and people with a low education. It consists of less PwD than clusters 2 and 4, but more than cluster 1.

Cluster 4, nicknamed *older urbanites*, choose three policies predominantly: the repair of elevators, wheelchair accessible vehicles and restrooms at the stations. It has many frequent PT users and PwD. Most are older people and most live in a big city. There are relatively few young people in this group. When contrasting cluster 4 to cluster 1, one can see that PwD that opt for wheelchair accessible vehicles, often opt for wheelchair accessible restrooms as well.

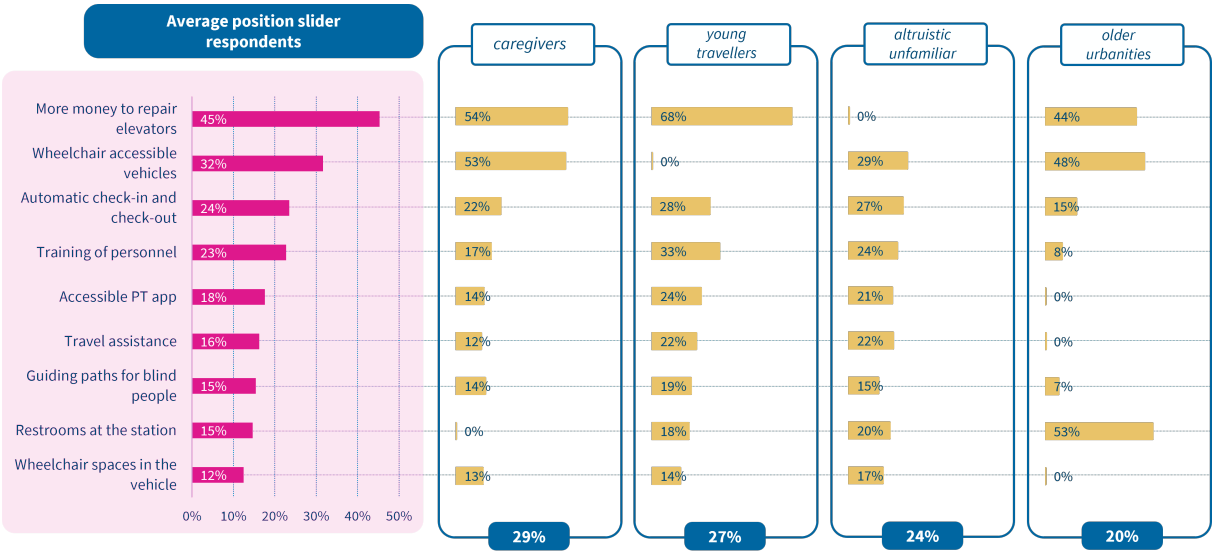

Figure 2: The elicited preferences of the four clusters with their respective cluster sizes.

Regarding the validity of a PVE in the context of accessibility policies, this study showed that a PVE can be a valuable tool in the context of accessibility policy to identify the preferences of both PwD and citizens in general. 1254 Respondents, of which 328 PwD, were able to prioritise what they deemed most important, under scarcity. J. Park & Chowdhury (2021) argued that this scarcity is the major factor that not all accessibility policies necessary are executed. A PVE can therefore help policy-makers to determine what policies are most urgent. Participants explained *why* they did (not) prioritise a certain policy, often using real-life examples. This is in line with findings from Mouter et al. (2021), stating that a PVE can sketch a picture of all considerations and nuances relevant to the decision-making. The results of this research show that the PVE was easy to understand for participants. Moreover, a large majority of respondents supported the use of PVEs for future decision-making processes, in the field of accessible PT for PwD. Therefore, the study shows that a PVE is a suitable method to study accessibility policies and can provide relevant insights for policymakers.

Generalizability

The sample is not fully representative of the population, so the results were reweighted as to increase generalizability. The sample is overrepresented by males and highly educated people, while it is underrepresented by people younger than 35 and people living in rural areas. Most respondents indicated that it was easy for them to make ends meet.

The sample was reweighted on gender, age and education to make the results more generalizable. Having a disability is not considered as a variable to reweight on, because clear data lacks in the Netherlands on the frequency of disabilities. Because of this, the reweighted data might still be overrepresented by PwD. Comparably, people living in rural regions and people with a low income might still be underrepresented in the reweighted results.

Recommendations for future research

Two main recommendations are made for future research.

First, a number of participants of the PVE criticized the limited scope of the research. Some argued that other issues are more urgent than the accessibility of PwD. Others felt like a number of policies were missing in the PVE. Future research could base itself on a much broader policy scope that exceeds PwD accessibility policies alone and can include policies such as the presence of PT in rural areas, ticket prices and zero-emission vehicles. But, it is advisable to narrow down the geographical scope. The aforementioned policies are often location bound. Hence, future research could apply the PVE method, a proven user-centric approach, to accessibility policies on a local level.

Second, this research identified two separate subgroups of PwD that comparable research did not identify yet: people who are extra sensitive to stimuli and people who have trouble walking or have low energy levels in general. These groups have distinct preferences and thus distinct needs. However, this research also found that a lot of PwD have multiple disabilities, suggesting the need for an integrated, intersectional (Crenshaw, 1991) approach. Future research has to acknowledge that PwD cannot be split in two or three distinct groups, for there are numerous varying disabilities and some PwD have multiple disabilities.

Practical recommendations

The study reveals relevant information for policymakers and PT operators. This section highlights the most important recommendations for practice:

The repair of broken elevators was as a top priority for PwD and citizens in general. All subgroups of PwD expressed that reliable elevators are the most urgent measure, *despite* its high cost. Additionally, elevators are important for parents with strollers, elderly and travellers carrying luggage. The main way to increase the uptime of elevators is to spend more money on maintenance contracts. Additionally, preventing vandalism could be effective.

Wheelchair accessible vehicles are the second most urgent measure. Many respondents rather prioritised this policy than prioritising multiple, less expensive policies. Based on these findings, policymakers are urged to accelerate the transition towards fully accessible vehicles, platforms and stops.

Automatic check-in and check-out is a promising innovation that can make it easier and quicker for PwD to use PT, especially for people with a visual impairment. Transdev (n.d.) offers this service already in all buses in Brabant.

Physical support by experienced personnel remains a necessity for certain subgroups of PwD. Thus it is advised to provide travel assistance in PT and to provide training for staff in supporting PwD, especially people with lesser known disabilities.

Restrooms at the stations are not the highest priority for many respondents. But, a subset of participants attached great value to this measure, indicating that accessible toilets are crucial for some travellers.

Lastly, this research showed that a **PVE** is able to identify the preferences of both PwD and citizens in general. Thereby a PVE helps policymakers to determine what accessibility policies are most urgent. The method can be used to complement the existing co-creation processes of accessibility policy.

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(File:Piet Mondriaan Victory Boogie Woogie.jpg, 2023)

Introduction

1.1. Public transport accessibility for people with a disability

Across the globe, public transport accessibility for people with a disability falls short on a multitude of levels (Mwaka et al., 2024), risking social exclusion (Bruno et al., 2024) and reduced quality of life (Aarhaug & Elvebakk, 2015). The Netherlands was recently urged by the UN to adopt urgent measures on this issue (UN CRPD [United Nations Committee on the Rights of Persons with Disabilities], 2024). To increase accessibility as effective as possible, an efficient allocation of resources is crucial.

Common topics of the studies on the accessibility of public transport (PT) for people with a disability (PwD), are the needs of and barriers encountered by PwD when using PT (Almada & Renner, 2015; Bezyak et al., 2019; Mwaka et al., 2024; J. Park & Chowdhury, 2018; Pyer & Tucker, 2014) and possible accessibility solutions (Bruno et al., 2024; Edwards et al., 2001; Zając, 2016). A distinction is made between physically impaired, visually impaired and mentally impaired individuals. Of the three types, the latter is studied least (Risser et al., 2015) [1].

1.1.1. The user's perspective

Multiple studies consulted PwD regarding accessibility of PT (Almada & Renner, 2015; J. Park & Chowdhury, 2018; Pyer & Tucker, 2014; Bezyak et al., 2019; Edwards et al., 2001; Chiscano, 2021; J. Park et al., 2020). Common methods to assess the PwD user's perspective are interviews and surveys. Interviews allow for detailed feedback, but lack in number of responses. Surveys support large response rates but miss detailed insights on how objectives are traded off.

However, it is good practise to not just consult minority groups like PwD about their experiences, but include them in the design of accessibility solutions as well (Del Hoyo et al., 2021). J. Park & Chowdhury (2021) recommend scholars to ask PwD what parts of a PT journey need to be addressed most, i.e. what improvements could have the biggest effect on their mobility. This will better inform decision makers when prioritising projects aimed at improving inclusiveness (J. Park & Chowdhury, 2021). Chiscano (2021) did include PwD in the design process and found that a group with PwD generated richer and more detailed insights on the design of PT than a group of policymakers alone. This could be because policymakers make decisions based on what they *think* PwD would prefer. However, the studied literature has not asked yet PwD what policy measures *they* would prefer.

The policy decisions PwD would make cannot be derived directly from the observed needs and barriers. First of all, not all accessibility solutions can be implemented due to monetary and resource constraints (J. Park & Chowdhury, 2021). That makes it often necessary to prefer one measure over another. Secondly, policy choices can include moral and altruistic considerations (Mouter et al., 2021). In other words, people might prefer a policy even if it might not benefit them. A general example is high-income voters casting a ballot for a socialist candidate.

Additionally, not just PwD are relevant in the discussion about PT accessibility. The opinions of the broader public are important as well, for two reasons. First, investments in accessibility generally come from common goods (Bruno et al., 2024). Any improvement of accessibility needs public support, assuming a democratic decision-making process. Second, there could be discrepancies between the preferences of the beneficiary group on the one hand (in this case PwD) and the broader public on the other hand (Mulderij et al., 2021). In the field of accessibility, research already found discrepancies between experts and PwD (J. Park et al., 2020). If and how discrepancies exist between PwD and citizens on the appraisal of accessibility policies is not yet researched.

[1] A proposed explanation for this scarcity in the literature is that the research is scaterred across multiple research areas (Risser et al., 2015). Another explanation could be that traditional research is not suited to reach people with a cognitive impairment. This research therefore tries to reach all subgroups of PwD, including people with cognitive impairments.

1.1.2. Knowledge gap and research question 1

A knowledge gap is identified in the policy measures People with a Disability and the public in general would prefer when they consider monetary and resource scarcity. The research aims to fill this knowledge gap by answering the following research question:

> *What policies do PwD and citizens in general prefer most with regard to the accessibility of Public Transport for People with a Disability?*

Researching this question will contribute to scientific knowledge as well as practical policy making.

For science, the study can improve the understanding of the preferences of both PwD and citizens regarding the accessibility of PT for PwD. These results might give an insight into similarities and differences between the preferences of PwD and citizens. For the appraisal of accessibility policies, this has not been researched before.

For practice, a better understanding of citizens' preferences can improve the quality of policy making on accessibility. J. Park & Chowdhury (2021) advise to ask PwD what accessibility improvements *they* would make, for it would help policymakers, practitioners and planners to prioritise projects that focus on inclusiveness. Moreover, including PwD in the decision-making process generates vital insights (Chiscano, 2021; Del Hoyo et al., 2021), that could improve the social inclusion and quality of life of PwD (Aarhaug & Elvebakk, 2015). The preferences of citizens can draw a clearer picture of public support for different accessibility measures. To conclude, the study tries to identify the policies that policymakers should strive for to improve the accessibility of PT for PwD.

1.2. Participatory Value Evaluation (PVE)

Recognizing this gap, this study proposes a research that allows PwD to make trade-offs between potential accessibility measures, acknowledging monetary and resource limitations. To this end, the novel method Participatory Value Evaluation (Mouter, 2021) is introduced. In this section, different alternatives are discussed briefly and a knowledge gap regarding the validity of PVE is identified.

The literature has used four different methods before to assess the user perspective of PwD, as presented in table 1.1.

Interviews (Almada & Renner, 2015; J. Park & Chowdhury, 2018; Pyer & Tucker, 2014) and focus groups (Chiscano, 2021) allow participants to express what issues they deem important and why. Participants being able to deliberate on their choices is important, for two reasons. First, reasoning based on experience can justify policy choices. Second, deliberation might expose previously covered knowledge (Quick & Zhao, 2011), so called black swans (Taleb, 2007). Contrastively, many of these studies are plagued by small sample sizes. That makes them less practically useful (Kapsalis et al., 2022). For focus groups specifically, an additional drawback is its costly nature.

Surveys (Bezyak et al., 2017, 2019; Edwards et al., 2001) and MCA (J. Park et al., 2020) facilitate large response rates but do not offer a detailed overview of why participants made a specific choice. Moreover, they do not always consider monetary or resource constraints. J. Park & Chowdhury (2021) argued that these constraints are the major factor that not all accessibility policies necessary are executed. Therefore a need arises for a research method that is suitable for a large sample size, while enabling PwD to give detailed responses and consider scarcity.

1.2.1. PVE as a public participation method

A Participatory Value Evaluation (Mouter, 2021) has successfully been used to let a large group of respondents prioritise their preferred policies, explain their choices, all while considering monetary and resource constraints (Bahamonde-Birke et al., 2024; Mouter et al., 2021; Mulderij et al., 2021). Participants can allocate resources to a set of alternatives. Since the resources are scarce, they have to make a

Table 1.1: The advantages and disadvantages of the methods used in the literature, as compared to a PVE

Method	**Sample size**	**Detailed responses**	**Considers scarcity**
Interviews	small	yes	possible
Focus groups	small	yes	possible
Surveys	large	no	no
MCA	both possible	no	no
PVE	large	yes	yes

trade-off. Next, participants are able to explain their choices. This is the methods strength. It sketches a picture of all considerations and nuances relevant to the policy evaluation (Mouter et al., 2021).

PVE is a novel method when applied to accessibility research in the transport environment. Part of this research is dedicated to explore the strengths and weaknesses of PVE in the appraisal of accessibility policies. This dedication has three reasons.

First, it is important to have a credible participation method in order to improve the accessibility of PT. Del Hoyo et al. (2021) state that an essential strategy towards an inclusive society is to promote public participation in decision making processes, especially for the most vulnerable groups. The UN CRPD [United Nations Committee on the Rights of Persons with Disabilities] (2024) stresses that the lack of participation hurts the development of accessibility standards in the Netherlands. One could argue that public participation improves inclusiveness in and of itself. Therefore it has value.

Second, if PVE as a method is not perceived as being useful, it will not be used. De Ruijter et al. (2025), Tuit (2022) and Golan (2023) have researched the validity of the PVE method, more specifically the face validity. Taherdoost (2016) defines face validity as: *"the degree to which a measure appears to be related to a specific construct."* In other words, the degree to which participants perceive the PVE to be beneficial in the discussion about accessible PT. There is reason to believe that people will not mark a PVE as helpful. Accessibility is a rather complex and inherent personal experience (UN CRPD, 2024). It might be difficult to understand for people without a disability. Moreover, in the Netherlands there are organisations that represent PwD towards governments and PT operators (UN CRPD [United Nations Committee on the Rights of Persons with Disabilities], 2024). They could see a PVE as a replacement of the existing co-creation infrastructure.

Third, an appraisal method about accessibility must be accessible to all members of society. Concerns exist about the accessibility of a PVE to people with visual impairments. The PVE complies with WCAG guidelines on level A (Ministry of General Affairs, 2025). That is the lowest level offered and does not guarantee accessibility for those using text to speech software.

1.2.2. Knowledge gap and research question 2

A second knowledge gap is identified in the validity of a PVE to assess the preferences of people regarding the accessibility of public transport. The research aims to fill this knowledge gap by answering the following research question:

> *How adequate is a PVE for determining the preferred policies of different subgroups of People with a Disability on Public Transport accessibility??*

Researching this question will contribute to scientific knowledge as well as practical policy making.

For science, the study can give an insight to the (face) validity of PVE in the accessibility domain. The face validity of a PVE has been researched before. But, this study is the first to evaluate the validity of a PVE in the domain of accessibility. Three reasons exist to test the face validity again for this field. First, accessibility is a complex issue (Vecchio & Martens, 2021). That raises the question how well participants are able to understand specific measures in a short period of time. Second, in the Netherlands co-creation

processes are already in place to advise policymakers about accessibility policies (UN CRPD, 2024). That raises the question if a PVE is seen as a complement to the existing decision-making process or a replacement. Third, a PVE about accessibility should be accessible to all subgroups of PwD, in particular people with visual impairments.

For practice, a PVE will only be applied on a large scale if it is considered useful. In order to be useful, the PVE has to be understood and appreciated by its participants.

1.3. Research questions

The objective of the research is twofold. First, to provide insight into the choices People with and without a Disability would make when they make a selection of preferred policies to improve accessibility of Public Transport under scarcity. Second, to assess to what extent a PVE is applicable to the appraisal of accessibility policies in Public Transport. These knowledge gaps will be filled by answering two main research questions:

A. *What policies do PwD and citizens in general prefer most with regard to the accessibility of Public Transport for People with a Disability?*

B. *How adequate is a PVE for determining the preferred policies of different subgroups of People with a Disability on Public Transport accessibility?*

The main research question is divided into four sub questions:

1. To explore the policies that could be effective in the Dutch Public Transport sector.
   Sub question: *What potential policies could make Public Transport more accessible for People with a Disability?*

2. To observe the preferences of citizens as derived by the PVE.
   Sub question: *What policies do citizens prefer most with regard to the accessibility of Public Transport for People with a Disability?*

3. To analyse if and how the preferences of People with a Disability, regarding Public Transport accessibility, differ between various subgroups.
   Sub question: *How do the perceptions of the various subgroups of People with a Disability compare?*

4. To validate the PVE in the context of accessibility policies in the transport environment.
   Sub question: *How do People with a Disability evaluate the validity of a PVE towards Public Transport accessibility policies?*

1.4. Methods used

This section explains the methods used to answer the sub questions presented above. An overview of the methods used for each sub question is given in table 1.2.

A PVE is the main method used. The main reason that a PVE is chosen is its ability to include scarcity, in the form of resource constraints. Resource constraints were cited by J. Park & Chowdhury (2021) as one of the main reasons that not all accessibility policies can be implemented, generating the need to ask PwD which policies should be prioritised. A general advantage of a PVE is that participants can express moral and altruistic considerations on the trade-off between policy effects (Mouter et al., 2021). Another advantage is that PVE highlights all the arguments for and against a policy by asking participants' opinions (Mouter, 2021). Hence, the PVE is expected to provide insights that can policymakers prioritise accessibility policy measures, based on public support and arguments for and against each measure.

Table 1.2: Overview of sub questions and corresponding research methods

Sub question	Research method
What potential policies could make Public Transport more accessible for People with a Disability?	Literature research, desk research, interviews
What policies do citizens prefer most with regards to the accessibility of Public Transport for People with a Disability?	PVE, quantitative analysis, Latent Cluster Class analysis (LCCA) and qualitative analysis
How do the perceptions of the various subgroups of People with a Disability compare?	PVE, quantitative analysis
How do People with a Disability evaluate the validity of a PVE towards Public Transport accessibility policies?	PVE, quantitative and qualitative analysis

The desk research is conducted to study the policies that have already been in place in the Netherlands on the accessibility of PT and identify topics that are considered important by policymakers.

The literature research helps to define the problem, but its main goal is to obtain an overview of policies that *could* be proposed to the respondents. This ensures consistency of this thesis with the literature.

Expert interviews are a common method to determine what policies are relevant in a PVE (Bahamonde-Birke et al., 2024; Golan, 2023). Pfadenhauer (2009) states that expert interviews are suited to complement a literature review.

The elicited preferences of different groups will be determined by means of quantitative analysis.

A Latent Cluster Class analysis (LCCA) is used to split the respondents in a number of groups that have similar preferences. This is relevant, for it analyses heterogeneity amongst participants. It is useful for policymakers to know which policies can count on consensus.

A qualitative analysis is performed to understand *why* participants did (not) give a policy priority and to understand *how* participants evaluate the PVE.

1.5. Scope

Considering the limited time frame and resources for this research, the scope is narrowed to people with a disability and public transport only. Both choices are explained below.

1.5.1. People with a disability

The research investigates the needs of people with a disability. People with a disability are defined according to the definition set by the UN Department of Economic and Social Affairs (n.d.):

> *Persons with disabilities include those who have long-term physical, mental, intellectual or sensory impairments which in interaction with various barriers may hinder their full and effective participation in society on an equal basis with others.*

Naturally, accessibility and inclusion go far beyond people with a disability. Bruno et al. (2024) uses the TRSE framework that adopts a holistic view on inclusive transportation. Luz & Portugal (2021) identified 10 dimensions of transport-related social exclusion, as shown in figure 1.1. This study focusses mainly on the *physical exclusion* component. For people with a cognitive impairment, the *digital-divide* exclusion might be relevant too (Durand, 2025). Additionally, *exclusion based on fear, prejudice, or feelings* can play a role as well (Velho et al., 2016).

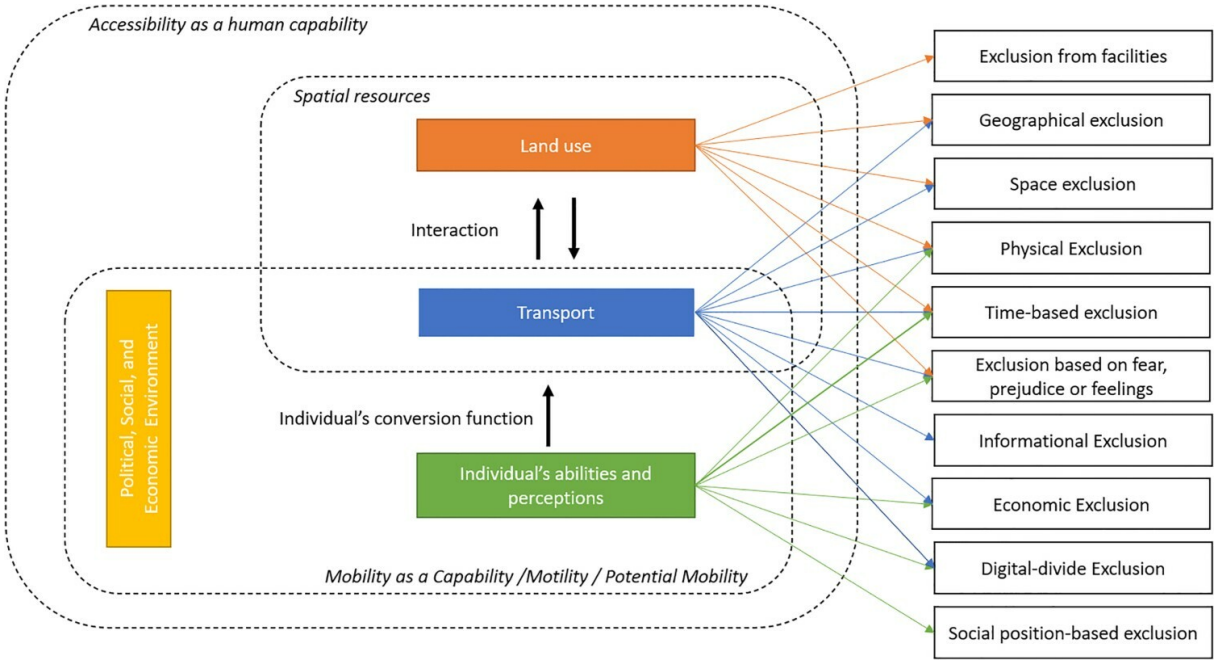


Figure 1.1: The 10 dimensions of transport-related social exclusion, in relations to human capability components (Luz & Portugal, 2021).

This research centres around PwD for three reasons. First, the literature, such as Mwaka (2024), is pivoted to PwD only. That makes the research easier to be built upon past findings, easier to place in existing literature and easier to be found by future researchers. Second, while it is true that accessibility measures benefit others too, focussing too much on this aspect might nudge people without a disability to focus on the measures that benefit them. The majority of people does not have a disability. Thus a focus on general accessibility policies might bias the outcome of the research. Third, it is easier to convince social organisations in the field of disabilities to share the research with their members if the research has 'people with a disability' in its name.

1.5.2. The Dutch public transport sector

The research study area is the Dutch public transport. The entirety of the Netherlands is considered to support as many respondents as possible. The door to door journey is not considered. Instead, this research focusses on the journey between two PT stops, for two reasons.

First, we live in a society where different agencies have different jurisdictions. The infrastructure next to a PT stop is often not managed by the public transport operator, but by a municipality (Van Oort, 2011). The study researches the entirety of the Netherlands. Including local issues related to the access and egress makes it difficult to provide concrete recommendations for transport operators and governmental agencies.

Second, the question arises where the journey chain ends and where it begins. Often the journey chain is defined as the travel from the origin to the destination (J. Park & Chowdhury, 2021; Staahl, 1997).However, this paradigm assumes that the destination and origin are accessible. This is not always the case. Narrowing the scope to just the journey makes a study researchable. Given the limited time and resources available for this research, this study narrows the scope further to the journey between the beginning PT stop and ending PT stop.

1.6. Reading guide

First, chapter 2 presents and explains the methodological framework of this study. Second, in chapter 3 RQ 1 is answered with the help of a desk research, literature research and expert interviews. Third, the design of the PVE is deliberated upon in chapter 4. Fourth, chapters 5, 6 and 7 give answers to RQs 2, 3 and 4 respectively. Fifth, a discussion is provided on the results, the main findings are related to the literature and scientific recommendations are discussed, all in chapter *8 Discussion*. Lastly, the main research questions A. and B. are answered in chapter *9 Conclusion*. Additionally, the scientific relevance is discussed and practical recommendations are given.

(File:Piet Mondriaan Victory Boogie Woogie.jpg, 2023)

Methodology

In this chapter the used methods are discussed in-depth. First, a motivation for the use of each method is given. Second, the three methods aimed to answer RQ 1 are discussed: *What policies do PwD and citizens in general prefer most with regard to the accessibility of Public Transport for People with a Disability?* These methods are the desk research, literature research and interviews with experts. Third, the PVE is discussed, including the data collection and data handling. Fourth, the data analysis is discussed.

2.1. Motivation for using each method

The used methods are presented in table 2.1. First, the choice for a PVE is discussed, since this is the main method used in this study. Note that a comparison between a PVE and alternative methods that were used by the literature is provided in section *1.2. Participatory Value Evaluation (PVE)*. Second, the choice for a desk research, literature research and interviews is deliberated upon. Third, the motivation for the various data analysis methods is presented briefly.

Table 2.1: Overview of sub questions and corresponding research methods

Sub question	**Research method**
1. What potential policies could make Public Transport more accessible for People with a Disability?	Literature research, desk research, interviews
2. What policies do citizens prefer most with regards to the accessibility of Public Transport for People with a Disability?	PVE, quantitative analysis, LCCA and qualitative analysis
3. How do the perceptions of the various subgroups of People with a Disability compare?	PVE, quantitative analysis
4. How do People with a Disability evaluate the validity of a PVE towards Public Transport accessibility policies?	PVE, quantitative and qualitative analysis

A Participatory Value Evaluation (PVE) ranks projects based on an experiment where participants can spend resources on a combination of projects considering a limited (government) budget (Mouter et al., 2021). The trade-off the participants made while selecting their policies highlights their importance of criteria and can be used to select one or more projects based on the project's desirability (Dekker et al., 2019).

A PVE has several advantages over alternative methods that have been used to study the PwD user's perspective. Interviews (Almada & Renner, 2015; J. Park & Chowdhury, 2018; Pyer & Tucker, 2014) and focus groups (Chiscano, 2021) allow participants to express what issues they deem important and why. Many of these studies are plagued by small sample sizes. That makes them less practically useful (Kapsalis et al., 2022). Surveys (Bezyak et al., 2017, 2019; Edwards et al., 2001) and MCA (J. Park et al., 2020) facilitate large response rates but do not offer a detailed overview of why participants made a specific choice. More importantly, they do not always consider monetary or resource constraints. The PVE has successfully been used to let a large group of respondents prioritise their preferred policies, deliberate their choices, all while considering monetary and resource constraints (Bahamonde-Birke et al., 2024; Mouter et al., 2021; Mulderij et al., 2021).

A general advantage of a PVE is that participants can express moral and altruistic considerations on the trade-off between policy effects (Mouter et al., 2021). Another advantage is that PVE highlights all the arguments for and against a policy by asking participants' opinions (Mouter, 2021). A disadvantage is PVE's limited ability to cope with human bias in the project combination phase. These biases can include the hypothetical bias (Schmidt & Bijmolt, 2019) but also participants taking decisions based on

gut-instinct, over-generalizing effects, and having difficulties comparing different orders of magnitude (Kahneman, 2011). However, Macharis et al. (2010) state that if participants know their opinions are included in the evaluation, they are motivated to make proper assessments.

The desk research, literature research and interviews are performed to define the PVEs scope, policy options and design. Bouwmeester (2021) defines five steps when performing a PVE. The various steps are shown in figure 4.1.

The first step of conducting a PVE is problem definition. A literature research and interviews help to narrow down the scope of the research and identify relevant gaps in the literature and in practise.

The second step corresponds to RQ 1: *What potential policies could make Public Transport more accessible for People with a Disability?* It is performed by a desk research, literature research and interviews. While the literature research helps to define the problem, the main goal is to obtain an overview of policies that *could* be proposed to the respondents. This ensures consistency of this thesis with the literature. The desk research has two main goals. First, it is conducted to study the policies that have already been in place in the Netherlands on the accessibility of PT. If effective measures are already taken in one field, it might not be necessary to include this measure in the PVE. Second, the desk research aims to identify topics that are considered important by policymakers. Combining these two sets of information creates an insight in topics that are relevant but are not yet targeted by adequate measures. Expert interviews are a common method to determine what policies are relevant in a PVE (Bahamonde-Birke et al., 2024; Golan, 2023). Pfadenhauer (2009) states that expert interviews are suited to complement a literature review. In this case, they complement both the literature research as well as the desk research.

The third step, designing the actual PVE is completed with the help of the interviewed experts. All experts are working for a company or organisation active in the field of accessible PT for PwD. Each of them have a unique and valuable perspective.

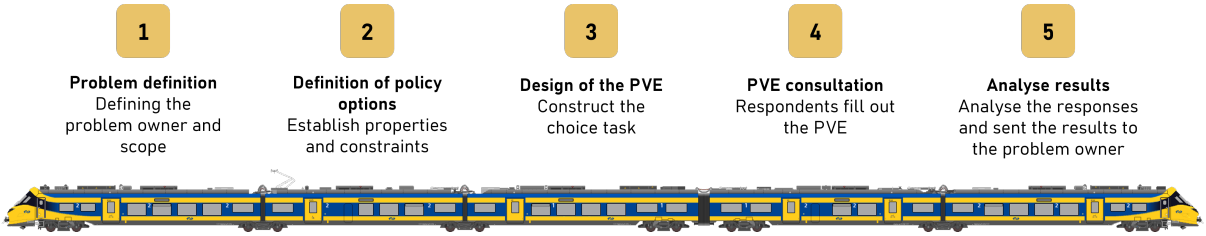


Figure 2.1: The five steps of a PVE as proposed by Bouwmeester (2021).

After the PVE is spread to the target audience, the results are analysed, by means of a quantitative analysis, a Latent Class Cluster Analysis (LCCA) and a qualitative analysis. This corresponds to the fifth step in the PVE framework.

A quantitative analysis gives insight into the elicited preferences of respondents. The data on the preferred policies answers what policies PwD and citizens prefer most. Combined with socio-demographics, it also gives an insight into the perceptions of the various subgroups of PwD. The data on the evaluation of the PVE provides insight in the face-validity of the PVE in the context of accessibility. How these three results are calculated is explained in section 2.6.1.

A LCCA is a frequently used method to establish subgroups based on a set of characteristics (Weller et al., 2020). Quantitative analysis alone provides an overview of projects that the participants combined consider valuable (Mouter et al., 2021). But, one has to consider the distribution of preferences amongst the population. For example, if a specific proportion of the population is strongly against a policy that is generally considered to be useful, then it might be socially desirable to abstain from the policy or make a compromise. The philosophy of a PVE urges policymakers to listen to all voices, also the weakest voices. Mouter et al. (2021) elaborate on this point by saying that decision-makers should know the distribution of preferences to make informed decisions. LCCA provides this partially by splitting the respondents into a number of subgroups, based on their preferences.

The qualitative analysis is comprised of two parts. First, participants could indicate why they did or did not choose a policy measure. One of the main advantages of a PVE is that it highlights all the arguments for and against a policy by asking participants' opinions (Mouter, 2021). In that regard, provides a *why* to what participants have chosen. That in turn can be used by decision-makers to make better decisions (Mouter et al., 2021). Second, participants could give a final opinion on the PVE. That input is taken to answer RQ 4: *How do People with a Disability evaluate the validity of a PVE towards Public Transport accessibility policies?*, together with the quantitative analysis. This can be used to improve PVEs and their application to accessibility in the future.

2.2. Desk research

A desk research is applied to answer RQ 1, as well as RQ 4. The desk research focused around two policy documents. These were selected after exploring legal documents on PwD accessibility. Additionally, the expert of the Ministry recommended to use these documents in this research. However, it has to be stated, that grey literature such as UN reports, Parliamentary questions and local guidelines were consulted as well. The first document to be investigated is the Decision Accessible PT (Besluit toegankelijkheid van het openbaar vervoer - BWBR0029974), that was signed back in 2011, including a proposed change (IENW/BSK-2023/143680) that focuses on digital inclusion. Second, the Governance agreement (Bestuursakkoord Toegankelijkheid Openbaar Vervoer 2022-2032) is discussed. This agreement is not a binding law, but rather a declaration of intent signed by all relevant governmental agencies and PT companies.

2.3. Literature research

The second of three methods aimed to answer RQ 1 is a literature research. An overview of relevant literature is made. Then, all accessibility solutions that can be translated into a policy directive are listed. The policy measures are grouped together. Lastly, the list of measures is then further aggregated in a two step process to obtain a list of workable size. In this section, the search strategy of policy measures is described.

The literature search is performed as to identify policy measures that could be relevant in the Dutch scenario. The following steps were taken: identify promising research directions, identify relevant studies, explore measures that could improve accessibility for PwD in PT. Next, the identified measures are evaluated, as to trim the list of measures to include in the research.

2.3.1. Paper search strategy

The identification of relevant papers follows a three step process. Usually, a literature research starts with a set of keywords, after which snowballing is applied. In this study, a different approach is taken. First, the literature of the course *CIEQ6231* (Course Browser TU Delft, n.d.) is explored. The course mentions a relevant paper for this topic, namely the paper of Bruno et al. (2024). Second, snowballing is applied to this paper in order to retrieve a set of relevant keywords. Third, search terms are applied to Google Scholar. Fourth, snowballing is applied to relevant studies, with the focus on literature studies.

The first step to retrieve literature in the domain of accessible public transport for PwD was to review the readings of the course *CIEQ6231* (*Course browser TU Delft*, n.d.). The course offered a lecture specifically on inclusive mobility. Three papers were published on Brightspace for this lecture. Two papers on the issue of digital exclusion were discarded, one paper of Bruno et al. (2024) was further examined. Backward snowballing was applied to Bruno et al. (2024), considering the recent publication date of the paper. This delivered 13 papers that could be relevant for our topic.

All thirteen papers were scanned to identify relevant literature and relevant keywords for the next search step. Zając (2016) was found to be most relevant. The paper mentions the following relevant

keywords:

- accessibility
- case study
- public space
- public transport
- reduced mobility
- universal design

Based on the keywords, the following search terms were applied to retrieve new papers relating to Zając (2016):

- universal design disability public transport
- universal design reduced mobility public transport

The two search terms are specific. So, another search term is utilised as well. Several papers referenced by Bruno et al. (2024) mention the importance of the user perspective when considering accessibility of public transport. Therefore the following search term was also applied to Google Scholar:

- accessibility transport user perspective

The three search terms combined generated 10 possible relevant articles. The abstract and keywords of articles were scanned. If the study was considered relevant enough, the paper was read more in depth, with special attention to the results and conclusion.

Next, backward and forward snowballing was applied to relevant studies, with the focus on literature studies. Off the retrieved papers in the second step, Unsworth et al. (2019) gives a detailed literature review on public transport accessibility for people using a mobility device. Similarly, Mwaka et al. (2024) gives a literature overview, as well as Risser et al. (2015). These papers were the basis to explore the literature more in-depth. When the exploration of new policy measures saturated, the literature research was halted. The complete overview of papers consulted is given in figure 2.2.

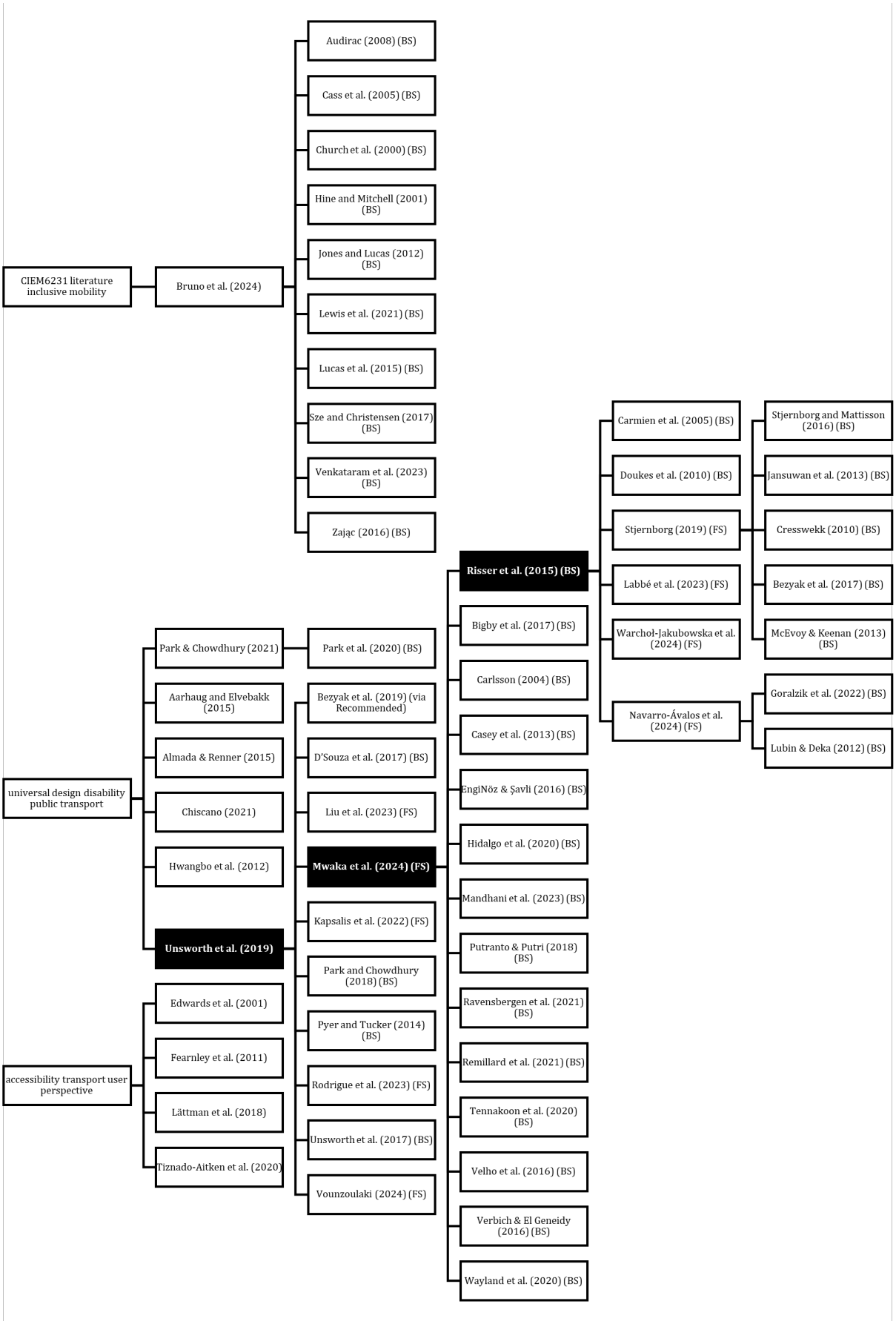


Figure 2.2: Literature tree diagram with literature studies in black.

2.3.2. Policy measure identification

The papers consulted provided a wide range of accessibility solutions that could be beneficial in the Dutch PT scenario. Some papers focussed on a wide range of solutions and thus gave an intuitive overview of possible policy measures. Others focussed on a single issue and commented on the applicability or success of a specific measure. Similar issues were matched and placed under the umbrella of a single measure, as much as it did not violate their goal or their means to reach that goal. Next, the measures were grouped by category: Technology, Personal support, Information, Vehicle, Station and Service level. Note that there do not exist distinct boundaries between their categories. Some categories are overlapping, for example Technology and Information. Several measures could be placed into multiple categories with some imagination, which makes for fuzzy boundaries between the categories.

Often times studies mention the measure, but do not necessarily state that it is lacking in their respective area of study. In this case, the study is still marked as mentioning that study. It can also be that the paper states the measure implicitly. An example of this is Remillard et al. (2021), who states that PT can be too expensive. If a paper mentions that a measure is not important or contra-productive, it is not noted in the overview.

Most studies consulted are international. Hidalgo et al. (2020) research PT accessibility in Latin America, while Putranto & Putri (2018), Stjernborg (2019) and Tennakoon et al. (2020) study accessibility experiences in Jakarta, Stockholm and Sri Lanka respectively. A special notion has to be made of the study by Sze & Christensen (2017). They review guidelines on accessible PT design in the US, the UK and Hong Kong. Bruno et al. (2024) studies accessibility policies in Dutch PT, Amsterdam specifically. In that respect, the overview of possible policy measures does offer solutions that were not only applied to the Dutch PT sector or even to the European PT sector, but to PT all around the world.

2.4. Expert interviews

Expert interviews is the third method used to answer RQ 1. Semi-structured interviews are conducted, a frequently used method known to obtain detailed and structured information from the target group (Yin, 2003). The semi-structured questions are asked on a relaxed conversational tone. This allows participants to share their opinions and experiences more freely (Bryman & Bell, 2015).

The first interviews focus mainly on defining the problem and policy options. In the later interviews the focus shifted towards the definition of policy options and the design of the actual PVE. After the actual interviews, some experts took the time to evaluate the attributes of the policy options and/or the design of the PVE. Again, many thanks to all experts for their willingness to help!

In total, 11 people from 9 different organisations are interviewed. The goal is to interview an as diverse set of experts as possible, with people from the government, PT operators and (representatives of) PwD themselves. Four experts work for a government. Two work for a semi-governmental organisation. Five are representatives of PwD or PT users. Three have a disability themselves. The interviews started by explaining the goal of the research to the experts. Then the experts are asked about their experiences regarding the subject and a concept choice task was discussed. The approach is detailed further in appendix *C Expert interviews*. In table 2.2 all experts are shown, including their corresponding organisation and link to the subject.

Table 2.2: Overview of Experts and Their Expertise

Expert	Organisation	Expertise
Researcher	TU Delft (previously)	PhD alumnus on inclusive mobility. Studied, inter alia, the inclusivity of the Amsterdam Transport Region according to the TRSE framework.
Policy officer	Rover	Policy officer on, inter alia, accessible PT. Rover represents the travellers of public transport. They have the legal right to give advise to transport companies and (regional) governments about the functioning and future of PT.
Policy officer	Ministry of Infrastructure and Water	Policy officer responsible for accessible PT (train, bus, tram, metro). Member of the team National strategy implementation UN treaty Disability. Coordinator of the task force Governance agreement accessible PT.
Policy advisor and PwD representative	Municipality of Amsterdam	Policy advisor on traffic and public space. Active in a local PwD representative organisation.
Policy advisor	Municipality of Amsterdam	Policy advisor on public space, involved in the physical accessibility of public space.
Policy advisor	Municipality of Amsterdam	Policy advisor on public transport and social transport. Responsible for the accessibility of public transport stops in Amsterdam.
Policy advisor	VRA (Transport Region of Amsterdam)	Policy advisor on inclusive mobility. Experienced in the setup of projects aimed to improve accessibility. The VRA grants all PT concessions in and around Amsterdam.
Policy officer	Ieder(in)	Policy officer mobility and social security. Ieder(in) is the umbrella organisation for Dutch NGO's representing and/or supporting PwD.
Board member	ALS patient association (ALS patiëntenvereniging)	Contact person for PwD and experienced with a disability themselves. Investigates the accessibility of public places.
Project manager	ProRail	Project manager for stations. Responsible for, inter alia, the accessibility of train stations.
Members' council	Eye association (Oogvereniging)	Representative of people with a visual disability. Represented PwD in the discussion about various policy documents such as the Governance agreement accessible PT.

2.5. PVE survey

The pivot point of this study is an online survey in the form of a PVE. The goal of the PVE is to answer RQ 2 through 4. The PVE aims to get an insight in the perceptions and preferences of various subgroups of people with a disability, as well as citizens in general. Furthermore, the validity of the method itself is evaluated. Respondents are asked by means of various questions if the PVE reflects the real world situation. First, the PVE design process is discussed. Second, the data collection is elaborated upon.

2.5.1. Designing the PVE

This paragraph provides a brief insight in the goal of the PVE and the main design principles. For a detailed blueprint of the PVE design, see chapter 4. The PVE was designed with five principles in mind:

i. The PVE should give answers to research questions 2 through 4

ii. The PVE should provide relevant insights for PT operators and governments

iii. The PVE should be easy to understand

iv. The PVE should use correct terminology regarding accessibility

v. The PVE should be as short as possible

First, the PVE should accomplish its main goal: to fill the knowledge gaps as detailed in the research questions:

2. *What policies do citizens prefer most with regard to the accessibility of Public Transport for People with a Disability?*
3. *How do the perceptions of the various subgroups of People with a Disability compare?*
4. *How do People with a Disability evaluate the validity of a PVE towards Public Transport accessibility policies?*

Second, the results PVE should be helpful for the problem owners, namely the PT operators and governmental agencies responsible for PT. A research has value in the end if it is used in the field. Third, the PVE should be easy to understand. This has two components, it should be textually easy to read, which means the text is written as much as possible in B1 level (*Is het b1?*, n.d.). Tied to this, it should also be conceptually easy to understand for people who are no PT experts. Fourth, the PVE should use correct terminology on PT and PwD. Fifth, the survey should be as short as possible. A long survey usually means that few people complete the entire survey, so that the results are less generalizable.

Expert consultation

The experts were consulted to select relevant policy measures that are included in the PVE and to improve the design of the PVE.

Policy measures that might be included in the PVE are discussed with experts. A general guideline is to include at most 10 alternatives at once in a PVE, so only measures that are perceived as relevant by the expert are included in the PVE.

The preliminary design of the PVE is improved significantly due to the input of various experts. In the context of the five steps of Bouwmeester (2021), stakeholder consultation is step three. As said, steps 1 and 2 are also accomplished due to the help of experts. They provided background knowledge to scope the problem and to define the policy alternatives, their impacts and their characteristics. ProRail gave detailed feedback on the description and scoping of all policy alternatives. One policy advisor of the Municipality of Amsterdam, the VRA and ProRail gave feedback on the impacts of all policy measures.

Pilot testing

A draft version of the PVE was tested by 10 people. Three members of the test panel have a disability. Five are interviewed experts: the expert of Ieder(in), one of the Municipality of Amsterdam, one of Rover, one of the Oogvereniging and the expert from ProRail. The other five people had never seen a draft of the PVE before. They were asked to fill out the PVE and provide feedback. Feedback centred around the usability of the PVE, specifically for blind people, understandability of formulations, completeness, excess of questions, length of the survey and correctness of information.

Based on their responses, questions and explanations were altered, as well as the order of the questions.

The constraint variable and one policy measure were reformulated. The existing constraint *governmental effort required* was reframed to *required effort of governments and PT operators* after one participant noted that many of the policies were the responsibility of operators. The policy measure *more elevators at stations* was reframed to *more money to repair broken elevators* after feedback from the expert of ProRail. They noted that all stations are already on their way to have an elevator or ramp by 2030.

An explanation on how the sliders work and on the meaning of the constraint *effort* were added after multiple testers pointed out that this was lacking.

One question was added, one question was changed and three face validity questions were removed. First, a new question was added that asked people if they know somebody with a disability. This question was only asked to people without a disability, to minimize the length of the PVE. Second, the question: 'what advice is the most important' was altered. Initially, the advice of experts was contrasted to the advice of citizens. The new formulation contrasts the advice of experts to the advice of PwD. Third, three face validity questions/statements were removed: 'I trust that this research is honest', 'If many people participate in this research, then the outcomes are easier to accept for me' and lastly 'If the government lets citizens think about these choices more often in this way, I get more trust in the government'. The questions were removed to minimize the length of the PVE survey.

The policy descriptions were altered. Three examples of substantive changes: One, in the initial description of *elevators* was stated that 'bigger stations need to have an elevator or ramp'. This was changed into 'all stations need to have an elevator or ramp by 2030' after feedback from the expert of ProRail. Two, the initial description of *travel assistance* stated that 'smaller PT operators do not offer travel assistance'. This was changed in 'Other train operators [than the NS] will offer travel assistance by the end of this year at the latest'. Three, the description of an *accessible PT app* was changed. The initial description only mentioned the NS app. The new description also mentions that there are apps of other PT operators.

Multiple testers stressed the importance of an accessible survey for people with visual impairments. Specifically, the expert of the Oogvereniging tested the survey on this aspect, for they had a visual impairment themselves. The survey was found to be not fully accessible for people using text-to-speech software. The problems were discussed with the data team of Populytics. Easy changes were carried out right away, such as changing the format for some questions from one matrix question to multiple radio questions and adding voice labels at the 'info buttons'. Notably, one part is harder to improve, namely the information pop-up that people see if they want more information about a specific policy option. In the PVE, it is thus explained how to navigate in and out of the information pop-up using text-to-speech software. Still, the pop-up was not compatible with all text-to-speech software, so that not all people with a visual impairment can get more information about a specific policy.

2.5.2. Data collection

The data collection is critical for the fourth step in the PVE process: to have respondents fill out the PVE. As explained in section 1.5., the study is centred around PwD, but all members of society are eligible to participate. The only requirement is that respondents are 16 years of older. Special attention was brought forth to PwD, since they might be hard to reach. Four methods were used to spraid the survey, as presented in figure 2.3. First, 22 social organisations in the field of disability shared the research. Second, the research was shared among the 13 thousand members of the Populytics panel. Third, the research was shared via social media. The LinkedIn post was reposted by 18 people, most of whom were active in either the field of PwD or PT, or both. Fourth, the research was shared via word of mouth.

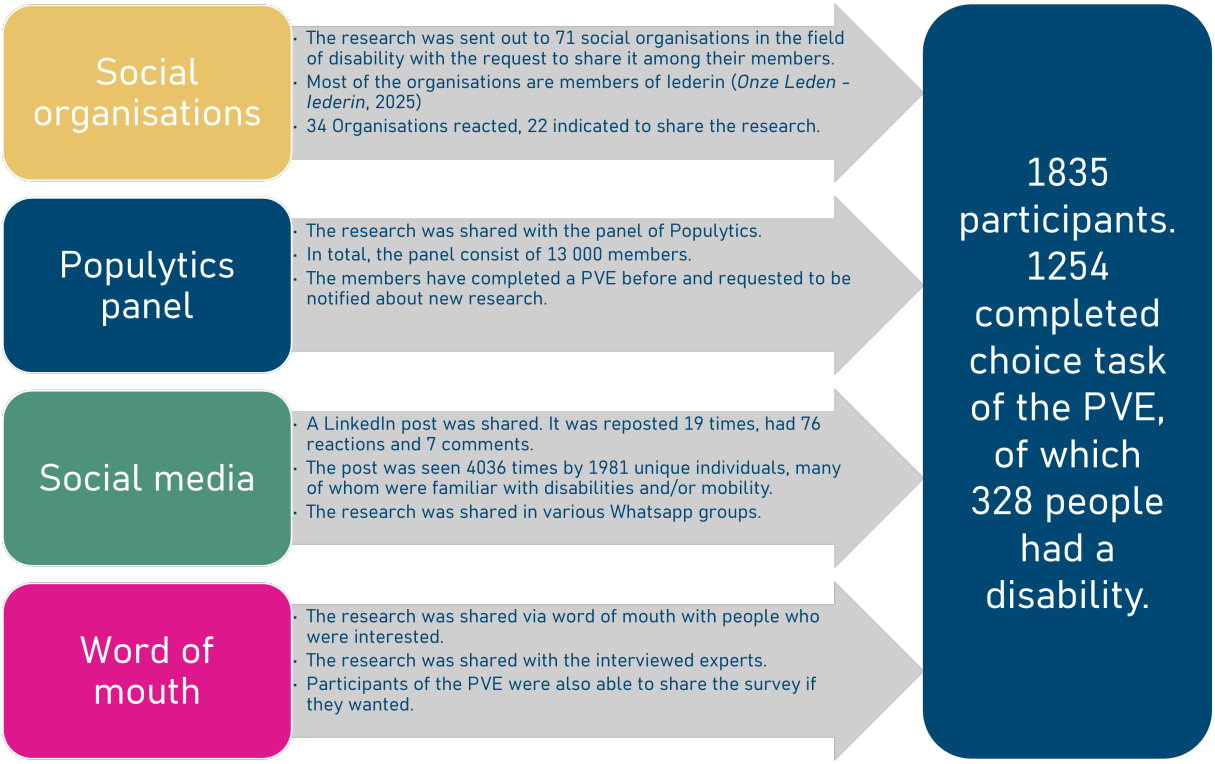


Figure 2.3: The platforms on which the PVE survey was shared.

2.6. Data analysis

The results of the PVE were analysed to answer research questions 2 through 4. In the context of the five step PVE framework, data analysis falls under the final step. The analysis can be split into three practices. First, a quantitative analysis is performed. Second, a Latent class cluster analysis (LCCA) splits respondents into separate groups based on their characteristics and preferences. Third, a qualitative analysis is done on the motivations of participants to obtain an overview of arguments for and against each policy measure.

2.6.1. Quantitative

A quantitative analysis is performed to answer RQ 2 through 4:

2. *What policies do citizens prefer most with regard to the accessibility of Public Transport for People with a Disability?*
3. *How do the perceptions of the various subgroups of People with a Disability compare?*
4. *How do People with a Disability evaluate the validity of a PVE towards Public Transport accessibility policies?*

The raw data was gathered by exporting the raw results of the PVE survey to excel. The analysis itself was performed with python in the Jupyter environment (Jupyter, n.d.). The data was filtered as to only include respondents that completed the choice task. In total, 1835 people participated in the research, 1254 of them completed the choice task. The answers of the other 581 respondents were discarded, for they did not provide enough relevant data for the research. This drop-off rate of 32% is common in similar research.

To answer RQ 2, the elicited preferences have to be determined. For each policy measure, participants could indicate that the *effort of the government and PT operators* dedicated to this policy should be

the *same as now*, that they should dedicate *more priority* or *much more priority*. These options have corresponding values $\{0, 0.5, 1\}$. Assuming that:

- $p_{nm} = \{0, 0.5, 1\}$ is the elicited preference of respondent n for policy measure m.
- N is the set of respondents, with $|N| = 1254$ number of respondents.
- P_{vm} with $v = \{0, 0.5, 1\}$ is the set of respondents that gave v priority to policy measure m.
- s_{vm} is the share of respondents that gave v priority to policy measure m.
- a_m is the average prioritisation of policy measure m.

Then the set P_{vm} is formed by all respondents that gave v priority to policy measure m.

$$P_{vm} = \{n \mid p_{nm} = v\} \tag{2.1}$$

So s_{vm} is given by the cardinality (size) of the set P_{vm} divided by the total amount of participants:

$$s_{vm} = \frac{|P_{vm}|}{|N|} \tag{2.2}$$

Naturally the following must hold:

$$\sum_{v} s_{vm} = 1 \tag{2.3}$$

Given that the prioritisation options have corresponding values $\{0, 0.5, 1\}$, a_m is defined as the sum of the shares of respondents that chose a certain prioritisation multiplied by the corresponding value v:

$$a_m = \sum_{v} s_{vm} v = \frac{1}{2} s_{0.5,m} + s_{1,m} \tag{2.4}$$

To analyse how preferences differ by socio-demographic characteristics, disability or travel behaviour, one must take a subset of N:

$$S \in N \tag{2.5}$$

Where S is defined as the subset of respondents with a specific characteristic. For example, S is a subset consisting of only males, or only people with a visual impairment.

Reweighting

To make the results more generalizable, reweighting is necessary. This can only be applied if each socio-demographic category consists of at least 30 respondents. That is the case in this research.

Reweighting will be applied on *gender*, *age* and *education*. Having a disability is not considered as a variable to reweight on. Clear data lacks in the Netherlands on the frequency of disabilities. For all three variables considered, a scientific hypothesis exists that supports a relationship between the personal characteristic and the elicited preferences.

Sil et al. (2023) found that woman might be disinclined to use PT since they can be harassed. Contrastingly, Friman et al. (2020) found that woman generally experience greater perceived accessibility. Bezyak et al. (2019) found no relationship between gender and the barriers encountered by PwD but did recommend future research to investigate this relationship further.

Durand (2025) and Drechsel (2024) found that older adults can have difficulties navigating PT, even though large differences exist within this group. Older adults might experience more issues with accessibility independent of disability. Wayland et al. (2020) studied young PwD specifically, stating that young people generally have many reasons to travel, for work, education, cultural and social events. Wiener & Willborn (2010) found an intersection between age, disability and discrimination.

Filmer (2008) found a strong link between education and disability, albeit that his research area was developing countries. Still, a relationship between certain types of disabilities and education is likely, which will influence the elicited preferences of low educated people.

The reweighting method used is Iterative Proportional Fitting (IPF), or 'multiplicatief wegen' in Dutch (CBS, 2008). A general rule of thumb is that it can only be applied if all categories of relevant socio-demographics (for example low, middle and high educated) have at least 30 observations. That is true for this research. The low-educated group is the smallest, consisting of only 33 respondents. IPF is different from post stratification because it can be applied also if some subcategories, say low-educated young females, have very few observations, for example less than 5 (CBS, 2008). That is the case for some subcategories of respondents. Notably, the subcategories consisting of an intersection of low-educated and young people.

To apply reweighting, only respondents that gave an answer to the three socio-demographic questions (gender, age, education) can be considered. Thus the dataset is filtered to only include participants that answered all three questions: $A \in N$ with $|A| = 1002$.

Next, a 3D contingency table is formed with each dimension representing a socio-demographic question (gender, age, education). Its values represent the number of participants that have that specific combination of gender, age and education. Assuming that:

- $x_{i,j,k}$ is the number of participants have gender i, age j and education k.
- $x^{(t)}_{i,j,k}$ is cell value in the contingency table for combination (i, j, k) at iteration t of the IPF algorithm.
- $\delta_i, \delta_j, \delta_k$ the distributions for gender, age and education respectively, as provided by CBS census data.
- M_i, M_j, M_k are the target values for the gender, age and education distributions respectively. They are normalized, so that they represent the amount of respondents with a characteristic (for example female or male), *if* the sample of participants were to be fully representative of the Dutch population.

The target values are derived from CBS census data so that:

$$M_x = \delta_x |A| \tag{2.6}$$

Naturally the following must hold for $x \in \{i, j, k\}$.

$$\sum_x M_x = |A| \tag{2.7}$$

To initialize the IPF algorithm, let us define:

$$x^{(0)}_{i,j,k} = x_{i,j,k} \tag{2.8}$$

For each iteration t of the IPF algorithm, the contingency table values $x^{(t)}_{i,j,k}$ are increased or decreased as to match the target values M_i, M_j, M_k. This is done in a three step process. The steps are represented by the *G*, *A* and *E* symbols next to t, representing the gender, age and education adjustment. Following the IPF guidelines, initially the first dimension *gender* is adjusted:

$$x^{(t,G)}_{i,j,k} = x^{(t-1)}_{i,j,k} \cdot \frac{M_i}{\sum_{j,k} x^{(t-1)}_{i,j,k}} \tag{2.9}$$

This ensures that the contingency table matches the target value M on i, gender:

$$\sum_{j,k} x_{i,j,k}^{(t,G)} = M_i \tag{2.10}$$

Next, the age dimension is modified as to match the target value:

$$x_{i,j,k}^{(t,A)} = x_{i,j,k}^{(t,G)} \cdot \frac{M_j}{\sum_{i,k} x_{i,j,k}^{(t,G)}} \tag{2.11}$$

Finally, the education dimension is adjusted:

$$x_{i,j,k}^{(t,E)} = x_{i,j,k}^{(t,A)} \cdot \frac{M_k}{\sum_{i,j} x_{i,j,k}^{(t,A)}} \tag{2.12}$$

However, one does not want a small group of under-represented respondents to overly influence the overall results. This can increase the variance of estimates (DeBell et al., 2010). Therefore, DeBell et al. (2010) recommends to have a maximum reweighting factor of 5 times the *average* reweighting factor. In this study, we assume a 'standard' reweighting factor of 1 (no reweighting at all). In this study the maximum reweighting factor for any subgroup is simplified to 5. If we strictly follow the advice of DeBell et al. (2010), then the maximum reweighting factor will be less than 5, for the *average* reweighting factor will be below 1 (by definition most respondents belong to an overrepresented subgroup). But, given that some subgroups are severely under-represented, a slightly higher and more defined maximum reweighting factor of 5 is applied.

After the three adjustments based on the gender, age and education targets, an upper limit of 5 is applied. This upper limit was reached for the subgroups consisting of low-educated people and for the subgroup young middle-educated woman. All cell values in the contingency table cannot exceed 5 times the number of participants with that gender, age and education profile:

$$x_{i,j,k}^{(t)} = \min(x_{i,j,k}^{(t,E)}, 5 \cdot x_{i,j,k}) \tag{2.13}$$

Finally, to complete the reweighting, the reweighted prioritisation as presented in the report is calculated. Again, the share of respondents that give each policy measure a certain prioritisation is calculated, as well as the average prioritisation. Assuming that:

- $S_{i,j,k}$ is the subset of A consisting of respondents with gender i, age j and education k.
- $s_{vm}^{i,j,k}$ is the share of respondents with gender i, age j and education k that gave v priority to policy measure m. It is distinct from s_{vm}, because it is corrected for under-represented groups.
- s_{vm}^{r} is the reweighted share of respondents that gave v priority to policy measure m.
- a_m^r is the reweighted average prioritisation of policy measure m.

Given that set A only consists of respondents who completed the three socio-demographic questions, the following must hold:

$$\sum_{i,j,k} S_{i,j,k} = A \tag{2.14}$$

Then, for each subset, the share of respondents that gave v priority to policy measure m can be calculated just as before, but then only for the respondents of that given subset:

$$s_{vm}^{i,j,k} = \frac{|\{n \in S_{i,j,k} \mid p_{nm} = v\}|}{|S_{i,j,k}|} \tag{2.15}$$

Then the reweighted share of respondents that gave v priority to policy measure m is the combination of all weighed subsets:

$$s^r_{vm} = \sum_{i,j,k} s^{i,j,k}_{vm} \frac{x^{(T)}_{i,j,k}}{\sum_{i,j,k} x^{(T)}_{i,j,k}} \tag{2.16}$$

The latter part of the equation represents the reweighting on the basis of the final contingency table. This is indicated by the capital T in $x^{(T)}_{i,j,k}$. In the table, each cell represents the number of participants with gender i, age j and education k, adjusted for the target size of that subset. To give an example, if $x_{i,j,k} = 3$ and this subgroup is severely under-represented, then $x^T_{i,j,k}$ could increase up to 15 (assuming a maximum reweighting factor of 5. Conversely, if $x_{i,j,k} = 179$ and this subgroup is severely over-represented, then $x^T_{i,j,k}$ could decrease, for example to 34.6.

The reweighted average prioritisation a^r_m is then given by:

$$a^r_m = \sum_v s^r_{vm} v = \frac{1}{2} s^r_{0.5,m} + s^r_{1,m} \tag{2.17}$$

2.6.2. Latent class cluster analysis (LCCA)

A LCCA is used to split the respondents in a number of groups that have similar preferences. For the conduction of the LCCA, latent gold is used (Vermunt & Magidson, 2016). Four modelling steps can be distinguished. But first, the used data is deliberated upon and the creation of two new variables for the LCCA analysis is discussed.

Before any analysis, the dataset is filtered as to only include respondents that answered the three socio-demographic questions gender, age and education. As explained, the three characteristics are likely to impact policy preference. Additionally, all answer categories with less than 30 respondents are excluded. The reason for this is that a LCCA needs clean data to provide meaningful results. For example, for the question about *gender*, only respondents that indicated to be either female or male are included in the LCCA.

Some personal characteristics consist of a large number of categories. For these personal characteristics, new variables are made that could be relevant covariates (personal characteristics). Specifically, two new variables are created.

The questions regarding travel behaviour are summarized into one variable: *PT usage*. PT is likely to impact the perception on accessibility policies. If one does not use PT, it is hard to estimate where the biggest barriers are located. But, the opposite relationship exists as well. If one experiences big hurdles when using PT, one might use PT as little as possible. PT usage focusses on the frequency of use of the train, bus, tram or metro. It has three levels: *frequent PT user*, *sporadic PT user* and *no PT user*. Frequent users are those who use any of the aforementioned modes at least once a month. Sporadic users use at least one mode several times a year or almost never. No PT users indicated that they had never used any of the four modes. There were only 9 respondents who had never used any of the modes. Hence, *no PT user* as a category was removed from the LCCA dataset.

Similarly, the questions about disability are aggregated into *PwD affiliation*. This variable splits respondents into three groups, those who have a disability, those who know somebody with a disability and those who do not have nor know somebody with a disability. PwD affiliation is a trinary variable with possible values: *has a disability*, *knows somebody with a disability*, *does not have a disability nor knows a somebody with a disability*. In an ideal scenario, the type of disability would play into effect when determining the clusters. However, the sample sizes for numerous disabilities are too small to provide meaningful results. A LCCA needs clean data to provide meaningful results. The advised minimum amount of responses for any option is 30. That is not always reached here. To give an example, only 15 individuals experienced difficulty talking. To include this as a category harms the ability of LCCA to

make meaningful clusters. One can merge different categories, but this ignores the heterogeneity amongst different disabilities.

The first step of the LCCA is to run four models with the policy measures as indicators and all socio-demographic characteristics, disability status and travel behaviour as *inactive* covariates (personal characteristics). Inactive means that they do not influence the formation of clusters. The four models have 2, 3, 4, and 5 clusters respectively. A model with more than 5 clusters becomes more difficult to understand, for the cluster sizes are small.

What model should be preferred is determined primarily based on the BIC value. The BIC value is a common metric for LCCA studies (Petersen et al., 2019). However, 2 additional factors are important as well: the size of the smallest cluster and the interpretability of the results. If the size of the smallest cluster is lower than 5% of the total respondents, a model with less clusters is to be preferred. Regarding the interpretability of the results, a model with more clusters than the *optimal* model (based on the BIC value) may be preferred. Petersen et al. (2019) state that interpretability is a common criteria to select a specific model size. A model with more clusters tends to provide more room for interpretation, since the clusters consist of a more heterogenous pool of respondents. Therefore, the following rule of thumb is applied:

i. Select the model with the lowest BIC value
ii. Check if the BIC value of the next model (with more clusters) is comparable to its BIC value. Comparable is defined as being within a range of 0.5%.
iii. Check if all its clusters consist of more than 5% of total respondents. If not, choose a model with fewer clusters.

Second, the p-values of all *inactive* covariates are assessed. If the p-value is lower than 0.2, the covariate is considered to be promising. In the next new run, this covariate will be put on *active*. Additionally, the dataset of respondents will only consist of participants on which there is data on that covariate. Small categories (less than 30 observations) are filtered out. On the other hand, if a covariate has a p-value higher than 0.2, the dataset of respondents will no longer be filtered based on available data on this covariate.

Third, a new model is run with the number of clusters determined in step 1. This model is run on a dataset with only 'complete' answers on the active covariates. The purpose of this model is to determine what covariates are significant, i.e. what covariates have a p-value lower than 0.05.

Fourth, a final model is run on a dataset with only 'complete' answers on the significant (and active) covariates. The results of this model will be presented in the LCCA section.

2.6.3. Qualitative

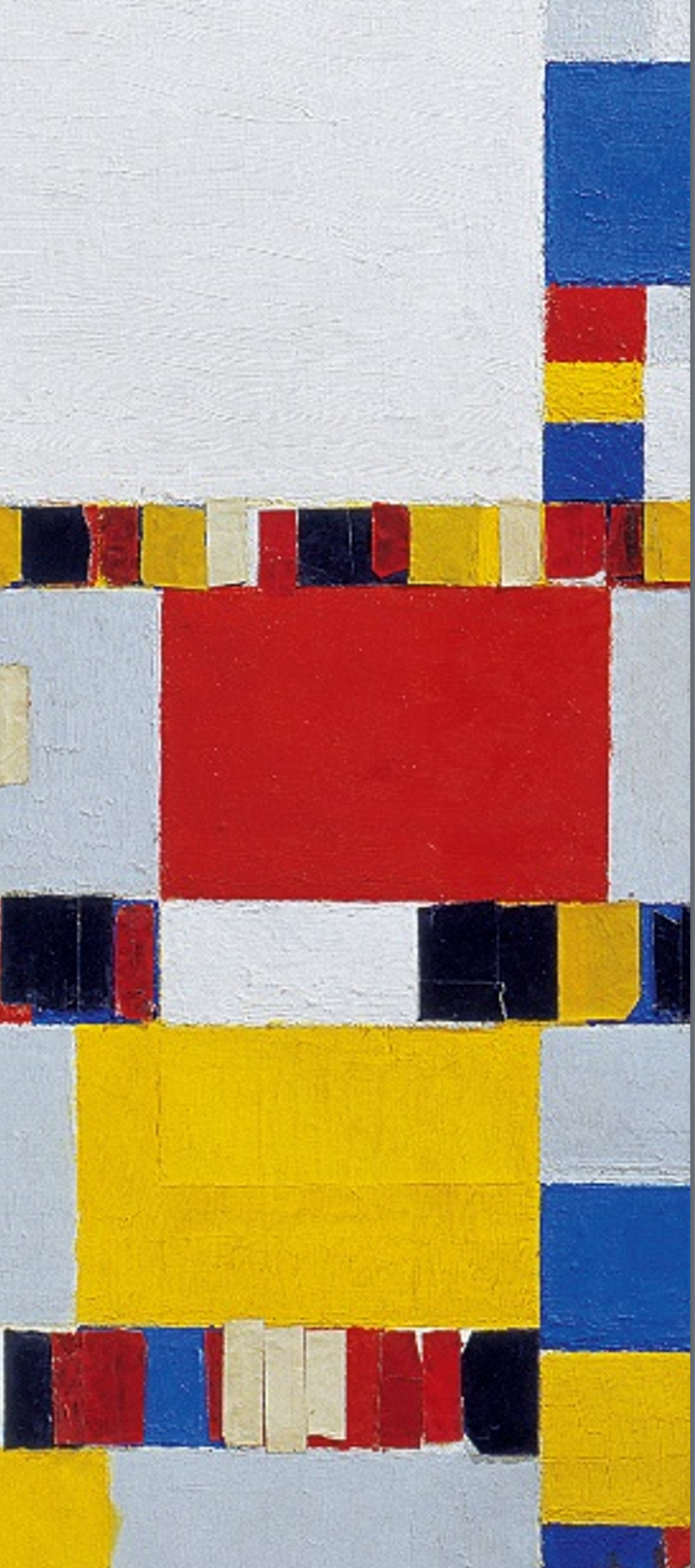
The third and last data analysis method is a qualitative analysis of the motivations of respondents. This helps to answer RQ 2 and 4:

2. *What policies do citizens prefer most with regard to the accessibility of Public Transport for People with a Disability?*
4. *How do People with a Disability evaluate the validity of a PVE towards Public Transport accessibility policies?*

To understand *why* participants did (not) give a policy priority, qualitative analysis is performed. For each policy measure, 100 random motivations were selected. The motivations were read one by one and grouped together in reasons for and against a measure. Then the motivations were categorized into groups. An example category *for* the policy *elevators* is: 'People with a disability are dependent on elevators to travel'. Each category is given an amount of stars equal to its occurrence:

1. Star indicates that the argument was given little: less than 10% of motivations mentioned this argument.
2. Stars indicate that the argument was given relatively much: between 10% and 20% of motivations mention this argument.
3. Stars indicate that the argument was given often: more than 20% of motivations mention this argument.

To understand *why* participants evaluate the PVE the way they do, a second qualitative analysis is performed. For this purpose, all answers to the open question 'Anything else you want to say about this survey?' are read. Since this field mostly consists of critiques (people tend to express negative emotions more profoundly than positive emotions), the main points of critiques are discussed. Additionally, example critiques are provided to give more context to the discussion.



(File:Piet Mondriaan Victory Boogie Woogie.jpg, 2023)

Selection of relevant policies

In this chapter, a number of policies are selected to be included in the PVE. That answers RQ1: *What potential policies could make Public Transport more accessible for People with a Disability?*. Three methods help to select the policies: a desk research, literature research and expert interviews. It has to be noted that in reality, the three methods were conducted iteratively. Two interviews took place before the literature research was completed. The desk research was inspired by a number of interviews. The literature research was then influenced by the desk research. But for clarity, the three methods are presented independently, in a three step process.

First, a desk study provides insight into the legal framework to improve accessibility for PWD. That is described briefly in the legal context section. Second, a literature research identifies a set of possible relevant policy alternatives. Third, the policy alternatives are proposed to the experts. Finally, the final selection of policy measures is explained and elaborated upon. In a PVE, it is not possible to compare too many alternatives at once. A general guideline is to include at most 10 alternatives at once.

3.1. Legal context

Two policy documents are of notable importance when examining the accessibility of PT for PwD. They set the legal boundaries of what needs to be done by PT operators. In Appendix A the full desk study towards policy documents is presented. A brief summary is given below.

The Decision Accessible PT (*wetten.nl - Regeling - Besluit toegankelijkheid van het openbaar vervoer - BWBR0029974*, 2015) (Besluit toegankelijkheid van het openbaar vervoer) is a binding document, dating back to 2011. So far, its set goals have not been met. Additionally, there are some gaps, notably regarding travel assistance in cases where grade level boarding is possible and regarding the operability of digital devices for PwD. The latter point is covered by new legislation that will go into effect on the 28 of June, later this year at the time of writing. However, considering that the goals of the initial regulations have not been met, the question arises whether the new legislation will succeed.

The Governance agreement Accessible PT (Ministry of Infrastructure and Water, 2022) (Bestuursakkoord Toegankelijkheid Openbaar Vervoer 2022-2032) is a non binding document, dating back to 2022. Due to the nature of the document, no hard criteria are given as to improve accessibility. The document uses the principle of proportionality often. That means that one should try to improve accessibility, but only if the burden is low enough. Nevertheless, the document provides guidelines on otherwise untouched issues, such as information exchange on the functioning of elevators and travel assistance, even if grade level boarding is possible. Unfortunately, the non binding nature restricts hard guidelines or regulation, for example, regarding travel assistance between modalities or travel assistance in bus, tram or metro networks.

To conclude, a legal framework exists to improve the accessibility of PT. But the proposed measures are either non-binding or have simply not been met. Therefore there is not a strong case to exclude possible policies from the PVE based on the fact that they are already in place in the Netherlands.

3.2. Relevant policies from the literature

In this section, a literature research is conducted to identify policy measures proposed by the literature. This is done in section 3.2.1. Next, all policy measures of the literature are weighted off. The identified measures are aggregated into a shortlist of policies that are discussed during the interviews with experts. Due to the large amount of measures, this is done in two main steps. The first step consists of three components. First, several measures are discarded right away, for being too vague, too specific or too general. Second, similar measures are merged. Third, three measures are rewritten to better align

with current practises and possibilities. The second step consists of a more elaborated discussion on all remaining points. It is explained why they should be included in the first concept PVE or discarded.

The two-step aggregation process is discussed in Appendix B. In section 3.2.1., only the initial list of policy measures is shown. Finally, eleven policy measures remain. They are proposed to the experts during the interviews. The policy measures are presented in section 3.2.2.

3.2.1. Identified policy measures

From the literature, 57 measures were identified. In principle, the measures are ranked according to the number of times it is mentioned. Sometimes an exception is made, if two or more measures are overlapping or comparable. In table 3.1 the full list of policy measures is given. The measures mentioned by J. Park et al. (2020) are not included in the overview, since their measures are directly derived from J. Park & Chowdhury (2018).

Table 3.1: Measures to improve the accessibility of PT as identified by the literature

Category	Point	Measure	Mentioned by
Technology	1.1	Route-finding app for PwD	Bezyak et al. (2017); Carmien et al. (2005); Hidalgo et al. (2020); Sze & Christensen (2017)
	1.2	Digital travel assistant (either human operated or digital)	Carmien et al. (2005); Doukas et al. (2010); Risser et al. (2015)
Personal support	2.1	Driver assistance (e.g. ramp use, stopping close, etiquette)	Almada & Renner (2015); Bezyak et al. (2017); Carlsson (2004); Casey et al. (2013); Hidalgo et al. (2020); Hine & Mitchell (2001); Martens et al. (2019); J. Park & Chowdhury (2018); Putranto & Putri (2018); Remillard et al. (2021); Risser et al. (2015); Stjernborg (2019); Unsworth et al. (2019); Velho et al. (2016); Wayland et al. (2020)
	2.2	Physical human support	Doukas et al. (2010); Risser et al. (2015); Stjernborg (2019)
	2.3	Assistance on demand, on short notice	Remillard et al. (2021)
	2.4	Education of other passengers	Velho et al. (2016) [1]; Wayland et al. (2020)
Information	3.1	Info on timetables, accessible vehicles	Bezyak et al. (2017); Carlsson (2004); Hidalgo et al. (2020); Hine & Mitchell (2001); J. Park & Chowdhury (2018); Risser et al. (2015); Stjernborg (2019); Verbich & El-Geneidy (2016)
	3.2	Readable and correct information signs	Carlsson (2004); Casey et al. (2013); J. Park & Chowdhury (2018); Stjernborg (2019); Sze & Christensen (2017); Unsworth et al. (2019)
	3.3	Audio stop announcement	Bezyak et al. (2017); Casey et al. (2013); Tennakoon et al. (2020) [2]

Continued on next page

[1] Velho et al. (2016) state that other passengers can express unsocial behaviour towards PwD.

[2] Tennakoon et al. (2020) mentions audible signals at crossings specifically.

Category	Point	Measure	Mentioned by
	3.4	Visual stop announcements	Bigby et al. (2017)
	3.5	Braille signboard	Enginöz & Şavli (2016)
	3.6	Training for PwD PT users	Risser et al. (2015)
Vehicle	4.1	Bus ramp / train bridge plates, kneeling bus	Almada & Renner (2015); Bezyak et al. (2017); Bruno et al. (2024); Carlsson (2004); Casey et al. (2013); Lubin & Deka (2012); J. Park & Chowdhury (2018); Sze & Christensen (2017); Unsworth et al. (2019)
	4.2	Accessible vehicles	Almada & Renner (2015); Bezyak et al. (2017); Cass et al. (2005); Church et al. (2000); Hine & Mitchell (2001); Jones & Lucas (2012); Martens et al. (2019); Tennakoon et al. (2020)
	4.3	Reduction of steps	Casey et al. (2013); J. Park & Chowdhury (2018)
	4.4	Seats for PwD	Almada & Renner (2015); Bruno et al. (2024); Carlsson (2004); Hidalgo et al. (2020); Jansuwan et al. (2013); Remillard et al. (2021); Stjernborg (2019); Velho et al. (2016); Verbich & El-Geneidy (2016)
	4.5	Uniform bus design	J. Park & Chowdhury (2018); Risser et al. (2015)
	4.6	Wider vehicle doors	Almada & Renner (2015); Sze & Christensen (2017)
	4.7	Automatic door opening	Carlsson (2004); Sze & Christensen (2017)
	4.8	Braille on bell pushes	Casey et al. (2013)
	4.9	Restrooms in vehicle	Remillard et al. (2021)
	4.10	Long enter/exit time	Carlsson (2004)
	4.11	Minimize crowdedness	Tennakoon et al. (2020)
	4.12	Clean vehicles	Mandhani et al. (2023)
	4.13	Seat belts	Almada & Renner (2015)
Station	5.1	Environment around stations (side walks, crossings, lights)	Almada & Renner (2015); Bezyak et al. (2017); Hidalgo et al. (2020); Hine & Mitchell (2001); Jones & Lucas (2012); Lubin & Deka (2012); Martens et al. (2019); J. Park & Chowdhury (2018); Putranto & Putri (2018); Risser et al. (2015); Sze & Christensen (2017); Unsworth et al. (2019)
	5.2	Lighting	Bigby et al. (2017); Mandhani et al. (2023); Risser et al. (2015); Stjernborg (2019); Tennakoon et al. (2020)
	5.3	Minimize crowdedness at station	Hidalgo et al. (2020); Hine & Mitchell (2001); Risser et al. (2015); Tennakoon et al. (2020)
	5.4	Elevators	Bezyak et al. (2017); Jones & Lucas (2012); Remillard et al. (2021); Stjernborg (2019); Sze & Christensen (2017)

Continued on next page

Category	Point	Measure	Mentioned by
	5.5	Ramps instead of steps	Unsworth et al. (2019)
	5.6	Escalators	Sze & Christensen (2017)
	5.7	Easy interchange within stations	Mandhani et al. (2023); Sze & Christensen (2017)
	5.8	Reductions of steps entering the station	Carlsson (2004)
	5.9	Colour contrasting handrails	Casey et al. (2013); Enginöz & Şavli (2016)
	5.10	Handrails next to steps	Carlsson (2004)
	5.11	Furniture to rest at stops	Hidalgo et al. (2020); Mandhani et al. (2023); Risser et al. (2015)
	5.12	Rain and wind shelter at stops	Hidalgo et al. (2020); Tennakoon et al. (2020); Unsworth et al. (2019)
	5.13	Guiding path for blind people	Enginöz & Şavli (2016); Sze & Christensen (2017)
	5.14	Priority for PwD in ticket queues	Hidalgo et al. (2020); Putranto & Putri (2018)
	5.15	Raised platform / curb	Jones & Lucas (2012); Sze & Christensen (2017)
	5.16	Wider platforms	Almada & Renner (2015); Sze & Christensen (2017)
	5.17	Maximum grading of platform	Sze & Christensen (2017)
	5.18	Braille floor plan	Sze & Christensen (2017)
	5.19	Accessible stations	Church et al. (2000)
	5.20	No cycle ways next to stop	Carlsson (2004)
	5.21	Less noise at stations (speech devices)	Bigby et al. (2017)
Service level	6.1	Smaller distance from destination to stop	Almada & Renner (2015); Hine & Mitchell (2001); Jansuwan et al. (2013); Lubin & Deka (2012); J. Park & Chowdhury (2018); Putranto & Putri (2018)
	6.2	All homes, work areas, care facilities near PT stop	Bruno et al. (2024); Church et al. (2000); Sze & Christensen (2017)
	6.3	Widen PT coverage area	Cass et al. (2005); Remillard et al. (2021)
	6.4	Minimum distance from home to bus stop	Bruno et al. (2024)
	6.5	Fare free / reduced fare PT for PwD	Church et al. (2000); Jansuwan et al. (2013); Lubin & Deka (2012); Remillard et al. (2021) [3]
	6.6	Minimize waiting time	Hine & Mitchell (2001); Jansuwan et al. (2013); Unsworth et al. (2019)
	6.7	Increase operating reliability	Hine & Mitchell (2001); Verbich & El-Geneidy (2016)
	6.8	Increase operating speed	Verbich & El-Geneidy (2016)
	6.9	Increase operating frequency	J. Park & Chowdhury (2018)
	6.10	Minimize transfers	Jansuwan et al. (2013)

Continued on next page

[3] Papers state that PT can be too expensive for PwD

Category	Point	Measure	Mentioned by
	6.11	Paratransit services	Bezyak et al. (2017)

3.2.2. Shortlist of possible policies

After two steps of aggregating the list of policy measures, eleven measures remain. Measures were discarded from the list for a variety of reasons. Some are too vague, too specific or too general. Others are already in place in the Netherlands, fall outside the scope, are not deemed effective for all PwD or are difficult to implement. Some measures were merged together or rewritten. A full discussion of the two discarding steps is provided in appendix B. The shortlist of eleven policies, presented in table 3.2, will be brought up during the interviews to discuss further. Policies from all six categories are included. The second column shows the points from table 3.1 that are merged to form any given policy measure.

Table 3.2: Possible measures to improve the accessibility of PT

Category	Point(s)	Measure
Technology	1.1; 1.2; 3.1	Accessible PT app
Personal support	2.1	Training of personnel
	2.2; 2.3	Travel assistance
	2.4	Education of other passengers
Information	3.5; 5.18	Travel information in braille
Vehicle	4.1; 4.2; 4.3; 5.14	Wheelchair accessible vehicles
	4.4	Wheelchair spaces in the vehicle
Station	5.4	Elevators
	5.11; 5.12	Facilities at stops
	4.9	Restrooms at the station
Service level	6.5	Fare free / reduced PT for PwD

3.3. Expert input

The main takeaways from the interviews regarding relevant policy measures are presented. For a in-depth overview, please refer to Appendix C. In this section, all discussed policy measures are highlighted and the main takeaways for each point are discussed one by one. The 11 measures identified by the literature research were proposed to the 11 experts during 9 interviews. Additionally, 9 measures were brought up by the experts themselves. After each interview, the shortlist of policy measures was modified based on the feedback of the experts. Thus a most recent concept of the PVE could be shown during each interview.

3.3.1. Measures discussed during the interviews

All measures discussed are ranked on how relevant the experts considered them. Next to the measures identified by the literature research, the experts proposed nine additional measures. Seven of these measures were also identified by the literature, but discarded. Two measures are new: *Complaint handling* and *Automatic check-in and check-out*. An overview of all measures is given in table 3.3. In the next section the main takeaways for each policy are discussed.

Table 3.3: Expert's consensus on policy measures

Expert's Opinion	Policy measure
Most relevant	Elevators
	Wheelchair accessible vehicles
	Travel assistance
	Accessible PT app
Relevant	Wheelchair spaces in the vehicle
	Guiding paths for blind people
	Restrooms at the station
	Automatic check-in and check-out
	Facilities at stops
	Complaint handling
	Travel information in braille
	Training of personnel
Less relevant	Paratransit services
	More PT stops
	Environment around stations
Irrelevant	Fare free / reduced PT for PwD
	Escalators
	Improved lighting at stations
	Education of other passengers
	Low signs and open door buttons

3.3.2. Main takeaways on each measure

Elevators, wheelchair accessible vehicles, travel assistance and an accessible PT app were widely considered to be very relevant. Below is discussed briefly what the experts said about each measure and what their main takeaways are.

Elevators were discussed extensively by all experts. Installing more elevators is incredibly expensive, sometimes costing more than a million per lift. But, ProRail said that all stations will have an elevator or ramp in 2030. So, installing new elevators is not necessarily relevant for this research. Generally elevators are seen as the weak point of PT because of their disturbances. The Municipality gave 93% as the uptime of elevators. They indicated that while the percentage is acceptable, the impact on travellers is major if an elevator is not working. Elevators are often the victim of vandalism. That is hard to change. ProRail indicated that the only way to increase the uptime is to spend more money on the maintenance contracts, but there might not be a lot of space for improvement. Nevertheless, the uptime of elevators was seen as one of the most pressing issues by all experts. So it is valuable to include elevators in this study. ProRail recommended to focus during the PVE design on the uptime of elevators rather than the construction of more elevators.

Wheelchair accessible vehicles was discussed in-depth with all experts. All experts stressed its importance. An accessible vehicle can only be accessible if the stop is accessible too. To start with vehicles, new vehicles tend to be accessible, older vehicles not. Upgrading older vehicles is very costly. But even in new vehicles grade level boarding can be difficult due to the gap between the vehicle and the platform. Regarding stops, most experts agreed that a lot of train stations are being made accessible, but also need to be maintained to be accessible. The Ministry talked about 93% of stations being accessible, but 35% of stations being in need of maintenance. The maintenance need arises when the track or the platform sinks such that the platform does not align with the vehicle any more. Regarding the accessibility of tram and bus stops, a lot has to be done. The Ministry calculated that to make bus stops

and tram stops accessible, 800 and 115 million is needed respectively. The Municipality indicated that it will be much higher.

Travel assistance was also discussed with all experts. The Oogvereniging identified three types of assistance: to help PwD enter the vehicle, to help people with a visual impairment change platforms and to help people change modes. The first type is perceived to be okay. But it can be improved by being faster and being offered on more stations. ProRail indicated that travel assistance will be offered on all train stations before the end of the year. The second type is not sufficient at the moment, deterring people from using PT. The third type is offered on only a couple of stations. That can be expanded. Ieder(in) stated that travel assistance can be improved on three levels: it can be faster, it can be offered in more places and it can be offered between different modes.

An Accessible PT app was considered relevant by all experts. They indicated that NS has an app but that does only show accessibility information about trains. Other modes are not included. Also, Ieder(in) stated that information about the (dis)function of elevators in and around the station needs to be integrated into one platform. A number of experts indicated that money is not the problem here. The Municipality said that one app is as expensive as one elevator. However, the Ministry stressed that it is hard to align all operators to share their data. That might cost a lot of time and effort. A question remains what data is interesting for travellers in such an app.

Eight policy measures were considered to be somewhat relevant by most experts.

Wheelchair spaces in the vehicle were discussed during four interviews. Trains usually do have spaces. Rover indicated that it is not always clear that a space is reserved for PwD and many spaces are right next to the toilet, which is not comfortable. Both factors might form a barrier to use it. The problem is mostly relevant for bus, tram and metro. Usually there is only space for one wheelchair. VRA: if there are two friends travelling togheter, they cannot sit next to each other.

Guiding paths for blind people were also discussed during four interviews. A lot is done already. The Municipality and VRA mentioned Navilens at Amsterdam Central Station as a positive example. ProRail made a digital twin of all their guiding paths and wants to add wayfinding methods based on sound. The Oogvereniging praised the quality of guiding paths in the train system but criticised the guiding paths for bus, tram, metro and interchange locations. Due to the lack of an overarching system, it is difficult if not impossible at times to navigate.

Restrooms at the station were also discussed during four interviews. ALS said that it is important to have accessible restrooms at stations. The Ministry noted that if there is a toilet at a station, it needs to be accessible for wheelchair users. But again, for the bus, tram and metro these facilities are way less frequently available.

Automatic check-in and check-out was proposed by the Oogvereniging. They called it one of the two most pressing issues for people with a visual disability, together with quality travel assistance. It is often hard to find check-in booths, which can deter people from using PT. In Brabant there is a pilot to allow automatic check-in and check-out via a special app.

Facilities at stops was discussed twice. Rover indicated that it is important for everyone. It is especially relevant for small stations. The Ministry was positive but urged to specify facilities. It could be interpreted in multiple ways, as shops, benches, shelter, restrooms, (bike) parking and so on.

Complaint handling was proposed and discussed briefly by Ieder(in). They stressed that it is important to have one ombudsman for accessibility in PT.

Travel information in Braille was discussed with most experts. The Oogvereniging indicated that wayfinding is important for all PwD. Multiple experts said that information is not always announced

via the speakers. The Municipality gave the metro as an example. There it is not clear which elevator or platform you have to go to if you cannot read.

The training of personnel was also discussed with almost all experts. Multiple times the word awareness was used. Especially bus drivers are not always aware of the needs of PwD. That can lead to unpleasant experiences, ranging from drivers accelerating too fast to people making fun of PwD.

Three measures were perceived to be less relevant than other measures.

Paratransit services were discussed during five interviews. Generally they are seen as very important. They are a vital part of the travel chain for some travellers, as ALS said. But, multiple experts did not consider paratransit to be a part of PT. The Ministry pointed out that paratransit is not an offical part of PT. Often, is not managed with a concession. In many cases, municipalities give subsidies for organisations that are willing to offer the service, usually on a volunteer basis. Moreover, both the VRA and the Ministry put paratransit opposite of PT. They stated that accessible PT could be a viable alternative for paratransit services.

More PT stops was discussed during three interviews. Its importance was widely recognized. Ieder(in) stated that there should be a PT every 100 to 300 meters, especially near health care facilities. But, as the Oogvereniging pointed out, the policy stands opposed to the current trend. For the past years, more and more stops were removed to increase economic feasibility. That trend is unlikely to reverse.

The environment around stations was discussed during five interviews. The VRA noted that it does contribute to independence. Rover said that it is interesting, but very expensive. The Municipality indicated that there are multiple components: bicycle parking, walking routes, benches. Ieder(in) also mentioned pavement. ALS indicated that they never had a problem with this before.

Five policy measures can be classified as irrelevant in comparison to the other measures.

Fare free / reduced PT for PwD was discussed with five experts. Most experts were not in favour. The Ministry said that it is not necessarily 'fair', since normal travellers account for the expenses of for accessibility measures. The only expert to be slightly positive towards this policy measure was Rover. They indicated that maybe a discount could be interesting if the PwD had to travel more than the normal traveller due to the lack of accessible connections. But, that is a rather niche application of a fare discount.

Escalators were brought up by the Ministry. They said that escalators are not an accessibility measure, for they cannot be used by all PwD.

Improved lighting at stations was discussed with Rover. They indicated that lighting is very personal. Some PwD prefer a lot of lighting while others prefer as little lighting as possible.

Education of other passengers was also discussed with Rover. They argued that most people already try to help PwD if necessary. An educational campaign will mostly reach people that already do well.

Low signs and open door buttons was also discussed with Rover. They mentioned that most accessible vehicles already have low buttons. Signs are made to be read from a far distance.

3.4. Selection of policy measures

A general guideline is to include at most 10 alternatives at once in a PVE, so it is necessary to scrap a number of measures. First, the measures that were perceived by the experts to be less relevant or were perceived mixed are removed from the list of policies.

The policy measures that were identified as less relevant concerns fare free / reduced PT for PwD, escalators, improved lighting at stations, education of other passengers and low signs and open door buttons.

The policy measures that were perceived mixed are discarded as well. Paratransit services are important, but it is not an official part of PT. More PT stops are helpful for a lot of people. But, it is unrealistic to assume that the trend of less and less stops can be reversed easily. An addional argument against including more PT stops in the PVE is that all travellers are concerned with less stops. Non-PwD respondents might therefore be biased towards this option in contrast to measures that target PwD. The environment around stations consists of many components. A vague measure should not be included in the PVE, since it can mean different things to different respondents. Moreover, like paratransit, the environment around stops are not managed by transport operators. Often municipalities are responsible. It is likely that the needs and barriers are location dependent. That makes it difficult to propose a national strategy on this measure based on the results of this research.

Second, three measures that were mostly perceived as being relevant are discarded.

First, facilities at stops is scrapped. The logic behind is comparable to the logic behind discarding the environment around stations. It consists of many different components, like shops, shelter, benches, restrooms and so on. One respondent might choose the measure because she wants more benches, another because he wants more shops. That makes it difficult to provide meaningful recommendations to PT operators and governmental organisations.

Second, complaint handling is scrapped. It was only discussed briefly with the VRA. No other expert brought it up. While it is important, the policy is distinct from other proposed policies. To elaborate on that point, most measures are touchable changes to the built environment, or a touchable service like travel assistance or an app. Complaint handling is a more managerial measure. That could make it hard for participants to compare it to the other measures.

Third, travel information in braille is discarded. The Oogvereniging indicated that travel assistance and user friendly check-in and check-out systems are the two most pressing issues for PwD. Subsequently, guidance paths are important too. Travel information was indicated as important, but less relevant. Therefore it is decided to include the former three and exclude travel information.

3.5. Conclusion

Based on the desk research, literature research and interviews with experts, nine policy measures were identified as most relevant to be included in this PVE study. The policies that are included in the PVE design are shown in table 3.4. To come back to RQ1 - *What potential policies could make Public Transport more accessible for People with a Disability?* - these measures can be labelled as policies that could make PT more accessible for PwD. They are identified as the most pressing and best defined policy measures in the current Dutch PT context.

Table 3.4: Policy measures to be included in the PVE

Category	**Policy measure**
Technology	Accessible PT app
	Automatic check-in and check-out
Personal support	Travel assistance
	Training of personnel
Vehicle	Wheelchair accessible vehicles
	Wheelchair spaces in the vehicle
Station	Elevators
	Guiding paths for blind people
	Restrooms at the station

(File:Piet Mondriaan Victory Boogie Woogie.jpg, 2023)

PVE design

In this chapter, the design of the PVE on accessible PT for PwD is outlined and explained.

PVE design steps

In the context of the five design steps defined by Bouwmeester (2021), this chapter shows the result of steps 1 through 3. Only the final PVE design is shown. Naturally, a lot of PVE concept designs were made. They were improved in an iterative matter thanks to the interaction with experts through interviews and written feedback. This chapter shows the result of this exercise.

First, the policy problem is recapped briefly. Second, the constraint variable is established. Third, the policies are highlighted. Namely, the impacts on the constraint variable of all measures identified in chapter 3 are discussed and the descriptions of each policy as shown to the participants is summed up. Fourth, the questions on disability, socio-demographic characteristics and travel patterns are presented. Fifth, the face validity questions aimed to answer RQ4 are introduced.

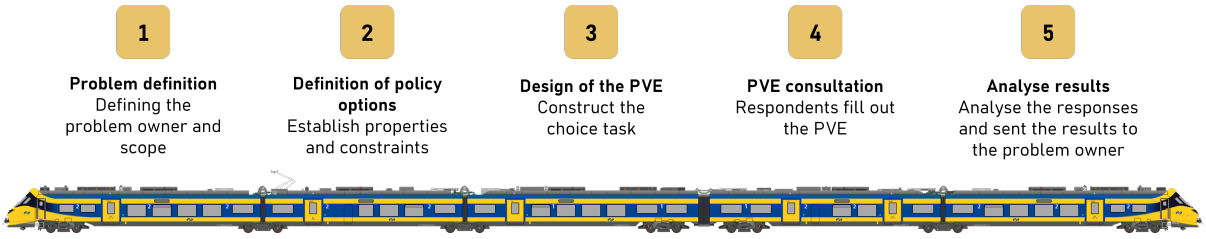


Figure 4.1: The five steps of a PVE as proposed by Bouwmeester (2021).

4.1. Policy problem

First, a quick recap of the policy problem. The PVE ultimately aims to answer the first main question. The problem is scoped towards PT only. To be more specific, the part of PT that is considered is the journey between the beginning PT stop and ending PT stop. Paratransit services or more PT stops are not considered as measures. All policies must be aimed at improving the accessibility for PwD.

A. *What policies do PwD and citizens in general prefer most with regard to the accessibility of Public Transport for People with a Disability?*

4.2. Constraint variable

One of the advantages of a PVE compared to other methods is that it lets participants make a trade-off between policies, while considering monetary and resource constraints (Bahamonde-Birke et al., 2024; Mouter et al., 2021; Mulderij et al., 2021). This has three main goals. First, the trade-offs that have to be made in a PVE will be more realistic compared to a simple prioritisation of needs. Second, participants can feel how it is to make tough decisions. Third, participants can be 'educated' if necessary about the relevant variables regarding a policy trade-off. Two possible constraints were considered: money and effort.

Money is generally an easy metric to compare alternatives upon, but in this instance it is hard to include as a variable. Three factors are at play. First, it is hard to estimate how much money an alternative will cost. During the interviews there already was disagreement on the cost of making tram and bus stops more accessible. The Ministry calculated that roughly 800 and 115 million is needed respectively. The Municipality indicated that it will be much higher. Second, money is not always the biggest issue at

play. For the accessible PT app, the Ministry indicated that it is hard to align all PT operators to share information on accessible PT. Another example is wheelchair spaces in the vehicle. When experts from the VRA and the Municipality gave written feedback on the policy impacts, they indicated that this policy does not necessarily cost a lot of money. Rather, it impacts the amount of seats per vehicle and thus the operator's KPIs. Third, the prices for different policy measures are of different orders of magnitude. The Municipality said that one PT app can cost as 'little' as 1 elevator. Comparing different orders of magnitude tends to be difficult for humans, creating bias (Kahneman, 2011).

Effort is the second metric to be considered as a constraint variable. Effort is a subjective metric, so any estimations need to be considered carefully. In this research, effort is a combination of two components:

i. How much money a measure costs
ii. How difficult it is to implement a policy (due to required cooperation, governance, etc.)

There are two advantages of effort in comparison to money. For one, it can incorporate non monetary effects, such as operator effort or political struggles. Additionally, policies that have diverging prices can still be compared in the same order of magnitude. Critics might argue that this does reflect reality. That is correct. Nonetheless, the goal of any policy survey design is not to reflect reality perfectly, but to provide meaningful recommendations to policymakers [1] The goal of this PVE is to provide an insight in the policies that policymakers should give more attention. If one or two measures are extremely expensive compared to the others, participants might prefer all others instead. That is not useful information for policymakers. Rather, a more useful recommendation is an emphasis on one, two or three points that need more priority. That result is more probable in case effort is the main metric.

Having both money and effort as a constraint variable was considered, but not preferred. It is common to have more than one variable as constraint, Golan (2023) for example uses three variables. But, effort is defined partially by the amount of money required. Moreover, it does not alleviate the issue of different orders of magnitude regarding costs.

4.3. Policies

In this section, the policies are discussed. All policies are formulated in a standardized matter. Two policies are framed on a conceptual level. Next, the impacts of all polices are discussed. Lastly, the descriptions as given to the participants are listed.

The policies identified in chapter 3 are rewritten so that the PVE is able to provide relevant insights, is easy to understand and uses the correct terminology for PwD. The formulation is standardised as much as possible, based on the following five principles:

i. The PVE should give answers to research questions 2 through 4 [2]
ii. The PVE should provide relevant insights for PT operators and governments
iii. The PVE should be easy to understand
iv. The PVE should use correct terminology regarding accessibility
v. The PVE should be as short as possible

[1] An often practised quote is: *All models are wrong (but some are useful).*

[2] Being:

What policies do citizens prefer most with regard to the accessibility of Public Transport for People with a Disability?
How do the perceptions of the various subgroups of People with a Disability compare?
How do People with a Disability evaluate the validity of a PVE towards Public Transport accessibility policies?

To provide relevant insights, positive formulations are used to limit bias. For example, each policy starts with *more, develop, make*. To be easy to understand, two steps are taken. First, as simple language as possible is used, preferably B1 level (*Is het b1?*, n.d.). Second, all measures should be intuitive to understand, also for non-experts of PT. All the formulation is made as short as possible; detailed descriptions of all policies can be accessed by participants with a single click.

Two policy measures are modified on a conceptual level.

First, the focus for elevators is on the uptime instead of the building of more elevators. The experts indicated that installing new elevators is incredibly expensive. Moreover, ProRail indicated that all stations will have an elevator or ramp in 2030. The weak point is elevators being out of order. ProRail recommended to focus during the PVE design on the uptime of elevators rather than the construction of more elevators. Therefore the focus of elevators is on uptime.

Second, wheelchair accessible vehicles are only viable if the platform has the correct height. The Ministry indicated that 35% of stations are in need of maintenance. This will be explained in the description of the policy measure. But, the formulation of the policy measure itself will be centred towards accessible vehicles, because it is more intuitive what is meant for non-experts of PT.

The policies in the WeValuate environment as seen by participants are shown in figure 4.2. The figure shows choice task during which participants have to prioritise different policy alternatives. The order of policies is randomized for each participant, as to minimize bias. The survey is in Dutch. In this report, the English translations are used.

The figure shows the policies with next to each policy a slider. This slider can be moved by respondents to give a measure *more priority* or *much more priority*. If the respondent does not move the slider, its position will indicate *same as now*, indicating that the policy will not get more priority than it currently gets.

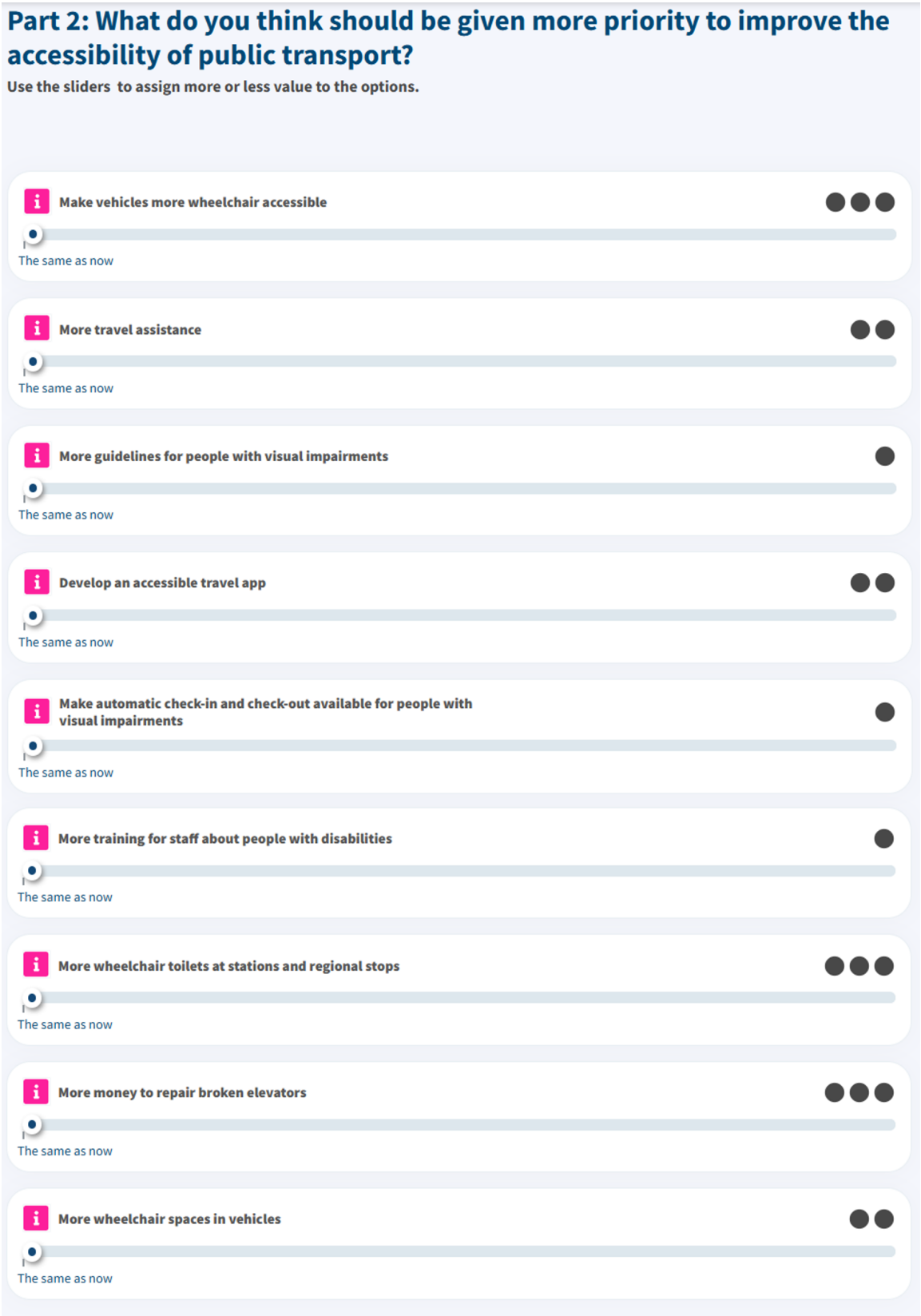


Figure 4.2: The choice task as seen by the participants

4.3.1. Impacts of policies

The impacts of the policies on the constraint variable *effort* were estimated with the help of the experts. A proposal was sent to one expert of the Municipality of Amsterdam. That estimation was based on the interviews with experts. The Municipality's estimation was then sent to VRA and ProRail. Their three estimations combined led to the impacts used in the PVE.

First, an average was taken of the three experts' estimations. The values were rounded to whole numbers.

Second, the effort required for the 'cheapest' measures was increased, for two reasons. First, the impacts are established so that not too many policy measures can get more priority simultaneously. That is also not possible in reality, unfortunately. The maximum effort to be 'spend' is 30. That forces participants to make a trade-off and prioritise policies according to their preferences. Second, it is not desirable to have too big differences between the impacts of one measure and another measure. Consequently, each measure has a minimum impact of 4.

Third, the visual representation of the effort required is simplified. For participants, the exact impact is not strictly relevant and can be distracting. Therefore the impacts are simplified into three categories: *low impact, medium impact and high impact*. In the PVE, this is shown by one, two and three dots respectively. The back-end of the PVE still uses the exact numeric numbers.

Table 4.1: Overview of Accessibility Improvement Options and Required Effort

Option	Effort Score (total=100)	Simplified Effort
Make vehicles more wheelchair accessible	21	***
More wheelchair toilets at stations and regional stops	17	***
More money to repair broken elevators	15	***
More travel assistance	11	**
Develop an accessible travel app	11	**
More wheelchair spaces in vehicles	10	**
More training for staff about people with disabilities	7	*
More guiding paths for people with visual impairments	4	*
Make automatic check-in and check-out available for people with visual impairments	4	*

4.3.2. Policy descriptions

In the PVE, participants can access a detailed description of the policy and its impacts. Under each description, the impact of each policy on the effort constraint is shown. The descriptions of each measure are presented in appendix D.

4.4. Personal characteristics

A number of questions are asked to the participants about their the socio-demographic characteristics, travel behaviour and their association with disabilities. This has three goals. First, it is necessary to know if people have a disability in order to answer RQ 3: *How do the perceptions of the various subgroups of People with a Disability compare?* Second, it allows to check representativeness. Third, it is useful to analyse the relationship between personal characteristics and preferences to see if there are any correlations. The questions and answer options (except for the questions on disability) are based upon the questions given in the Lelylijn PVE (Populytics, 2023).

Socio-demographics

Six questions regarding socio-demographic characteristics are asked, as shown in table 4.2. The last three questions are asked after the choice task to limit the amount of question before it. During the survey, people will drop off. Their given answers are registered nonetheless. Therefore it is useful to have the choice task as early as possible, to maximize the responses in the choice task. Question six is a subjective question. It asks the perceived ease of paying for the things somebody needs. This is a proxy of income. Income is not asked, since people may not want to answer this question or do not know their exact income.

Table 4.2: Socio-demographic questions and answer options as included in the PVE.

Question	**Answer options**
What is your age group?	Younger than 25, 25 to 34, 35 to 44, 45 to 54, 55 to 64, Older than 64, Prefer not to say
What is your gender?	I am a woman, I am a man, Other, Prefer not to say
What is your highest level of education?	Primary school, Pre-vocational secondary education (VMBO), General secondary education (HAVO/VWO) years 1–3, General secondary education (HAVO/VWO) years 4–6, Secondary vocational education (MBO) level 1, MBO level 2, 3 or 4, University of applied sciences (HBO), University, I don't know / Prefer not to say
In which province do you live?	Drenthe, Flevoland, Friesland, Gelderland, Groningen, Limburg, North Brabant, North Holland, Overijssel, Utrecht, Zeeland, South Holland, Somewhere else, I don't know / Prefer not to say
What type of area do you live in?	I live in a large city, I live in a small city, I live in a village, I live in a rural area, I don't know / Prefer not to say
How easy or difficult is it for you to make ends meet?	Very easy, Easy, Neither easy nor difficult, Difficult, Very difficult, I don't know / Prefer not to say

Travel behaviour

Six questions are asked about travel behaviour, as presented in table 4.3. Question 2 is only asked if the respondent indicated to travel several times a month by train or more.

Table 4.3: Travel behaviour questions and answer options as included in the PVE.

Question	**Answer options**
How often do you use the train?	Daily or almost daily, Several times a week, Several times a month, Several times a year, Almost never, I've never used it, I don't know / Prefer not to say
Which train operator do you travel with? *(If you travel with multiple train operators, choose the operator you travel with most)*	NS, Arriva, Keolis, Blauwnet, R-net, RRReis, I don't know / Prefer not to say
How often do you use the bus?	Daily or almost daily, Several times a week, Several times a month, Several times a year, Almost never, I've never used it, I don't know / Prefer not to say
How often do you use the tram?	Daily or almost daily, Several times a week, Several times a month, Several times a year, Almost never, I've never used it, I don't know / Prefer not to say
How often do you use the metro?	Daily or almost daily, Several times a week, Several times a month, Several times a year, Almost never, I've never used it, I don't know / Prefer not to say
How often do you use Paratransit services? *(Valys / regiotaxi)*	Daily or almost daily, Several times a week, Several times a month, Several times a year, Almost never, I've never used it, I don't know / Prefer not to say

Disability

Three questions are included in the PVE about having a disability, as shown in table 4.4. All participants have the opportunity to self-identify any difficulties they might have. If a participant indicated they have difficulty walking, question 2 is asked about the use of mobility devices in PT. If they indicated not to have a disability, question 3 is asked. The reasoning behind question 3 is that some respondents are likely caregivers or family of people with a disability. They might be inclined to pick policy measures that help their acquaintance.

Table 4.4: Disability related questions and answer options as included in the PVE.

Question	**Answer options**
Click what applies to you	I have difficulty walking; I have difficulty seeing; I have difficulty hearing; I have difficulty speaking; I have difficulty with my memory or cognitive abilities; None of the above; I don't know / Prefer not to say; Different, namely ...
Do you use a mobility device in public transport?	Yes, a wheelchair; Yes, an electric wheelchair; Yes, a mobility scooter; Yes, a walker; No; I don't know / Prefer not to say
Do you know someone with a disability?	Yes, somebody that has difficulty walking; Yes, somebody that has difficulty seeing; Yes, somebody that has difficulty hearing; Yes, somebody that has difficulty speaking; Yes, somebody that has difficulty with their memory or cognitive abilities; None of the above; I don't know / Prefer not to say; Different, namely ...

4.5. Face validity

The validity of the PVE method regarding accessibility policymaking is tested through the means of face validity. The participants are asked to what degree they agree with a number of statements. In addition, the participants are able to give a grade to the PVE, on a scale from 1 to 10. The seven face validity questions are presented in table 4.5.

Table 4.5: Face validity questions and answer options as included in the PVE.

Question	**Answer options**
I was able to express my opinion.	Strongly agree, Agree, Neutral, Disagree, Strongly disagree, I don't know / Prefer not to say
I think this is an important topic.	Strongly agree, Agree, Neutral, Disagree, Strongly disagree, I don't know / Prefer not to say
I found the material difficult to understand.	Strongly agree, Agree, Neutral, Disagree, Strongly disagree, I don't know / Prefer not to say
This tool should be used more often.	Strongly agree, Agree, Neutral, Disagree, Strongly disagree, I don't know / Prefer not to say
I learned something about the choices and the topic.	Strongly agree, Agree, Neutral, Disagree, Strongly disagree, I don't know / Prefer not to say
Did you give your opinion to the government before about this subject?	No; Yes, through a survey; Yes, through a physical or online gathering; Yes, I am active in a representative organisation; Different, namely ...
What do you think about the importance of advice from people with disabilities versus experts?	Only the advice of people with disabilities is important, not that of experts; The advice of people with disabilities is more important than that of experts; The advice of people with disabilities is equally important as that of experts; The advice of experts is more important than that of people with disabilities; Only the advice of experts is important, not that of people with disabilities; I don't know / Prefer not to say

4.6. Conclusion on PVE design

In this chapter, the design of the PVE was discussed. With the PVE, RQs 2 through 4 are answered. The next three chapters are each devoted to their corresponding sub-question.

9 Conclusion

8 Discussion

7 PVE face validity

6 Policy preferences PwD

5 Policy preferences respondents

4 PVE design

3 Selection of relevant policies

2 Methodology

1 Introduction

(File:Piet Mondriaan Victory Boogie Woogie.jpg, 2023)

Policy preferences respondents

In this chapter, RQ2 is answered: *What policies do citizens prefer most with regard to the accessibility of Public Transport for People with a Disability?* The question is answered by analysing the results of all respondents. The analysis consists of three parts: a quantitative analysis of the results, including a reflection of the effect of travel behaviour, a qualitative analysis of the motivations given for choosing a policy and lastly a latent class cluster analysis (LCCA). But prior to the presentation of the three analyses, the representativeness of the respondents is discussed.

5.1. Representativeness

The sample of PVE respondents is not fully representative of the population, so the results were reweighted to make the results more generalizable. First, the representativeness of the sample is analysed based on the descriptive statistics. Second, the effect of the reweighting is discussed.

5.1.1. Descriptive statistics

The sample is not fully representative of the population, as shown in table 5.1. The answers of respondents are compared to the numbers provided by the Dutch institute of statistics (CBS, 2024, 2025)[1].

The sample is overrepresented by males and highly educated people, while it is under-represented by people younger than 35 and people living outside the Randstad. It might be explainable why the latter two groups are under-represented. People in the Randstad tend to use and be dependent on PT more often. Young people might be less familiar with, or interested in, disabilities than older generations. The males and highly educated dominance has no direct explanation. This is a trend in other PVE's as well (Populytics, 2024b).

It has to be noted that a significant proportion of respondents did not answer all socio-demographic questions, even though they completed the choice task that was presented afterwards. The question about somebody's province that was asked after the choice task and has more respondents. This is predominantly the case for gender and education level. A possible explanation is that respondents did not consider the characteristics to be important. One respondent said the following in the comments at the end of the PVE: *'I find personal questions irrelevant: it's all about opinion'*.

Next, two subjective socio-demographic questions are asked, as presented in 5.2. Like gender and education, a number of people did not fill out the questions. This time the questions are presented after the choice task, which might partially explain the low response rate.

The respondents are roughly evenly distributed over large cities, small cities and villages. Rural areas are under-represented. That is expectable given the low overall presence of PT in these areas. When emailing social organisations, one organisation from a rural region (albeit next to the Hague) replied as follows: *We do not actually know of any physically disabled people using public transport in the Westland.*

Most respondents indicated that it was easy for them to make ends meet. There are two possible explanations for this distribution. First, the Netherlands is often considered to be a rich country. Therefore it might be indicative of the population. A second explanation for this statistics is that people are inclined to give socially desired answers in a survey, the so called social-desirability bias (Nederhof, 1985). Even if people have a hard time making ends meet, they might indicate the opposite. Or they prefer not to answer. Mulderij et al. (2021) found that a small part of participants indicated that they *could not make ends meet*, even though more than 1 in 3 respondents had a net household income below €2000 per month.

[1] The CBS uses the age category *15 to 35*. In this research, only people over 16 years or older where able to participate.

Table 5.1: Objective socio-demographic characteristics: gender, age, education, province. Expected distributions taken from CBS (2024, 2025).

Question option	Respondents	Percentage	Expected
Gender			
Woman	405	39.74%	50.28%
Man	614	60.26%	49.72%
Other	15		
Prefer not to say	9		
Not answered	211		
Age			
Younger than 35 years	179	14.35%	25.52%
35 to 64 years	658	52.77%	38.86%
Older than 64 years	410	32.88%	20.49%
Prefer not to say	1		
Not answered	6		
Education level			
High	811	78.51%	36.11%
Intermediate	189	18.30%	35.95%
Low	33	3.19%	27.94%
Don't know / Prefer not to say	9		
Not answered	212		
Province			
Zuid-Holland	258	23.08%	21.40 %
Noord-Holland	247	22.09%	16.59 %
Utrecht	137	12.25%	7.80 %
Gelderland	118	10.55%	11.98 %
Noord-Brabant	86	7.69%	14.74 %
Flevoland	67	5.99%	2.51 %
Friesland	53	4.74%	3.69 %
Groningen	46	4.11%	3.35 %
Overijssel	41	3.67%	6.63 %
Limburg	29	2.59%	6.32 %
Drenthe	20	1.79%	2.81 %
Zeeland	16	1.43%	2.18 %
Somewhere else	9		
Don't know / Prefer not to say	2		
Not answered	125		

5.1.2. Reweighting

The sample was reweighted on gender, age and education to make the results more generalizable. Having a disability is not considered as a variable to reweight on. Clear data lacks in the Netherlands on the frequency of disabilities.

Because of this, the reweighted data might still be over- or under-represented by certain groups. PwD might be overrepresented in the reweighted data. Comparably, people living in rural regions and people with a low income might still be under-represented in the reweighted results. As discussed in section 2.6.1., people with a low education are still under-represented in the reweighted data. While the prioritisations are generally homogenous, some groups put their emphasis on other points. For example, people with difficulties making ends meet prioritise wheelchair spaces and travel assistance more than the general population. The elicited preferences by socio-demographic characteristic can be found in Appendix E. In the interpretation of the results, these nuances have to be taken into account.

The reweighting method used is Iterative Proportional Fitting (IPF), or 'multiplicatief wegen' in Dutch (CBS, 2008). A general rule of thumb is that it can only be applied if all categories of relevant socio-demographics (for example low, middle and high educated) have at least 30 observations. That is true for

Table 5.2: Subjective socio-demographic characteristics: living area and income

Question option	Respondents	Percentage
What kind of area do you live in?		
I live in a large city	359	28.63%
I live in a small city	296	23.60%
I live in a village	268	21.37%
I live in a rural area	56	4.47%
Don't know / Prefer not to say	2	0.16%
Not answered	273	21.77%
How easy or difficult is it to make ends meet?		
Very easy	257	20.49%
Easy	394	31.42%
Neither easy nor difficult	246	19.62%
Difficult	45	3.59%
Very difficult	12	0.96%
Don't know / Prefer not to say	27	2.15%
Not answered	273	21.77%

this research. To apply reweighting, only respondents that gave an answer to the three socio-demographic questions (gender, age, education) are considered, which are 1002 respondents in total.

The reweighted results, contrasted to the the non-reweighted results are shown in figure 5.1. The results do not change much. A number of differences are notable. In the reweighted results, elevators and wheelchair accessible vehicles get more priority. As seen in appendix E, this might be due to young people and woman giving these respective measures more priority than average. In the reweighted results, their preferences play a bigger role. Restrooms at the station gets less priority, possibly because low educated people, an under-represented group, give it less priority than average and because older people, an overrepresented group, give it more priority than average.

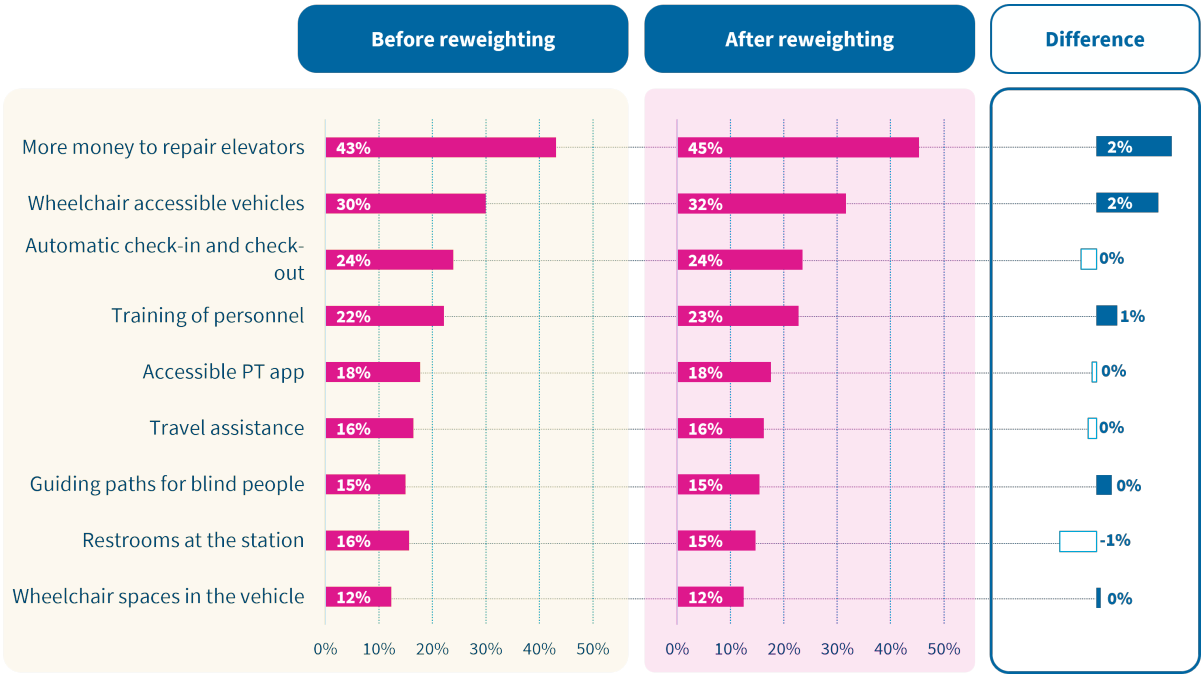


Figure 5.1: The non-reweighted results of the choice task, compared to the reweighted results of the choice task.

5.2. Policy preferences

In this section, the policy preferences of the respondents are analysed. First, the reweighted results of the choice task are presented. Second, an analysis is conducted towards the impact of travel behaviour on policy preference.

First, the reweighted results of the choice task are presented. In figure 5.2 each policy measure is presented, with alongside it how many participants placed the slider in each position. It is seen that 30% of respondents left the slider at *same as now* for the option elevators. In contrast, over 70% indicated that the reparation of broken elevators should get more priority than it has now.

The first thing to note is that participants were hesitant to give *much more priority* to a policy measure. Instead, most opted to distribute their effort over multiple measures.

The majority of respondents indicated that the reparation of elevators and wheelchair accessible vehicles should get more priority. Elevators is the clear number one. Notably, over 15% of participants stated that this policy should get *much more priority*, a significant share of the sample population. A large amount of the respondents gave more priority to automatic check-in and check-out and training of personnel. The latter was indicated more often as deserving *much more priority*. Wheelchair spaces in the vehicle was perceived by only a quarter of respondents to get too little attention currently. That does not mean that wheelchair spaces are not important, that respondents perceive it as not important or that respondents believe that enough is done regarding this policy. The results in figure 5.2 show that most respondents prioritise other policies over wheelchair spaces. In the section F, a brief reflection is given on *why* respondents did or did not give more priority to a policy.

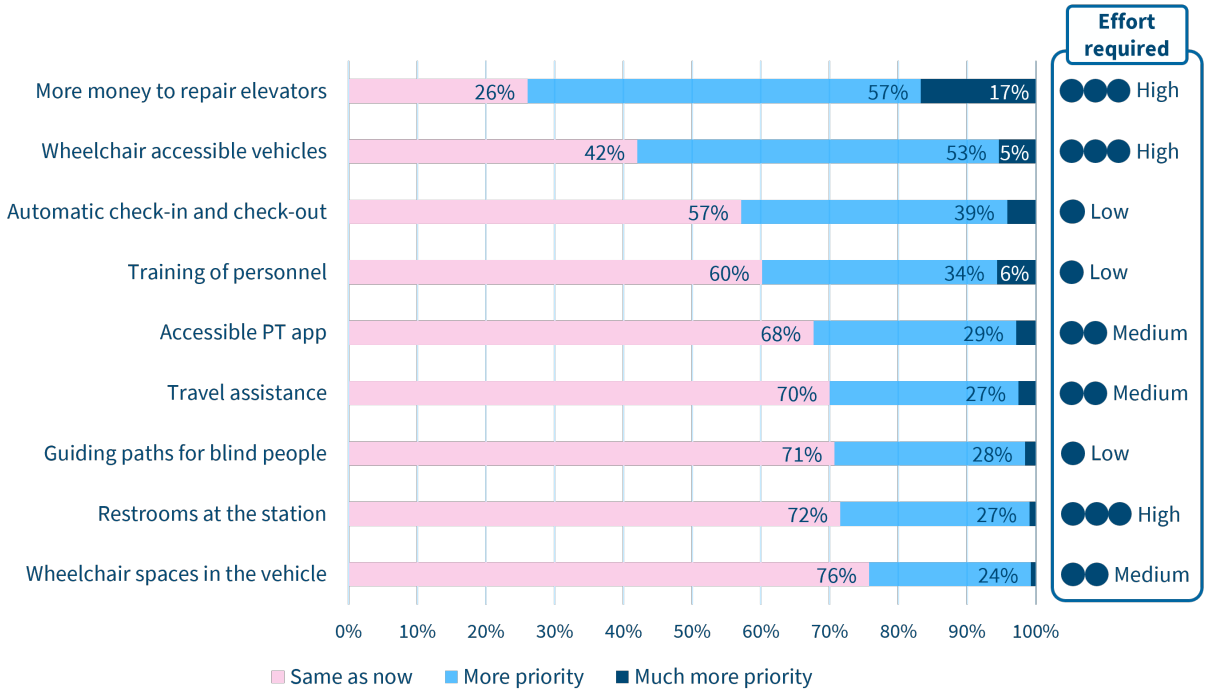


Figure 5.2: The elicited preferences of participants in the choice task, compared to the *effort* required to give the policy measure more priority.

The outcome of the choice task can be partially explained by the required effort of each policy measure. As determined in section *4.2. Constraint variable*, participants are bound to the constraint variable effort. Effort consists of two components:

i. How much money a measure costs

ii. How difficult it is to implement a policy (due to required cooperation, sacrifice of space etc.)

Wheelchair accessible vehicles require the most effort, followed by more money to repair elevators. These policy measures are chosen by participants, *despite* requiring the most effort. Both automatic check-in and check-out and training of personnel only cost little effort, which might explain why a large share of people gave priority to these measures. Regarding the policies that require a mediocre amount of effort, the accessible PT app was considered to be most urgent.

5.2.1. Impact of travel behaviour

Travel behaviour can partly explain the elicited preferences of participants, as presented in figures 5.3 and 5.4. Generally, the preferences of the different travel groups do not differ a lot. As with socio-demographics, some groups put emphasis on specific policies. Respondents who travelled at least once per month with a given mode are included in these statistics.

Travellers of the train, bus, tram and metro prioritise elevators more than the general population. This is especially the case for metro travellers. This could be because metro travellers are more dependent on elevators or because the elevators in metro systems have a lower uptime. Frequent bus users prioritise training more than the general population. Users of paratransit prioritise wheelchair accessible vehicles and wheelchair spaces inside the vehicle more. This indicates that this might be lacking for some paratransit services. On the other hand, they give less priority to the training of personnel, indicating that personnel of paratransit might be more familiar with PwD than PT personnel. People that do not use any of the aforementioned modes at least once per month prioritise automatic check-in and check-out more than the general population. Additionally, they prioritise the repair of elevators less than the general population.

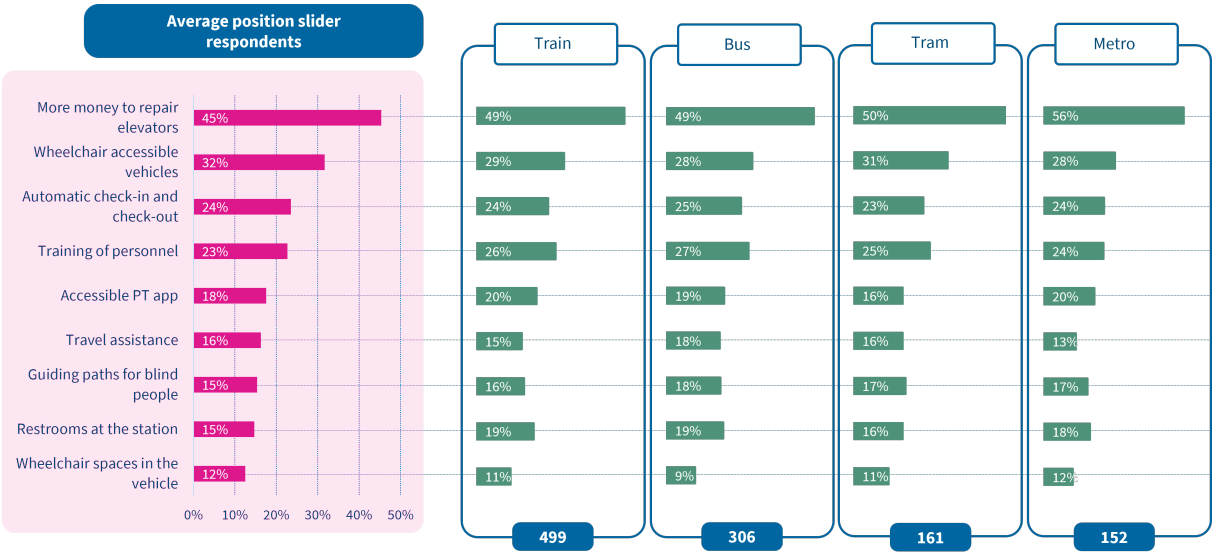


Figure 5.3: The elicited preferences of participants in the choice task. Each mode consists of the respondents that indicated to use that mode at least once a month. Left the average preferences of respondents. 100% means: all respondents indicated that this policy should get *much more priority*. 0% means: none of the respondents indicated that this policy should get *(much) more priority* than it gets now.

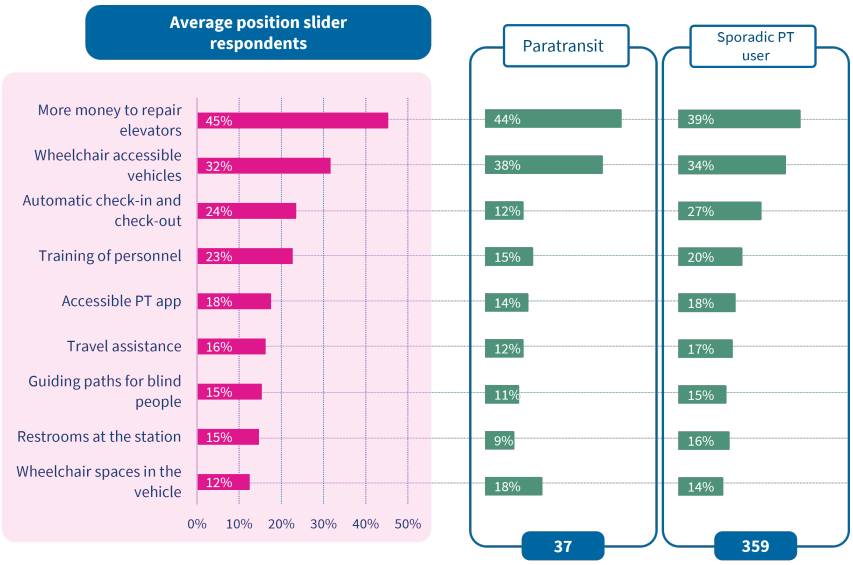


Figure 5.4: The elicited preferences of participants in the choice task. Each mode consists of the respondents that indicated to use that mode at least once a month. Left the average preferences of respondents.

5.3. Latent Cluster Class analysis (LCCA)

In this section, the results of the Latent Cluster Class analysis (LCCA) are discussed. The LCCA can provide insights into what types of respondents exist, based on their elicited preferences and any significant personal characteristics. The goal of a LCCA is to create the most parsimonious model that describes the relations between the indicators (Kroesen, 2019). In other words, a model with a minimum amount of clusters, that are as homogenous within the cluster and as heterogenous between the clusters. The covariates (personal characteristics) are included only if they are significant. A significant covariate indicates a relationship between the covariate and class membership.

First, the amount of clusters is determined. Second, the significant personal characteristics are presented. Third, the elicited preferences for each cluster are presented. Next, an interpretation is given for each cluster.

5.3.1. Model estimation

First, the amount of clusters to be differentiated upon is decided. A common method is to assess the BIC value (Petersen et al., 2019). The BIC value of the 3 cluster model is the highest, as presented in table 5.3. However, in this case a 4 cluster model is preferred, for it provides for greater interpretation possibilities.

Table 5.3: LL and BIC values for 2, 3, 4 and 5 clusters

Model	LL	BIC(LL)	Max. BVR
2-Cluster	-5256.2383	10738.8926	42.4820
3-Cluster	-5195.2573	10723.4794	45.0133
4-Cluster	-5151.1770	10741.8674	18.8488
5-Cluster	-5103.9420	10753.9461	16.7507

5.3.2. Descriptive statistics

Now that the number of clusters is decided upon, the significance of the policy measures is investigated. Additionally, personal characteristics are added to the model as covariates and checked for significance.

Policy measures

The significance levels of all policy measures, also named indicators, are presented in Appendix G. All indicators were significant at the 0.05 level. That proves that the model can account for heterogeneity between the clusters with respect to the indicators.

Personal characteristics

Personal characteristics are added to the model as covariates and checked for significance. First, the significant covariates are presented. Second, a brief interpretation of the significant variables is provided by looking at the literature.

The personal questions as asked in the PVE are included. Also, certain new variables were tested as well, who were an aggregation of the PVE questions. Of all variables considered, only four covariates proved to be significant: *gender* and *age* and two novel variables: *PwD affiliation* and *PT usage*. The significance levels of the variables are shown in table 5.4.

Table 5.4: Significance levels of the covariates (personal characteristics)

Covariate	**Wald**	**p-value**
Age	22.7251	0.00089
Younger than 35		
35 to 64		
Older than 64		
Gender	19.7284	0.00019
male		
female		
PwD affiliation	17.7039	0.007
Has a disability		
Knows somebody with a disability		
Does not have a disability nor knows somebody with a disability		
PT usage	12.0728	0.0071
Frequent PT user		
Sporadic PT user		

The two new variables were constructed manually using data manipulation. Gender and age were asked directly in the PVE survey.

PwD affiliation is a trinary variable with possible values: *has a disability*, *knows somebody with a disability*, *does not have a disability nor knows a somebody with a disability*. In an ideal scenario, the type of disability would play into effect when determining the clusters. However, the sample sizes for numerous disabilities are too small to provide meaningful results. A LCCA needs clean data to provide meaningful results. The advised minimum amount of responses for any option is 30. That is not always reached here. To give an example, only 15 individuals experienced difficulty talking. To include this as a category harms the ability of LCCA to make meaningful clusters. One can merge different categories, but this ignores the heterogeneity amongst different disabilities.

PT usage focusses on the frequency of use of the train, bus, tram or metro. It has three levels: *frequent PT user*, *sporadic PT user* and *no PT user*. Frequent users are those who use any of the aforementioned modes at least once a month. Sporadic users use at least one mode several times a year or almost never. No PT users indicated that they had never used any of the four modes. There were only 9 respondents who had never used any of the modes. Hence, *no PT user* as a category was removed from the LCCA dataset.

Gender and age were significant, while education is not. This could have two possible explanations. First, it can be that education is not correlated enough with the indicators enough, implying that education does not directly interact with any of the latent variables. Second, it could be because the education responses are unbalanced. Namely, only 33 respondents indicated to have a low education, while 811 respondents noted that they have a high educational level.

5.3.3. Cluster preferences

The model identified 4 clusters based on the elicited preferences for the policy measures and the given personal characteristics. Note that the clusters are never black and white. People cannot simply be distributed amongst a set of 'types' for each participant makes their choices on a unique set of experiences. Nevertheless, the clusters could provide insights into the types of answers people gave in the PVE survey. In Appendix G, the complete result of the clusters is given, including the precise impacts of personal characteristics. For the sake of completeness, the correlations between the clusters and education, living area and income is shown. In this paragraph, the clustering results are discussed briefly and example motivations of each cluster are presented.

In figure 5.5, the results of the LCCA are shown. Clusters are mostly formed based on the indicator values. Three indicators, or policy measures, are most striking. Elevators and wheelchair accessible vehicles are given more priority by the majority of cluster 1, while they get no priority in cluster 3 and 2 respectively. Restrooms at the station, the third policy that requires high effort, is given the most priority by cluster 4, while almost nobody of cluster 1 attaches priority to it.

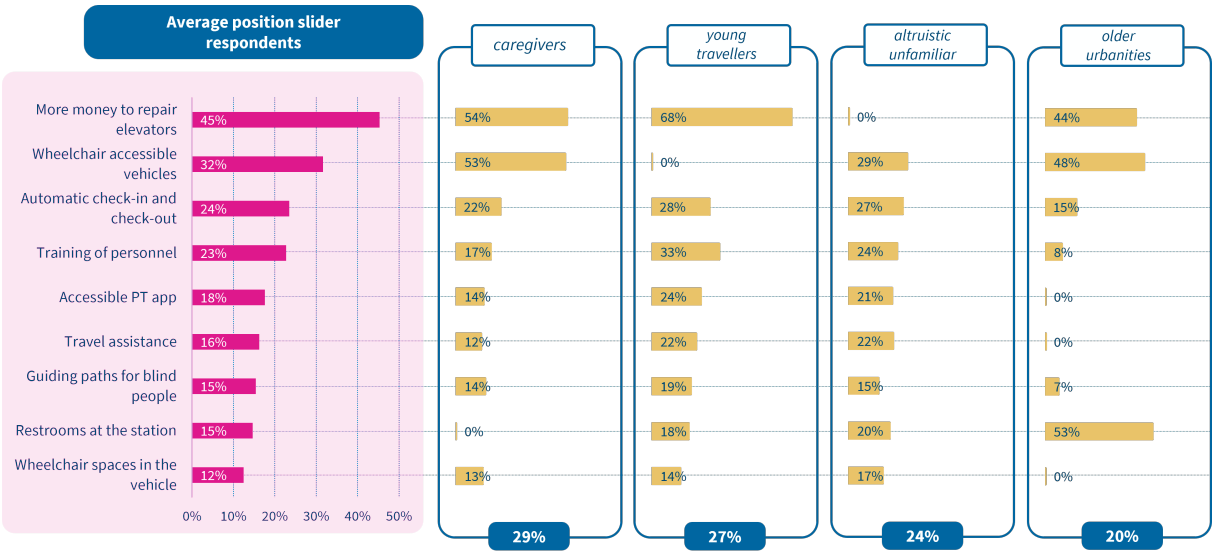


Figure 5.5: The elicited preferences of the four clusters with their respective cluster sizes.

Cluster 1, nicknamed *caregivers*, mostly gives priority to wheelchair accessible vehicles and broken elevators. Almost nobody of this cluster gave priority to wheelchair accessible toilets. The cluster consists of relatively few PwD, but relatively many people that know somebody with a disability. This is interesting, because it suggest a discrepancy in the prioritisation of needs between PwD and the people around PwD. Furthermore, the cluster consists of relatively few older people. Participants in this cluster chose predominantly for two policies, accessible vehicles and functioning elevators.

A number of motivations are presented to exemplify cluster 1:

> *"Because of prioritisation, I chose two statements, which I think are the most important."*
> On restrooms: *"my answers are mainly based on the experiences and needs of my acquaintances with motor and/or visual impairments. These have only a minor need for more*

wheelchair-friendly toilets. they do need more frequent ov. and you don't give that option."
On elevators: *"I wanted to give this one more priority because I see in my surroundings that it is really annoying when a lift turns out to be broken. Once, my mother even had to get back on the train with her PGB clients because she couldn't get off the platform otherwise. But given the limited space for prioritisation, I had to drop these in consideration with the other items."*
On wheelchair accessible vehicles: *"If someone can enter a train or bus with a wheelchair without assistance, it makes a huge difference in the effort it takes for that person to get around. In addition, it is less of a spectacle that everyone is watching, and the person in the wheelchair can feel more 'just a traveller'."*

Cluster 2, nicknamed *young travellers* opted for elevators and not for wheelchair accessible vehicles. Since wheelchair accessible vehicles was the policy that required the most effort [2], this cluster had some effort left to 'spend' on other measures. They chose, as compared to the other clusters, relatively much for the training of personnel, automatic check-in and check-out, an accessible PT app and guidance paths. In this cluster, there are relatively many PwD and relatively many frequent PT users. Additionally, there are relatively many young people. This cluster did not strive to make PT 'fully accessible'. Instead, it prioritised a set of measures that can quickly help PwD to use PT, such as reliable elevators, the training of personnel and automatic check-in and check-out.

A number of motivations are presented to exemplify cluster 2:

On elevators: *"Broken lifts or alternative ways of getting onto a platform, such as ramps. These are low-maintenance so it costs little. You only need space for it. Does provide significantly more capacity (not 1 wheelchair per minute due to slowness of lift)."*
"They are so incredibly often out of order making it impossible to get on or off a platform. Travelling on to the next station to travel back there to get to the lift on the other side is not always possible because you have to request travel assistance in time to get on and off trains again. A working lift prevents so much suffering and increases independence."
On wheelchair spaces: *"Provide equal boarding or independent opportunities for a wheelchair to enter a train. Ensure that a wheelchair does not end up in the "3rd class" next to the toilet but can make decent use of the entire train facilities."*
On training: *"People with a motor or visual impairment who do not travel accompanied usually do not have a mental or intellectual disability; this is apparently unknown to many others."*

Cluster 3, nicknamed *altruistic unfamiliar*, did not choose to spend money on elevators. Instead, it distributed the available effort relatively evenly over all other policies. They think it is important that all issues are addressed. The cluster consists of many sporadic PT users. It consists of less PwD than clusters 2 and 4, but of more PwD compared to cluster 1. It consists of relatively many older people, males, and people with a low education. Possibly, the people that do not have a disability and use PT sporadically, prioritised so that as many issues as possible were addressed. That hints towards choices made on the basis of equity.

A number of motivations are presented to exemplify cluster 3:

On elevators: *"Had to drop out unfortunately because of the perceived great effort."*
On travel assistance: *"It seems pretty annoying to me when you are standing there with your wheelchair, but there is insufficient help to help you either in or out of the train."*
On automatic check-in and check-out: *"I just think that that bleep dispenser is almost impossible to find by touch"*

[2]Note that this is due to the fact that wheelchair accessible vehicles not only encompasses the accessibility of the vehicle itself, but also the platform or stop.

> On wheelchair spaces: *"I have the idea that there is now basically enough space, but that the problem is that not all (fellow) travellers take it into account. At least I notice this myself as a cyclist when I take my bike with me and the designated space is 'occupied' and people sometimes make it (very) difficult when I claim that space anyway."*

Cluster 4, nicknamed *older urbanities*, choose three policies predominantly. That is, they prioritised the repair of elevators, wheelchair accessible vehicles and restrooms at the stations. Also, automatic check-in and check-out, training and guiding paths were chosen. The measures that are shown in figure 5.5 as 0% are chosen, but just extremely infrequently, as the last quote below shows. Cluster 4 consitst predominantly of frequent PT users and of relatively many PwD. Most are older people and most live in a big city. There are relatively few young people in this group. When contrasting cluster 4 to cluster 1, one can see that PwD that opt for wheelchair accessible vehicles, often opt for wheelchair accessible restrooms as well. Even though restrooms are not prioritised often, the LCCA results do show that a part of the participants value wheelchair accessible restrooms at the stations.

A number of motivations are presented to exemplify cluster 4:

> On restrooms: *"More and clean toilets everywhere especially when those toiletless trains are running."*
> *"One prefers not to use those toilets, they are often DIRTY!"*
> On guidance paths: *"Forced choice. I do think it is important, especially in the case of temporary stops this is lacking (there is a lot of work going on in the city at the moment, so you have to deal with temporary stops)"*
> On Accessible PT app: *"Not everyone can use an app. Think old age, digital illiterate, visually impaired etc."*
> On travel assistance: *"The current station assistance works fine!"*
> *"Gladly ! Especially from one platform to another"*

5.4. Motivations given by participants

In this section, the types of motivations that respondents gave are presented. For each policy measure, 100 random motivations were examined and clustered. In Appendix F the motivations for each policy measure are analysed more in-depth.

In figure 5.6 the types of motivations are shown that respondents gave when they did *not* select a policy. The amount of stars indicate the frequency of a given motivation. Three types of motivations are given most often.

First, most people who did not give more priority to a policy did so because they judged the status quo to be acceptable. To give training of personnel as example: a lot of people said that personnel already did their best, or that there is already enough training for personnel. Contrastingly, broken elevators only got one star in this category. Relatively few people indicated that the uptime of elevators is acceptable in the status quo.

Secondly, an often cited reason to not prioritise a policy is that other policies should get more priority instead. The frequency of this motivation roughly follows the elicited preferences as presented in figure 5.2.

The third most cited motivation against a policy is that the given measure is not effective or infeasible. That argument was given most for an accessible PT app. A lot of respondents said that an app is not a solution for all PwD. This is in line with the main findings of Durand (2025). Another argument in this category against the app is that the government should improve the existing apps rather than making a new one.

	Not a problem / status quo is acceptable	Should not be neccesary if PT is accessible	Infeasible / ineffective solution	Cost inefficient solution	Others measures get more priority	Also a problem for non-PwD	Hurts other travellers	Not the responsibility of the government / PT operators	I don't know enough to decide
More money to repair elevators	★		★★					★	
Wheelchair accessible vehicles	★★★			★					
Automatic check-in and check-out	★★		★		★	★			★
Training of personnel	★★★	★			★				
Accessible PT app	★★	★	★★★		★				
Travel assistance	★★★	★★			★★				
Restrooms at the station	★★		★		★★	★★			
Guiding paths for blind people	★★★				★★			★	★
Wheelchair spaces in the vehicle	★★★		★		★★★		★		

Figure 5.6: The types of motivations given to *not* give a policy more priority. The amount of stars indicate how often a certain argument is given: 1 star: <10% of motivations; 2 stars: 10-20% of motivations; 3 stars: >20% of motivations.

In figure 5.7 the types of motivations are shown that respondents gave when they did give a policy more priority. The amount of stars indicate the frequency of a given motivation. Two types of motivations are given most often.

First, most respondents chose a policy because they considered the status quo to be unacceptable on that point. Hence, the most cited arguments *for* and *against* the policies have to do with the perception of the underlying problem. Required effort or 'fairness' are cited way less often. That suggest a consensus on the need of accessibility policies, but disagreement on which problems are the most urgent.

Second, a lot of motivations to prioritise a policy can be summarized as: 'it helps PwD to use PT'. A related argument is that a policy increases the independence of PwD. That was most cited for wheelchair accessible vehicles. Both arguments were given by PwD and people without a disability.

Interestingly, the argument that a policy helps other travellers as well was not given as often. One might expect otherwise given the large amount of non-PwD that participated in the PVE. It indicates that people do not primarily select policies based on self-interest, but rather focus on the interests of the focus group, in this case PwD.

	Is a problem now / status quo is unacceptable	Helps PwD to use PT	Increases the indepence of PwD	Cost efficient solution	Feasible solution	Also a problem for non-PwD	Other travellers also benefit
More money to repair elevators	★★★	★★★	★				
Wheelchair accessible vehicles	★★★		★★★				★
Automatic check-in and check-out	★	★★★	★	★	★		★★
Training of personnel	★★★	★★★		★			
Accessible PT app	★★	★★★	★				★
Travel assistance	★★	★★★					
Restrooms at the station	★★	★★				★★	
Guiding paths for blind people	★★★		★	★			
Wheelchair spaces in the vehide	★★★	★★					

Figure 5.7: The types of motivations given to give a policy more priority. The amount of stars indicate how often a certain argument is given: 1 star: <10% of motivations; 2 stars: 10-20% of motivations; 3 stars: >20% of motivations.

5.5. Conclusion

A PVE was performed to investigate the preferences of citizens. The results were analysed quantitively, by means of a Latent Cluster Class Analysis (LCCA) and qualitatively by exploring the open-answer responses. The results are three folded.

First, the top priority of citizens is to spend more money to repair broken elevators. This is seen as

the most urgent issue, hindering the PT usage of PwD. The second measure that participant gave *(much) more priority* to is wheelchair accessible vehicles. Interestingly, these measures also required a lot of *effort* to be implemented. Participants still prioritised these issues *despite* the high costs. These results show that participants prefer long-term policies that enable most PwD to travel independently over short-term solutions that do not improve independence in the long term. A novel measure was identified to be possibly beneficial: automatic check-in and check-out. This is mostly relevant for people with a visual impairment, because for them it can be hard to find the check-in poles. But, the policy measure can also help people with cognitive impairments, people sensitivity to stimuli and travellers in general.

Second, the motivations of respondents showed that participants gave policies priority because of their perceived *necessity* and *effectiveness*. Necessity means that participants considered the status quo to be unacceptable. Effectiveness means that a policy measure could help PwD to use PT. In the PVE, respondents show altruistic and moral considerations. For example, PwD also gave priority to policies that do not directly benefit them. Surprisingly, the cost of a measure or the interest of another group than PwD was cited little as a reason to (not) choose a policy. The motivations were thus centred around necessity of a measure given the status quo and how effectively PwD will be helped.

Third, the LCCA showed that there is a subset of respondents for whom wheelchair accessible restrooms at the station are very important, even though this policy is not prioritised often by the participants in general. This group consists of relatively many PwD.

9 Conclusion

8 Discussion

7 PVE face validity

6 Policy preferences PwD

5 Policy preferences respondents

4 PVE design

3 Selection of relevant policies

2 Methodology

1 Introduction

(File:Piet Mondriaan Victory Boogie Woogie.jpg, 2023)

Policy preferences People with a disability

In this chapter, RQ 3 is answered: *How do the perceptions of the various subgroups of People with a Disability compare?* This is done in two main ways. First, the representativeness of PwD is discussed. Second, the elicited preferences in the choice task are presented for each disability type.

6.1. Representativeness

The representativeness of PwD is discussed. Descriptive statistics are used for this purpose. But first, four general comments have to be made.

First, the PVE survey was not fully accessible for people with visual impairments. This research took the existing PVE digital infrastructure that has accessibility level A (Ministry of General Affairs, 2025). Then, the accessibility was tested by PwD and improved. When the PVE was released, participants noted that it was not accessible yet. The software team of Populytics alleviated some issues. But, the information pop-up showing an in-depth description of each policy remained inaccessible for people using text to speech software. A comment on this was added. Professional testing is to be preferred, but that was not possible due to the limited scope of this research.

Second, by definition an online survey is not accessible for everyone. In particular, some PwD with cognitive impairments are not able to complete such survey. A spokesperson of a social organisation for PwD with multiple cognitive and physical disabilities (mental age sometimes only 2 years) stated that this survey is impossible to complete. Not all PwD are or can be consulted by a research like this. The only people that will complete this survey are those who have access to and know how to navigate the internet.

Third, it has to be noted that there are no policies directly aimed at people with hearing impairments. This was criticized by some members of this community. As outlined, the policies were selected after careful consultation with experts. Still, in hindsight it could be relevant to include a policy directly aimed at people with a hearing impairment.

Fourth, this research identified two separate subgroups of PwD that were not included in the initial survey. The PVE only had five PwD categories and an option *different, namely ...* Many respondents filled out this option so that two new subgroups were identified: people who are extra sensitive to stimuli and people who have trouble walking or have low energy levels in general. Because these options were not given in the initial PVE, the results might underestimate the amount of people with these types of disabilities.

The descriptive statistics of PwD are presented in table 6.1. The sample is not representative of the entire PwD population. However, 328 PwD in total completed the PVE survey. Thus the results can still provide valuable insights on the preferences of PwD.

The sample might be overrepresented by people with walking impairments. But, clear data on the occurrence of disabilities in the Netherlands lacks, so it is hard to conclude anything with certainty. It can be noted that 1 in 6 respondents has more than one disability. For some subgroups of PwD, this even is the majority. For example, almost all people with speaking impairments also have another disability. Most of them have a walking impairment as well, as presented in appendix H. This will impact the policy preferences of this subgroup.

Table 6.1: Disability descriptive statistics

	Singular disability	Multiple disabilities	**Total**
Walking	171	48	**219**
Standing / energy	7	14	**21**
Seeing	23	25	**48**
Hearing	34	29	**63**
Speaking	1	14	**15**
Cognitive abilities	11	18	**29**
Stimuli	12	11	**23**
Total	259	69	**328**

6.2. Policy preferences PwD

The elicited preferences per subgroup of PwD are discussed. Note that some people have multiple disabilities. In this case, their preferences are shown for each of the disabilities they indicated to face.

In figure 6.1 the preferences of people with difficulties walking, standing, low energy levels, seeing and hearing are presented. The first thing to note is that their preferences do not vary greatly. The biggest difference is the prioritisation of training for personnel. People who have difficulties standing or have low energy levels in general prioritise it 11 percentage points more than the general population. Moreover, all groups give all measures at least some extra priority. However, each group puts emphasis on other policies.

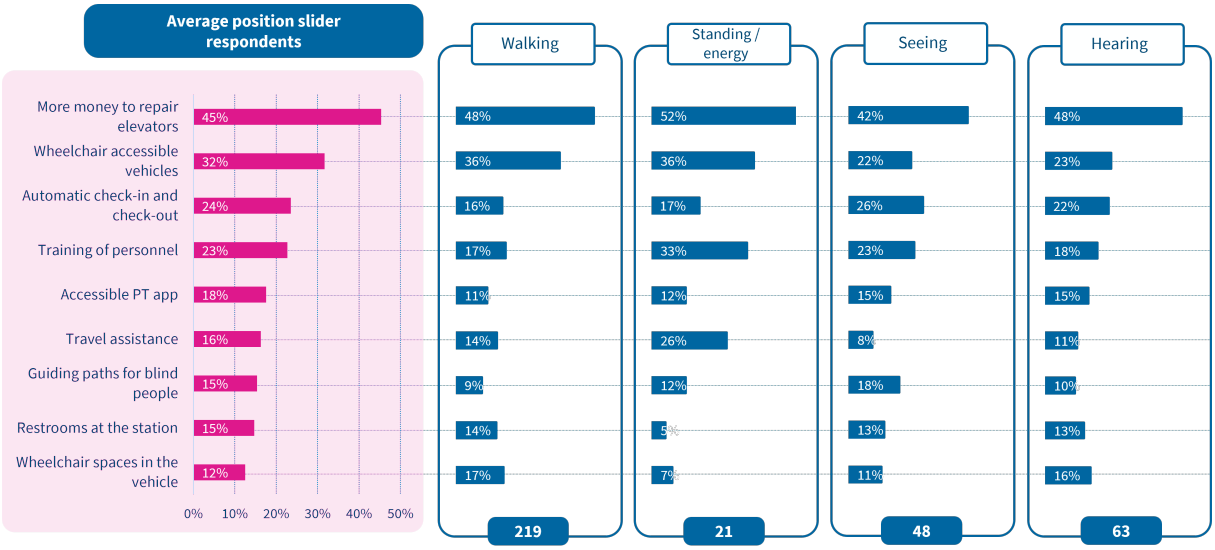


Figure 6.1: The elicited preferences in the choice task, broken down to disability type. On the left, the general preferences of citizens are shown. The bottom boxes indicate the amount of individuals that self identified to have this disability.

People that have difficulties walking give more priority to the repair of elevators, wheelchair accessible vehicles and wheelchair spaces in the vehicle. Consequently, all other measures get less priority. The choices are explainable, since the three more preferred measures directly benefit people with mobility impairments. Nevertheless, all measures get priority. Even measures that do not benefit this subgroup are chosen, such as guidance paths [1]. This shows a sense of altruism or moral considerations impact the

[1] An example motivation showing moral considerations, regarding guidance paths: ”That does matter because they cannot see the indicated changes and need more time to move to another place”
Two example motivations on automatic check-in and check-out: ”Seems convenient and is simple to solve. I am not visually

prioritisation of policies.

People that have difficulties standing or generally have low energy levels diverge from people with walking impairments on two points. They give way more priority to the training of personnel and travel assistance. This indicates that this group does benefits from assistance but does not necessarily feel heard by PT staff. Possibly this is due to the nature of their disability. It is easy to spot a person in a wheelchair, but it is difficult to recognize a person who has trouble standing for a prolonged period of time.

People that have difficulties seeing give more priority to automatic check-in and check-out and guiding paths for blind people. These two measures are tailored to people with vision impairments. The third policy identified as urgent for people with visual impairments is travel assistance. However, this gets significantly less priority from the target group than from the citizens in general. Moreover, more money to repair elevators still gets the most priority, far above the other measures. It proves that elevators are important for all people with a disability, not just people with mobility impairments. The chosen measures suggest that this subgroup prefers policies that improve their ability to travel independently.

People that have difficulty hearing prioritise elevators and wheelchair spaces more than the average respondent. All other measures were prioritised less, due to the high effort required of elevators.

In figure 6.2 the preferences of people with difficulties speaking, cognitive disabilities or difficulties coping with stimuli are presented. Additionally, the preferences of people who indicated to not have any disability are shown.

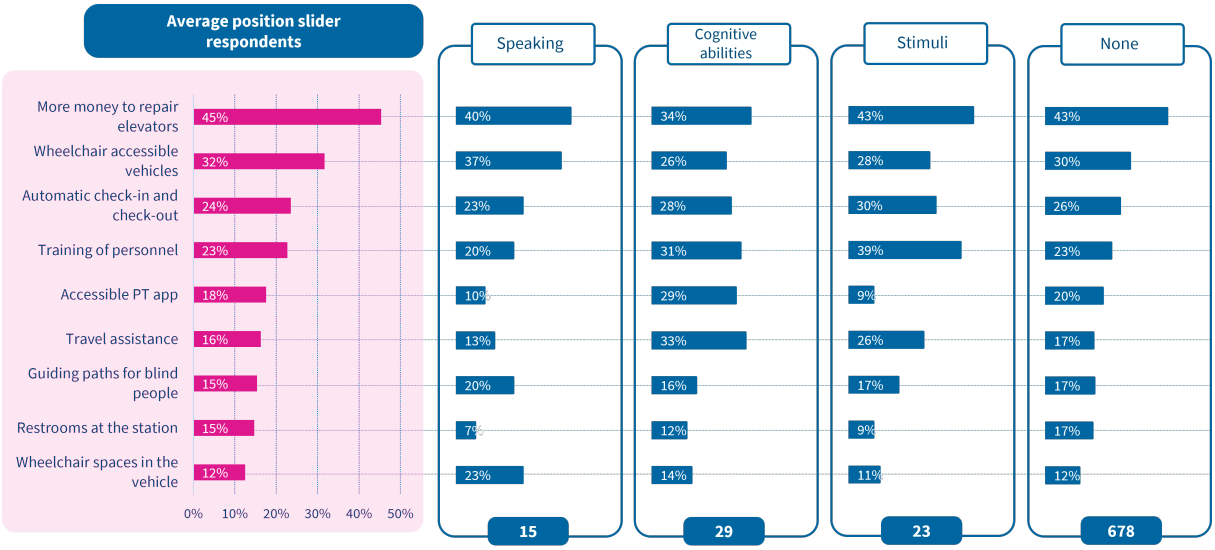


Figure 6.2: The elicited preferences in the choice task, broken down to disability type. On the left, the general preferences of citizens are shown. The bottom boxes indicate the amount of individuals that self identified to have this disability.

People with difficulty speaking prioritise elevators, wheelchair accessible vehicles, wheelchair spaces and guiding paths. An explanation for these choices is that many people with speaking difficulties had more than one disability. For example, some people have difficulties speaking and walking. The measures this group focused on are aimed to let PwD travel independently. The training of personnel or travel assistance was not prioritised more than average. But, wheelchair accessible vehicles and guiding paths was. Wheelchair spaces gets remarkably much priority compared to the other subgroups. This group might prefer the spaces reserved for wheelchairs to be empty, so that they do not have to 'speak up' to claim their spot.

People with reduced cognitive abilities make significantly different decisions than other subgroups. While elevators is still their top priority, they devote much effort to travel assistance and the training of

impaired but the first time, I also did not understand that you should not hold your pass against the display but just below it." "It is already quite a tour for visually impaired people to travel, so make it a bit easier for them."

personnel. It shows that this group, just like people with low energy levels, does not necessarily feel heard by PT staff. In the motivations, many respondents from this subgroup said that personnel did not show understanding of their condition when they asked to help. For example, one participant noted that a staff member said 'just look at the signs' when the participant asked for directions. Another policy measure that was prioritised relatively much by this group is a PT app. That suggests that the current apps are less suitable for people with cognitive impairments. A accessible PT app could provide directions as well as travel information.

People with difficulties coping with stimuli also prioritised the training of personnel and travel assistance. Sensory overload is relatively unknown. It might not be common knowledge that sometimes it is not helpful to have a sparkling conversations, since it might cost too much energy. This subgroup of PwD does indicate that a bigger presence of travel assistance is helpful in times of need. And, training could further prepare PT personnel to help people in an effective way.

6.3. Conclusion

The preferences of the subgroups of PwD are generally homogenous. For example, the repair of broken elevators is the top priority for all subgroups. However, three deviations have to be noted.

First, people with visual impairments give relatively much priority to automatic check-in and check-out and guiding paths for blind people. These two measures are tailored to this subgroup. The expert on visually impaired identified travel assistance as urgent too. However, this gets significantly less priority from the target group than from the citizens in general.

Second, people with cognitive impairments give relatively much priority to the training of personnel, travel assistance and an accessible PT app. This could mean three things. First, people with cognitive impairments may currently not be able to use PT independently. Second, this subgroup of PwD may not necessarily feel heard by PT staff. Third, an accessible PT app could help people with cognitive impairments to travel more independent.

Third, two additional subgroups of PwD gave more priority to the training of personnel and to travel assistance. This concerns people sensitive to stimuli and people who have difficulties standing or have low energy levels in general. Like people with cognitive impairments, this group may not always feel heard by PT staff. The elicited preferences imply two things. First, these groups could benefit from travel assistance. Second, the training of personnel could raise *awareness* about their needs.

9 Conclusion

8 Discussion

7 PVE face validity

6 Policy preferences PwD

5 Policy preferences respondents

4 PVE design

3 Selection of relevant policies

2 Methodology

1 Introduction

(File:Piet Mondriaan Victory Boogie Woogie.jpg, 2023)

PVE face validity

In this chapter, the face validity of the PVE is discussed to answer RQ4: *How do People with a Disability evaluate the validity of a PVE towards Public Transport accessibility policies?* This is done in three ways. First, the critiques respondents gave on the research are discussed. Second, the responses to the face validity statements are reviewed. Third, a brief comparison is provided between the responses in this PVE and the responses in previous PVE's.

7.1. Critiques of respondents

In this section the critiques of respondents are discussed. First, the average grade given to this PVE by respondents was a 6.94. The PVE survey gets a 'generous pass', meaning that most respondents were positive about the research. Naturally, some respondents were less positive. It is valuable to assert their critiques as to provide research directions for future studies. Four topics are touched upon that came up several times. First, the *effort* constraint is discussed. Second, the focus on policies for PwD is considered. Third, a short discussion is provided on what policies were *not* included. Fourth, the presence of people without a disability is debated. After the four discussions, a number of positive critiques are presented to supplement the general, positive, opinion of the respondents.

7.1.1. Effort constraint

First, a large number of people criticized the effort constraint. They argued that one should not have a constraint, for accessibility is a basic human right. The author of the study agrees with this argument. But, one has to acknowledge that it is improbable that enough money will be set aside for this goal. Thus, the necessity arises to prioritise one project over another (J. Park & Chowdhury, 2021).

A number of example critiques from this group:

> "I think everything is important what a ridiculous survey. The government should do much more for people with disabilities, there are two laws and a UN convention for this. Which is not complied with by the whole of the Netherlands. If someone steals something they are punished, but if it is not wheelchair accessible nothing happens. The wheelchair user is the victim of this and the perpetrators do not pursue these laws and a un convention. Where can we, wheelchair users point this out?"
>
> "But what struck me most is that the budget ran out so quickly. In short, the budget for accessible PT is far too low. All PT should be accessible without assistance. People should be self-governing as much as possible. These are standards of decency in a rich country like the Netherlands, you can't just leave people to their own devices, figure it out yourself if the lift doesn't work...."
>
> "The insinuation that we can only take a limited number of measures bothers me when we are handing out 46.4 billion euros a year to the fossil industry. Just imagine how freaking accessible we could make PT with that."
>
> "The way of prioritising, with a cap, is bizarre. Accessibility is not a choice, but a basic right."
>
> "There is always a financial constraint to it, but I am willing to pay more tax to make more possible. That option is never given in these kinds of consultations."

7.1.2. Focus on PwD

Second, a smaller group did not agree with the focus of the research on policies aimed to help PwD. They argued that accessibility for PwD is not important at all or less important than other problems society faces.

The author would argue that this frame is incorrect, for accessibility is a right by law. The government has the duty to improve accessibility. Moreover, substantiate moral arguments exist to care about PwD, even if you do not have a disability yourself (Rawls, 1999). Still, this group could form a barrier when implementing accessibility policies.

A number of example critiques from this group are presented. It has to be stated that the research does include the 'money factor', as outlined in section *4.2. Constraint variable*.

> "I find this survey and the questioning quite suggestive and guiding. One assumes a priori that you think accessibility should improve."
> "This research does not include the money factor. In principle, you can say that everything should be better equipped for disabled people, but that is not realistic. You can't exclude a small group of people, but not everything has to be equipped to perfection for them. Public transport organisations like NS have been making losses for years and taking measures for a small group only increases expenditure while hardly increasing revenue."
> "I absolutely do not want to spend more money on this issue. Accessibility is already amply covered. Besides, there are enough social tools like buddies who can help."
> "Every euro could be better spent on, for example, biodiversity and climate."

7.1.3. Excluded policies

Third, the scope of the research was debated, more specifically the absence of a number of accessibility policies. This study narrows its scope down to the journey between the beginning PT stop and ending PT stop, as explained in section 1.5. A number of people considered this scope to be too narrow.

Three policies were considered to be missing. First, this study does not include *more PT stops* as a policy measure. Numerous people criticized this point, because a lot of rural areas do not have sufficient PT at all. This is referred to as geographical exclusion in the TRSE framework (Bruno et al., 2024). Second, the scope does not consider *paratransit*, even though paratransit is important for PwD to travel. Third, participants considered the *price of PT* to bee too high to be used by PwD. All three policies were discussed with the experts, as summarized in section 3.3. Ultimately, they were either considered to be unrealistic, unchangeable or unfair. Hence, they were placed out of scope for this research.

A number of example critiques given by this group:

> "I do not travel by public transport in our region, public transport is not an option, there is a bus once an hour and it stops one kilometre from my home."
> "It is a pity that an important question which is important to many especially outside the Randstad was not asked namely whether people think there are enough stops / lines especially by bus, from my small town to the city centre is not too bad but the church villages are already often poorly connected to PT and the real hamlets is completely poverty trumps!"
> "No question was asked about Valys/regional transport (paratransit) while this is often a better way of travelling for people with disabilities. For me even currently the only possibility. I did expect that based on the invitation."
> "You don't ask at all WHY I don't travel by PT. It is because it is too expensive and, besides, inaccessible. I can think of very few scenarios where for me the car doesn't win out."

7.1.4. People with and without a disability

Fourth, the possibility of people without a disability participating in this research was debated. Interestingly, most people that commented on this point were the people without a disability themselves. They felt like they were not able to make proper judgements because they did not know enough about the subject. In section 5.4. about the motivations given by participants this was also seen. But, the argument was given relatively little. Moreover, it can still be valuable to include people without a disability in the target group to identify measures that might not have positive support from the broader population.

A number of example critiques given by this group:

> ”I have too little insight into this subject to know where the main bottlenecks are and so it is very difficult to determine where the priorities lie. For a topic like this, I think it is just right to approach a specific target group and approach people outside the target group in a different way because informing about it is important.”
> ”I don’t have a disability myself and therefore focused on options that can benefit most people with disabilities.”
> ”My opinion is less relevant than that of people with disabilities. Where I live, the nearest PT is far away and extremely inconvenient. Far and always changing trains.”

7.1.5. Positive critiques

Most respondents indicated that the PVE was valuable, both for them and for policymakers. Participants appreciated that the PVE was realistic, it showed that not all policies could be implemented. Moreover, some respondents against stressed the importance of the topic and stated that a PVE could be could be an addition, or even replacement, of the decision-making process.

Below, a number of short reflections are shown that participants gave:

> ”The sliders combined with the meter is a fine way of indicating interests, taking into account the maximum load on the PT operator.”
> ”Nice and interesting this method.”
> ”Repeat this after a certain period. World changes fast and it is always good to evaluate.”
> ”Although I myself am definitely not a frequent user of public transport in any form, I can remember from the sporadic times I did use it that public transport is not really equipped for disabled people in any form. I think it is very important that this is addressed and should be optimised in many/all areas.”
> ”It is nice that this study is being done, and if possible I would like to see the results.”
> ”Let it be a binding opinion without left-wing advisors”

7.2. Face validity statements

The answers to the five face validity statements are discussed. In table 7.1 and figure 7.1 the responses are shown.

In the first statement, The majority participants stated that they *were able to express their opinion*. 16% of respondents did not feel this way, for example because they did not like the constraint variable.

Second, the statement with the most positive response was *I think this is an important topic*. 75% Agrees or strongly agrees with this statement.

Third, only 6% of participants indicated that the PVE was *difficult to understand*. That is notable, since the majority of participants did not have a disability. Thus, it shows that this PVE was able to simplify the complex issue of accessibility enough so that citizens can give their opinion in a short amount of time.

Fourth, 67% of respondents believes that *this tool should be used more often to make policies about accessibility*. This does show that a wide majority of respondents believe that a PVE is a valid way to advise policymakers about accessibility. This does show that a wide majority of respondents believe that a PVE is a valid way to advise policymakers about accessibility.

Lastly, 44% indicated that they learned something about the choices that need to be made and about the topic.

Table 7.1: Responses to face validity statements (%)

Statement	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	Don't know / Prefer not to say	Total
I was able to express my opinion.	14%	46%	23%	12%	4%	1%	100%
I think this is an important topic.	30%	45%	19%	3%	1%	1%	100%
I found the material difficult to understand.	2%	3%	10%	36%	48%	0%	100%
This tool should be used more often.	22%	45%	25%	4%	2%	2%	100%
I learned something about the choices and the topic.	6%	38%	36%	14%	5%	2%	100%

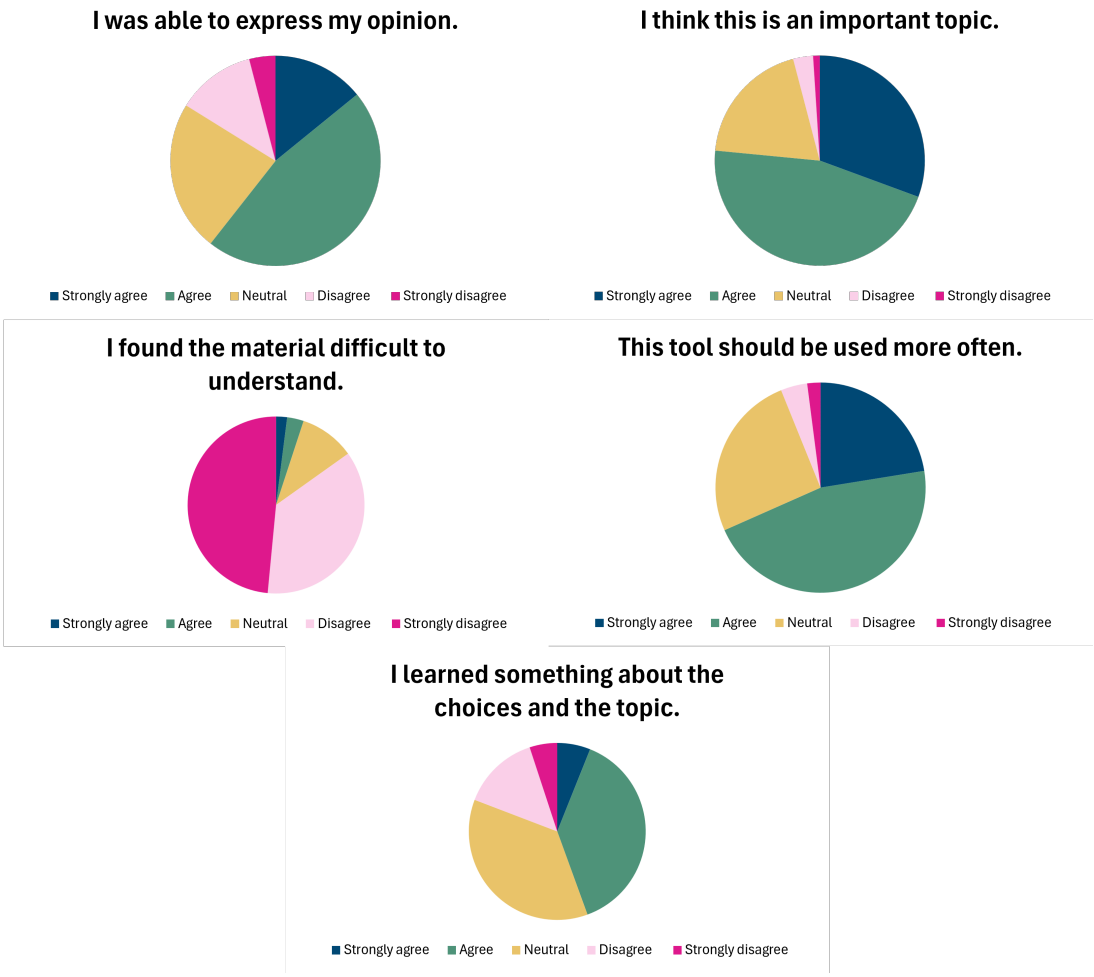


Figure 7.1: The face validity pie charts.

7.3. Comparison to other PVE's

In this section, the answers to the face validity statements are compared to previous PVE's. In table 7.2 the comparison is shown. All presented PVE's are about or relate to PT. There has not been a PVE yet specifically on accessibility for PwD.

The first statement was not asked in previous research, so it is hard to compare upon. A comparable statement was asked in the Schiphol PVE. Compared to that result, less participants in our study indicated to be able to express their opinion. The lower figure could be explained by the group of participants that did not agree with constraining the amount of effort that could be distributed amongst policies.

The second statement was asked. Participants responded more positive to these statements, so that one might conclude that the other themes are more important for people. Of course, it is hard to say anything with certainty. But it is intuitive to believe that PVE's on subjects that directly impact much of the population are ranked as more important than a PVE on a subject that directly impacts only a part of the population. Nevertheless, still 3 in 4 respondents indicated that the topic is important to them. Considering that 1 in 4 respondents did not indicate that the topic is important, it implies that accessibility might be less important for citizens in general than other PT goals, such as high-speed rail or environmental friendly transport.

The third statement show that this PVE was easiest to understand, compared to the other PT related PVE's. It shows that the complexity of accessible design was conveyed in an understandable matter.

The fourth statement ranked relatively low, albeit positive. A possible explanation is that a lot of social organisations exist whose job it is to advise local governments and PT operators about accessibility. Since the PVE was distributed amongst their members, the fear might exist that a PVE will replace this co-creation process. The author of this research stresses that the goal of this PVE is different. Namely, to provide additional insights to complement the current decision-making processes. The findings imply that a PVE should not be a *replacement* of the existing decision-making of accessible policies, but an *addition* to it.

The fifth statement was also ranked relatively low. It can mean two things. First, that a lot of respondents are already familiar with the accessibility of PT for PwD. For example because they are part of or know a member of a PwD representative organisation. The second explanation is that accessibility measures are intuitive to understand, also for people without a disability. This corresponds to the outcomes of statement 3.

Table 7.2: The share of respondents that (strongly) agreed with a statement for various PVE's (%)

Statement	**PT accessibility for PwD 2025**	**PVE VRA 2024**	**Mobility vision 2024**	**Amsterdam makes space 2024**	**Lelylijn 2023**	**Schiphol 2022**
I was able to express my opinion.	60%	-	-	-	-	70% [1]
I think this is an important topic.	75%	84%	89%	88%	85%	-
I found the material difficult to understand.	6%	30%	7%	32%	-	-
This tool should be used more often.	67%	78%	81%	81%	83%	71% [2]
I learned something about the choices and the topic.	44%	72%	57%	68%	69%	-

7.4. Conclusion

The participants were positive about the PVE and it's application. Nonetheless, some respondents criticized the PVE for constraining the number of policy measures that could be prioritised. However, it is unrealistic to assume that all measures necessary can be performed in the future (J. Park & Chowdhury, 2021). Hence, the need for trade-off's arises. Other respondents criticized the limited scope of the research. Further research could focus on the trade-off between accessibility policies and other PT policies, such as the presence of PT in rural areas, ticket prices and zero-emission vehicles.

Nevertheless, 1254 respondents, of which 328 PwD, were able to prioritise what they deemed most important. An overwhelming majority of respondents indicated that the PVE was understandable. A large majority marked the importance of the subject. Participants explained *why* they did (not) prioritise a certain policy, often using real-life examples. Hence, the results of the PVE could give an overview of all considerations and nuances relevant to the decision-making. Furthermore, a large majority recommended to use PVE's for future decision-making processes in the field of accessible PT for PwD.

To conclude, the results show that a PVE is able to simplify a complex issue such as accessibility enough to be understandable by the wider population in a short amount of time. The study shows that a PVE can be performed to accessibility policies and provide relevant insights for policymakers.

[1] Question asked in the research: "I felt I could give all my opinions on how citizens should be involved in decision-making about Schiphol and how information should be provided."

[2] Question asked in the research: "I think this research is a good way to give my opinion about the Schiphol Social Council and the Environmental House."

(File:Piet Mondriaan Victory Boogie Woogie.jpg, 2023)

Discussion

In this chapter a discussion is provided on the research. First, the remarkable findings of this study are discussed and positioned amongst the literature. Second, limitations are discussed and recommendations are made for future research.

8.1. Remarkable findings

8.1.1. Elevators

Repairing broken elevators was found to be the top priority to make PT more accessible for PwD. It was cited as crucial by all subgroups of PwD and by non-PwD, across socio-demographics and across different travel patterns.

Other studies also cited broken elevators as a barrier towards the use of PT. Stjernborg (2019) studied complaints regarding accessibility in Stockholm. Of all complaints, 35% relate to elevators/escalators being out of order, with the majority of these complaints being centred towards elevators (Stjernborg, 2019). Some travellers mention that elevators can be out of order for one or two months (Stjernborg, 2019). In this PVE, similar comments were written. Pyer & Tucker (2014) gave the example of an electric wheelchair user who did not want to use PT because he feared being stranded on a platform if elevators are not working.

However, our study stands out for identifying broken elevators as the top priority for PwD travellers. Literature studies Mwaka et al. (2024) and Unsworth et al. (2019) did not identify elevators as the main barrier of PT. Bezyak et al. (2017) found that 'only' 17% of respondents (consisting of PwD from various subgroups) encountered problems with elevators. The findings of our study imply that in the Netherlands, a much bigger group faces issues due to elevators being out of order.

8.1.2. Accessible vehicles and wheelchair spaces

The policy measure that respondents gave the second most priority is wheelchair accessible vehicles. All subgroups of PwD indicated that this is one of the most urgent policies. Only people with visual and hearing impairments prioritised it lower, albeit still relatively high.

Again, the importance of wheelchair accessible vehicles is in line with previous research. Bezyak et al. (2017) found that 20% of respondents experienced issues with the gap between the vehicle and the platform. Mwaka et al. (2024) and Pyer & Tucker (2014) even label inaccessible vehicles as the number one issue for PwD. As stated, this research does not go that far. Friman & Olsson (2023) find that travel autonomy impacts (perceived) accessibility. This argument was also given by participants to choose wheelchair accessible vehicles, as well as elevators. Almada & Renner (2015) stressed that making vehicles accessible is not just about providing assistive technology like ramps, but about including PwD in society without feeling a burden to other people. Several respondents of this PVE underlined this statement.

Of all policy measures included in the research, wheelchair spaces was labelled by citizens as being least urgent. Velho et al. (2016) on the other hand, found that the 'debate' with other passengers to claim the wheelchair space is the main social barrier for people with a physical disability. However, people with speaking impairments did prioritise wheelchair spaces significantly more than other subgroups of PwD. A big portion of this group had multiple types of disabilities, for example speaking *and* walking impairments. This is in line with findings from Bezyak et al. (2017), who found that people with communication disabilities also experienced issues related to wheelchair access. These findings support a case for intersectionality (Crenshaw, 1991) and an universal design approach (Mace, 1985).

8.1.3. Training of personnel and travel assistance

The training of personnel was suggested by the literature because many PwD had experienced negative attitudes from drivers towards them or encountered personnel who was unaware of their needs. J. Park & Chowdhury (2018) found that bus drivers attitudes and unawareness was a common barrier for both physically and visually impaired travellers. Bezyak et al. (2017) and Hidalgo et al. (2020) recommend training for drivers and other staff after having found similar results.

Our study did not identify the lack of training as the main barrier of PT, but participants did give it relatively much priority. Especially individuals with cognitive impairments, sensitivity to stimuli and people who had low energy levels prioritised the training of personnel. This is partially in contrast to findings from Bezyak et al. (2017). In that study, only people with visual impairments experience significantly more issues related to the lack of knowledge from drivers (Bezyak et al., 2017).

Travel assistances is a measure related to the training of personnel but was touched upon way less in the literature. A reason for this could be the nature of the Dutch PT sector. Almada & Renner (2015) for example, perform a case study in Brazil, where bus drivers are the only one's providing travel assistance. Risser et al. (2015) did discuss travel assistance and does underline the importance of physical human support. Interestingly, travel assistance was indicated as important for visually impaired by the expert on visually impaired but was not prioritised as significantly by this subgroup. Our study did identify travel assistance as an urgent issue for PwD in general, albeit less urgent than the training of personnel.

8.1.4. Accessible PT app

An accessible PT app is perceived mixed by the literature. The findings of this research reflect these diversities. Some participants would like a centralized app for all information regarding accessibility. For example, many people with a cognitive impairments prioritised this policy measure. This is in line with Hidalgo et al. (2020), who found that a mobile application can be beneficial for this subgroup of PwD. Others preferred the information to be integrated in existing apps instead. A third group of respondents noted that digital applications are not accessible for everyone, much in line with the research stating that personal support will remain a necessity (Risser et al., 2015; Durand, 2025). The experts that were consulted in this research named better communication, for example about broken elevators, a possibility for short term improvement. Both Hidalgo et al. (2020) and Edwards et al. (2001) support this statement, by saying that information about service status is crucial for PwD.

8.2. Limitations and future research directions

Five limitations of this research are discussed. For each limitation, research recommendations are given.

First, a number of participants of the PVE criticized the limited scope of the research. The concerns comes from two directions. Some did not agree with the framing that accessibility for PwD is important in the first place, arguing that other issues are more urgent. This group could form a barrier when implementing accessibility policies. Others felt like a number of policies were missing in the PVE: *more PT stops*, *paratransit* and *PT ticket price*. All three policies were discarded after consultation with experts, as summarized in section *3.3. Expert input*.

Therefore, the need arises for further research that differentiates itself from our study in two ways. First, it would have to base itself on a much broader scope that exceeds PwD accessibility policies alone. To be more specific, the coverage area of PT and the cost of PT are relevant for all travellers, so that the focus shifts towards accessibility policies in general [1]. Second, it is advisable to narrow down the geographical scope. Geographical exclusion and the quality of paratransit are both location specific. To research this on a national scale is undoable, if not irrelevant. Future research could apply the PVE method, a proven user-centric approach, to accessibility policies on a local level.

[1] Note that the author does not recommend to compare accessibility policies primarily with the PT ticket price. The provision of viable transport options for PwD is a responsibility of the entire society, not just PT users.

Second, critics might argue that the high prioritisation of elevators is due to the availability bias. The availability bias occurs when people base their opinions on recent experiences - or experiences they think happened recently - instead of actual statistics (Kahneman, 2011). In other words, if someone can clearly remember a recent event, that person might think that the event happens frequently, even though that is not necessarily the case. An example: people see the policy measure 'more money to repair *broken* elevators', they remember somebody talking about some elevator being broken, they conclude that elevators must be broken all the time. Hence, they give the policy measure elevators the maximum priority.

This research studies *perceived* accessibility, which is inherently distinct from *objective* accessibility (Moleman & Kroesen, 2024). Arguably, perceived accessibility is more important, since it determines peoples decision to travel by a certain mode, or to not travel at all. In a general study towards perceived accessibility, Friman et al. (2020) argued that functionality should be the main focus of PT operators. A large part of functionality is reliability (Friman et al., 2020). As stated, one of the main issues cited by participants was the unreliability of elevators.

Elevators was cited by all subgroups of PwD to be the most important measure. It has the highest amount of participants that motivated *why* they prioritised this measure. That cannot only be attributed to *perception*. The research indicates that the unreliability of elevators is an issue and should urgently be addressed. Therefore, future research could focus on how the objective and subjective reliability of elevators can be improved, for example via the prevention of vandalism or the increase of information sharing.

Third, the sample is not fully representative of the population, so the results were reweighted as to increase generalizability. The sample is overrepresented by males and highly educated people, while it is under-represented by people younger than 35 and people living in rural areas. Most respondents indicated that it was easy for them to make ends meet. The sample was reweighted on gender, age and education to make the results more generalizable. Having a disability is not considered as a variable to reweight on, because clear data lacks in the Netherlands on the frequency of disabilities. Because of this, the reweighted data might still be overrepresented by PwD. Comparably, people living in rural regions and people with a low income might still be under-represented in the reweighted results.

Future research could consult a greater number of people so that the results are more representative of the population. Alternatively, under-represented groups could be targeted in the spreading of the survey to obtain a representative sample.

Fourth, the PVE survey was not fully accessible for people with visual impairments. This research took the existing PVE digital infrastructure that has accessibility level A (Ministry of General Affairs, 2025). Then, the accessibility was tested by PwD and improved. Testing should ideally be performed by a designated institution. In this research, the limited scope did not make this feasible. The approach did allow for a 48 people with a visual impairment to participate, but did not prove to be failure proof. Future research should start with an accessible online tool that has an AAA level (Ministry of General Affairs, 2025) and then improve it from there. Additionally, surveys could be offered via calling or on paper.

Fifth, respondents self-identified as two novel subgroups of PwD that were not included in the initial design of the PVE. Therefore the real number of participants that fall into these groups might be underestimated. This concerns people who are extra sensitive to stimuli and people who have trouble walking or have low energy levels in general. This research suggest that these groups have distinct preferences and thus distinct needs. Further research could include these groups as separate categories of PwD. However, this research also found that a lot of PwD have multiple disabilities, suggesting the need for an integrated, intersectional approach. Hence, future research should view PwD as a heterogenous group with heterogenous needs, that can still benefit from the same policies, such as reliable elevators, or inclusive decision-making.

(File:Piet Mondriaan Victory Boogie Woogie.jpg, 2023)

Conclusion

A Participatory Value Evaluation (PVE) is performed in the Netherlands to identify the accessibility policies that people with a disability and citizens in general prefer. Participants were asked to prioritise policies they deemed beneficial for PwD. But, they could only distribute a limited amount of *effort*. Therefore they had to make trade-offs. In total, 1254 participants completed the policy trade-off in the PVE, of which 328 have a disability.

This chapters summarizes the main results by answering sub research questions 1 through 4, as well as the main research questions A and B. Next, the scientific relevance of our study is highlighted. To conclude, a set of practical recommendations are given.

9.1. Sub research questions

RQ1: What potential policies could make Public Transport more accessible for People with a Disability?

Relevant policies were identified by the means of three methods: a desk study, literature study and interviews with experts. From the literature, 57 possible measures were identified. The experts proposed 9 additional measures. After consultation with experts, 9 policy measures were selected based on urgency, feasibility and effectiveness in helping PwD. The measures can be categorized in four groups, as presented in table 9.1. Four measures were widely considered to be the most relevant: elevators, wheelchair accessible vehicles, physical human support and an accessible PT app.

First, elevators was discussed with all experts. Most stations have or are scheduled to have an elevator. On the other hand, *broken* elevators are considered to have a large influence on PwD travellers. The experts saw this as one of the biggest issues impacting accessibility.

Second, the importance of wheelchair accessible vehicles is frequently discussed in the literature, in one form or another. It encompass not only the vehicle itself, but also the station or stop. All experts addressed it and all identified it as relevant for PwD. However, the policy is the most costly and long-term of all proposed policies.

Third, multiple experts and scientific studies stressed the importance of physical human support, stating that the current travel assistance can and should be expanded. The impact of (in)adequate driver assistance is also discussed a lot in the literature. Originating from this issue, the additional measure *training of personnel* is included in the PVE.

Fourth, the literature recommended a route finding app multiple times. The experts explained that there are already numerous apps for travellers, but none of them provide the necessary information for PwD to plan their entire journey. Thus, an accessible PT app is proposed as a relevant policy measure.

Table 9.1: Policy measures to be included in the PVE

Category	Policy measure
Technology	Accessible PT app
	Automatic check-in and check-out
Personal support	Travel assistance
	Training of personnel
Vehicle	Wheelchair accessible vehicles
	Wheelchair spaces in the vehicle
Station	Elevators
	Guiding paths for blind people
	Restrooms at the station

RQ2: What policies do citizens prefer most with regard to the accessibility of Public Transport for People with a Disability?

A PVE was performed to investigate the preferences of citizens. The results were analysed quantitively, by means of a Latent Cluster Class Analysis (LCCA) and qualitatively by exploring the open-answer responses. The results are three folded.

First, the top priority of citizens is to spend more money to repair broken elevators. This is seen as the most urgent issue, hindering the PT usage of PwD. The second measure that many participant gave *(much) more priority* to is wheelchair accessible vehicles, as shown in figure 9.1. Interestingly, these measures also required a lot of *effort* to be implemented. Participants still prioritised these issues *despite* the high costs. These results show that participants prefer more expensive, long-term policies that facilitate independent travel for most PwD, over less expensive measures that do not improve independence in the long term. A third, novel, measure to get more priority was automatic check-in and check-out. Transdev (n.d.) offers this service already in buses in Brabant. This is mostly relevant for people with a visual impairment, but the policy measure can also help other PwD and travellers in general.

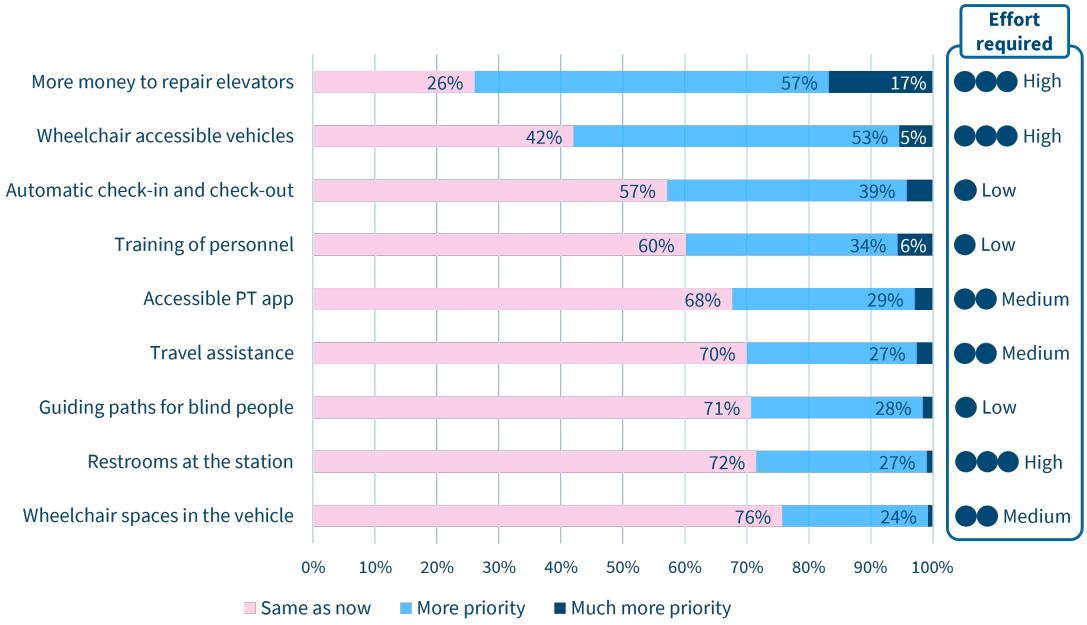


Figure 9.1: The elicited preferences of participants in the choice task. Participants could give a policy *more priority* and *much more priority*. *Same as now* is the default option, indicating that enough is done already regarding this policy.

Second, the motivations of respondents showed that the main reason for and the main reason against a policy is the perceived *necessity* of the policy. Necessity means that participants considered the status quo to be unacceptable. A much cited reason for a policy is the perceived *effectiveness*. In this PVE, respondents show altruistic and moral considerations. For example, some people without a disability tried to prioritise as many policies as possible. Surprisingly, the cost of a measure or the interest of another group than PwD was cited little as a reason to (not) choose a policy. The motivations were thus centred around necessity of a measure given the status quo and how effectively PwD will be helped.

Third, the LCCA showed that there is a subset of respondents for whom wheelchair accessible restrooms at the station are very important, even though this policy is not prioritised often by the participants in general. This group consists of relatively many PwD. The LCCA was performed to find heterogeneity among respondents, based on their elicited preferences and any significant personal characteristics. Note that the clusters are never black and white. Nevertheless, the clusters provide insights into the types of

answers people gave in the PVE survey. There were four clusters identified, as presented in figure 9.2.

Cluster 1, nicknamed *caregivers*, mostly gives priority to wheelchair accessible vehicles and broken elevators. Almost nobody of this cluster gave priority to wheelchair accessible toilets. The cluster consists of relatively few PwD, but relatively many people that know somebody with a disability. Furthermore, the cluster consists of relatively few older people.

Cluster 2, nicknamed *young travellers*, opted for elevators and not for wheelchair accessible vehicles. This cluster did not strive to make PT 'fully accessible'. Instead, it prioritised a set of measures that can quickly help PwD to use PT, such as reliable elevators, the training of personnel and automatic check-in and check-out. This cluster consists of relatively many PwD, frequent PT users and young people.

Cluster 3, nicknamed *altruistic unfamiliar* did not dedicate effort to elevators. Instead, they distributed it relatively evenly over all other policies. They think it is important that all issues are addressed. The cluster consists of many sporadic PT users and relatively many older people, males and people with a low education. It consists of less PwD than clusters 2 and 4, but more than cluster 1.

Cluster 4, nicknamed *older urbanites* choose three policies predominantly: the repair of elevators, wheelchair accessible vehicles and restrooms at the stations. It has many frequent PT users and PwD. Most are older people and most live in a big city. There are relatively few young people in this group. When contrasting cluster 4 to cluster 1, one can see that PwD that opt for wheelchair accessible vehicles, often opt for wheelchair accessible restrooms as well.

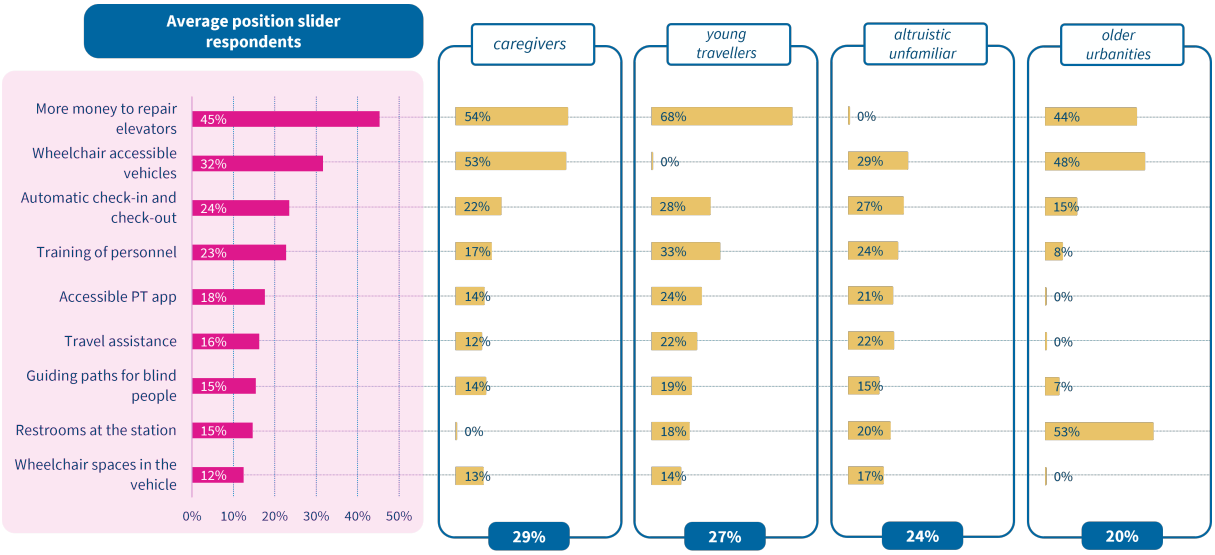


Figure 9.2: The elicited preferences of the four clusters with their respective cluster sizes.

RQ3: How do the perceptions of the various subgroups of People with a Disability compare?

The preferences of the subgroups of PwD are generally homogenous. For example, the repair of broken elevators is the top priority for all subgroups. However, three deviations have to be noted.

First, people with visual impairments give relatively much priority to automatic check-in and check-out and guiding paths for blind people. These two measures are tailored to this subgroup. The expert on visually impaired identified travel assistance as urgent too. However, this gets significantly less priority from the target group than from the citizens in general.

Second, people with cognitive impairments give relatively much priority to the training of personnel, travel assistance and an accessible PT app. This could mean three things. First, people with cognitive impairments may currently not be able to use PT independently. Second, this subgroup of PwD may not necessarily feel heard by PT staff. Third, an accessible PT app could help people with cognitive impairments to travel more independent.

Third, two additional subgroups of PwD gave more priority to the training of personnel and to travel assistance. This concerns people sensitive to stimuli and people who have difficulties standing or have low energy levels in general. Like people with cognitive impairments, this group may not always feel heard by PT staff. The elicited preferences imply two things. First, these groups could benefit from travel assistance. Second, the training of personnel could raise *awareness* about their needs.

RQ4: How do People with a Disability evaluate the validity of a PVE towards Public Transport accessibility policies?

The participants were positive about the PVE and it's application. Nonetheless, some respondents criticized the PVE for constraining the number of policy measures that could be prioritised. However, it is unrealistic to assume that all measures necessary can be performed in the future (J. Park & Chowdhury, 2021). Hence, the need for trade-off's arises. Other respondents criticized the limited scope of the research. Further research could focus on the trade-off between accessibility policies and other PT policies, such as the presence of PT in rural areas, ticket prices and zero-emission vehicles.

Nevertheless, 1254 respondents, of which 328 PwD, were able to prioritise what they deemed most important. An overwhelming majority of respondents indicated that the PVE was understandable. A large majority marked the importance of the subject. Participants explained *why* they did (not) prioritise a certain policy, often using real-life examples. Hence, the results of the PVE could give an overview of all considerations and nuances relevant to the decision-making. Furthermore, a large majority recommended to use PVE's for future decision-making processes in the field of accessible PT for PwD.

To conclude, the results show that a PVE is able to simplify a complex issue such as accessibility enough to be understandable by the wider population in a short amount of time. The study shows that a PVE can be performed to accessibility policies and provide relevant insights for policymakers.

9.2. Main research questions

A. What policies do PwD and citizens in general prefer most with regard to the accessibility of Public Transport for People with a Disability?

Most effort has to be devoted to the repair of broken elevators. All subgroups of PwD, as well as citizens in general prioritised this policy most. Similarly, wheelchair accessible vehicles is considered important. Participants prioritised these policy measures *despite* the high costs, indicating that the government and PT operators should focus on long-term policies that enable most PwD to travel *independently*.

However, some subgroups of PwD also prioritised the training of personnel and travel assistance, two short-term measures that enable *dependent* PT usage. These subgroups are people with cognitive impairments, people sensitive to stimuli and people who have difficulties standing or have low energy levels in general. For them, physical assistance remains a necessity.

A novel measure was identified to be possibly beneficial: automatic check-in and check-out. This is mostly relevant for people with a visual impairment. But, the policy measure can also help people with cognitive impairments, people sensitivity to stimuli and travellers in general.

B. How adequate is a PVE for determining the preferred policies of different subgroups of People with a Disability on Public Transport accessibility?

This study showed that a PVE can be a valuable tool to identify the preferences of both PwD and citizens in general. It allowed for large response rates. Moreover, participants could explain *why* they prioritised a measure, which provided relevant information for policy-makers.

The face validity results reveal two factors in favour of a PVE. First, it showed that this PVE about accessibility was understandable by the wider population. Second, it showed that a large majority of respondents supported the use of PVEs for future decision-making processes, in the field of accessible PT for PwD.

9.3. Scientific relevance

Five unique contributions to the literature are identified.

First, our study is the first to apply a PVE to the field of accessibility. The study found five advantages of using a PVE. First, a PVE is able to accommodate large sample sizes, which can increase its practical usefulness (Kapsalis et al., 2022). Second, a PVE can also reach members of the PwD community. One remark that has to be made is that the PVE should be tested for is compatibility with text-to-speech software beforehand. Third, the results showed that the PVE was easy to understand for participants. This suggests that a complex issue such as accessibility can be simplified enough to be understandable in the timespan of a PVE survey. Fourth, respondents could prioritise what they deemed most important, under scarcity. J. Park & Chowdhury (2021) argued that this scarcity is the major factor that not all accessibility policies necessary are executed. A PVE could therefore help policy-makers to determine what policies are most urgent. Fifth, participants could explain *why* they prioritised a certain policy. Hence, a PVE can sketch a picture of all considerations and nuances relevant to the decision-making (Mouter et al., 2021).

Second, the study found that participants mostly prioritised policies for one of two reasons. For one, because they considered the status quo to be unacceptable Or, because they believed that a policy measure could help PwD to use PT. People show altruistic or moral considerations. For example, the different subgroups of PwD also select policies that do not benefit them directly. This is in line with previous findings in other fields (Mouter et al., 2021). Surprisingly, cost of a measure or the interest of another group than PwD was cited little as a reason to (not) choose a policy. The motivations were thus centred around *necessity* and *effectiveness*.

Third, our study stands out for identifying broken elevators as the top priority for PwD travellers. Literature studies Mwaka et al. (2024) and Unsworth et al. (2019) did not identify elevators as the main barrier of PT. Bezyak et al. (2017) found that 'only' 17% of respondents (consisting of PwD from various subgroups) encountered problems with elevators. The findings of our study imply that in the Netherlands, a much bigger group faces issues due to elevators being out of order.

Fourth, the study applied an user-perspective approach to the preferences of people with a cognitive disability. Risser et al. (2015) stressed the need for such a user-centred approach. The results show that people with a cognitive impairment prioritise travel assistance and training, in line with Risser et al. (2015) and Hidalgo et al. (2020) and a PT app, in line with Hidalgo et al. (2020). But, this subgroup also values elevators, which was not found by previous research before.

Fifth, our study identified two separate subgroups of PwD that comparable research did not identify yet. Participants self-identified as people who are extra sensitive to stimuli and people who have trouble walking or have low energy levels in general. The results show that these subgroups have distinct preferences, so it is probable that they have distinct needs and experiences as well. Additionally, this research found that many PwD had more than one disability.

9.4. Practical recommendations

The study reveals relevant information for policymakers and PT operators. This section highlights the most important recommendations for practice:

The repair of broken elevators was as a top priority for PwD and citizens in general. All subgroups of PwD expressed that reliable elevators are the most urgent measure, *despite* its high cost. Additionally, elevators are important for parents with strollers, elderly and travellers carrying luggage. The main way to increase the uptime of elevators is to spend more money on maintenance contracts. Additionally, preventing vandalism could be effective.

Wheelchair accessible vehicles are the second most urgent measure. Many respondents rather prioritised this policy than prioritising multiple, less expensive policies. Based on these findings, policymakers are urged to accelerate the transition towards fully accessible vehicles, platforms and stops.

Automatic check-in and check-out is a promising innovation that can make it easier and quicker for PwD to use PT, especially for people with a visual impairment. Transdev (n.d.) offers this service already in all buses in Brabant.

Physical support by experienced personnel remains a necessity for certain subgroups of PwD. Thus it is advised to provide travel assistance in PT and to provide training for staff in supporting PwD, especially people with lesser known disabilities.

Restrooms at the stations are not the highest priority for many respondents. But, a subset of participants attached great value to this measure, indicating that accessible toilets are crucial for some travellers, with and without a disability.

Lastly, this research showed that a **PVE** is able to identify the preferences of both PwD and citizens in general. Thereby a PVE helps policymakers to determine what accessibility policies are most urgent. The method can be used to complement the existing co-creation processes of accessibility policy.

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Appendix A

Desk research

In this section, a number of relevant regulations are touched upon. The author of this thesis is no law expert, so that mostly general observations and comments will be made. Nevertheless, the policies outlined give an insightful overview of what is done currently and what goals are set.

It is important to note that in the Netherlands, the PT system is governed by a multitude of public bodies, ranging from the Ministry of Transport and Water, the provinces, the different Traffic regions (Vervoerregio's) and to some extent the municipalities. This makes for a patchwork of rules, regulations, guidelines, goals, definitions and above all, exemptions. Given the limited scope of the research, it is impossible to address all nuances of the Dutch Public Transport governance framework regarding accessibility for People with a Disability. For an in-depth review of the governance framework of accessibility in one specific region, the Traffic region of Amsterdam (VRA), the author gratefully refers to Bruno (2024). This desk research of this thesis will focus on rough guidelines and goals set for the Dutch PT network as a whole.

In this regard, two policy documents are outlined more thoroughly. First, the Decision Accessible PT (Besluit toegankelijkheid van het openbaar vervoer - BWBR0029974), that was signed back in 2011. In addition, a proposed change (IENW/BSK-2023/143680) is discussed. This change is set to be implemented on the 28th of June 2025, later this year at the time of writing. The proposed change of the regulation is based on the European Accessibility Act (EU 2019/882). Second, the Governance agreement (Bestuursakkoord Toegankelijkheid Openbaar Vervoer 2022-2032) is discussed. This agreement is not a binding law, but rather a declaration of intent signed by all relevant governmental agencies and PT companies.

A.1. Decision Accessible PT (Besluit toegankelijkheid van het openbaar vervoer)

The first policy document to be discussed is the Decision Accessible PT (Besluit toegankelijkheid van het openbaar vervoer - BWBR0029974). The first version dates back to 2011. Over the years, it has been modified two times, mostly regarding the definition of concession owners and consumers. A modification that is set to be implemented at the time of writing, is focused on digital accessibility (IENW/BSK-2023/143680). As said, this proposed modification originates from the European Accessibility Act (EU 2019/882). First, a number of key articles are highlighted. Second, the proposed changes are discussed further. Third, the impact of the policies is discussed, as well as some general thoughts on the success of the regulation overall thus far.

First things first, a number of key articles are highlighted. Note that the articles will be highlighted in English, while the regulation is in Dutch. The author recommends its readers to read the original law articles in Dutch.

Article 2, paragraph 1, states that all modification have the goal to make PT accessible on a level that PwD who can participate in society independently and can make themselves known to others, can use PT unhindered. The goal is clearly not that all PwD are able to travel independently. The goal is that a large part of the PwD population, who are able to participate mostly independent in other parts of society, are able to use PT in the easiest way possible.

Article 4, paragraph 1, discusses specific design aspects of the vehicles. Namely, vehicles must allow or provide: grade-level boarding, extended door-opening for passengers with disabilities, user-friendly controls of vehicles (think of open door push buttons), accessible seating and spaces for mobility aids,

adequate manoeuvre space, and sufficiently safe seating, handrails, and supports. Paragraph 2 states that if a vehicle is equipped with a toilet, at least one toilet needs to be accessible. Additionally, the toilet needs to be reachable for PwD thought the means of visual signs and wheelchair paths.

Article 5, paragraph 1, talks about the need of the platform to ensure grade-level access to the vehicle, to provide guidance paths and to ensure unhindered access paths. Paragraph 2 states that facilities at stations or stops, namely ticket counters or machines, facilities providing travel information and service, waiting rooms and sanitary facilities, needs to accessible. Paragraph 3 stresses that stops need to be accessible from the public road network, also for people with a mobility device. Paragraph 4 states that exemptions can be made upon paragraphs 1 and 2 for the sake of space limitations of the stop or station.

Article 6, paragraph 1, states that facilities in stops or stations relating to the purchase of PT tickets, travel information, platform information or service provision, need to be accessible for people with a mobility device and people with a visual or hearing impairment. Paragraph 2 states that counters, doors, seats, handrails, and grips need to be comfortable and safe to use for PwD. Paragraph 3 stresses that guidance towards the facilities highlighted in article 5 paragraph 2, towards connection PT and taxi services, need to be provided in the form of guidance paths. Paragraph 4 is interesting, stating that physical assistance needs to be provided at a train station in case grade-level boarding cannot be provided. In other words, if grade-level boarding is provided, physical assistance is not mandatory to provide.

Articles 8 through 10 specify that travel information, both general travel information and travel information relating to the accessibility of a journey for PwD, needs to be accessible online, in the vehicle and at the station, for PwD.

Article 17 is the most notable, for it states the timeline for the measures to be implemented. In paragraph 1 it is stated that all new, renewed and improved vehicles, stops, stations and travel information needs to be accessible as specified by articles 4 through 10. Paragraph 2 states when all vehicles, stops, stations and travel information needs to be accessible as specified by articles 4 through 10:

a. Starting from July 1, 2011, insofar as it concerns buses and metros;
b. Starting from January 1, 2020, insofar as it concerns trams;
c. Starting from January 1, 2030, insofar as it concerns trains;
d. Starting from January 1, 2016, insofar as it concerns stops or stations for buses;
e. Starting from January 1, 2015, insofar as it concerns stops or stations for metros;
f. Starting from January 1, 2020, insofar as it concerns stops or stations for trams;
g. Starting from January 1, 2020, insofar as it concerns stops or stations for trains;
h. Starting from January 1, 2015, insofar as it concerns travel information.

As of 2025, none of the objectives have been fully met.

Second, the proposed changes that will go into effect 28 June, later this year at the time of writing. The changes are focused on digital accessibility.

Article 10b, section 1e states that the law applies to interactive terminals that are operated by the passenger themselves, expect for terminals that are integrated in the rolling stock itself. Paragraph stresses that section 1e is applicable to not only train services, but also urban and suburban and regional transport operators.

Appendix 1, paragraph 3, explains that the above mentioned operating systems must be accessible, in the sense that, inter alia, the information is provided through more than one human sense, is understandable for the user and is presented in a way that is noticeable by the user. Paragraph 3 states also that operators must try to provide information about: the accessibility of bus and train, the built environment in and surrounding the station and the availability of travel assistance. Lastly, paragraph 3 states that operators must provide information about smart ticketsystems, such as electronic reservations and ticket booking, realtime travel information, such as timetables, malfunctions and connections, as well as

additional travel information, such as personnel deployment at stations, elevators that are not functioning or temporarily out of order services.

Article 10f, paragraph 1, discusses when changes have to be made: in case there are no fundamental changes needed to the services and in case there is no unproportional burden to the operator.

Appendix 1, paragraph 2 explains these notions further. Whether a change to the service is fundamental or not can be decided by the operator. Whether a change to the service makes for an unproportional burden to the operator is decided upon with the help of the following criteria. First, the costs must be proportional to the operating costs of the serviced. Second, the costs must be proportional to the benefits, namely how many PwD will be able to use the service as a consequence of the changes implemented. Third, the costs must be proportional to the net profits of the operator.

Third, a short reflection is provided on the impacts of the regulation thus far. The first thing to be noted is that the original document provides for a binding framework towards accessibility. The second thing to be noted is that this binding framework did not lead to an improvement of the network within the set deadline.

Train stations needed to be accessible by 2020. Today, it is projected that all stations have a elevator or ramp by 2030. Not to speak about the recurring maintenance need regarding platform height. Travel assistance is indicated as one way to improve the accessibility of PwD, in case the platform is inaccessible. However, travel assistance is needed for several PwD subgroups, even if the platform is accessible. The regulation does not provide travel assistance for these subgroups of PwD. The regulation sets to allow unhindered access for PwD who normally can participate in society independently and can make themselves known to others. The author would argue that this goal is not yet met.

This failure of the regulation raises the question whether the proposed changes will have their desired effect. The proposed changes can improve the transit experience, especially for people with a visual impairment and people who have difficulties with digital devices.

A.2. Governance agreement Accessible PT (Bestuursakkoord Toegankelijkheid Openbaar Vervoer 2022-2032)

The second policy document to be discussed is the Governance agreement Accessible PT (Bestuursakkoord Toegankelijkheid Openbaar Vervoer 2022-2032). This document is signed by the Minister of Infrastructure and Water, all Deputies of the 12 Provinces and the MRDH and VRA, hereafter referred to as decentral PT authorities, the PT concession owners, namely NS, RET, GVB, HTM, Transdev, Arriva, Keolis, Qbuzz and EBS and lastly by ProRail. A number of highlights in the document are discussed step by step. To conclude, a brief reflection is given.

Article 1 sets the goal of the agreement. The parties who signed the agreement, hereafter referred to as the Parties, must try to maintain the same level of accessibility and must try to increase accessibility, so that as many people as possible can use PT. The agreement sets to make PT barrierless in 2040, but wants most measures to be implemented by 2032, the end date of the scope of the document.

Article 2 sets the scope of the agreement. Paragraph 2 states that any agreement shall only be executed if the agreement is feasible. Considering the principle of proportionality all the parties will test a measure regarding feasibility and safety. Paragraph 3 states that the parties have to explain any nonfulfillment to (representatives) of PwD.

Article 3 states that the Parties will gather on a regular basis to discuss concession transcending matters regarding accessibility.

Article 4 states that the Ministry and decentral PT authorities will implement the agreements made in their concessions, preferably so that its impacts are measurable. Moreover, the financial impacts of articles 9 (Accessible bus, tram and metro stops), 12 (Accessibility of toilets in trains) and 17 (Travel assistance) are researched by the Ministry and PT authorities.

Article 5 encourages consumer organisations and (representatives of) PwD to join national and local consultation groups for PT.

Article 6, paragraph 2 states that travel information has to provided in language level B1. Paragraph 4 states that the Parties must try to improve travel information about accessibility facilities and interoperability of data, so that this information can be incorporate into apps and other travel information applications. Paragraph 5 states that travel information should be provided in through more than one sense.

Article 9 talks about the accessibility of bus, tram and metro stops. Paragraph 1 states that the Ministry will try to implement clear minimum requirements for new or renewed stops, based on Article 5 of the Decision Accessible PT. Paragraph 3 states that the Ministry will not make regulation on when stops that are not accessible or have been made accessible have to fulfil the requirements as outlined in paragraph 1. Decentral PT authorities will encourage concession owners to comply with these requirements. Paragraph 6 states that the Ministry will encourage the Parties to comply with the requirements as set out in paragraph 1 by collection and distributing positive examples and simulating knowledge exchange.

Article 10 talks about the accessibility of PT interchange points and the public spaces around PT. Paragraph 1 states that ProRail talks with decentral PT authorities in case changes are made to PT interchange points, as to make accessibility measures of the train attach to the accessibility measures of bus, tram or metro and to, if applicable, shared mobility in the vicinity of the station. Paragraph 2 states that if the Ministry or decentral PT authorities are involved in the construction of a new PT interchange point, they will try to integrate the accessibility measures.

Article 11 talks about the accessibility of toilets at stations for visually impaired. In all stations with a toilet, ProRail will provide at least one toilet that is findable for people with a visual impairment, before the end of 2025. NS will test the accessibility of payment processes for toilets, together with the Oogvereniging. Well done Peter.

Article 12 talks about the accessibility of toilets in trains. Paragraph 1 states that all new trains shall have an accessible toilet. Paragraph 2 states that research will be conducted towards equipping older trains that have big maintenance with accessible toilets. Paragraph 4 states that temporary replacement trains shall have a toilet if possible.

Article 13 talks about the accessibility of busses. The Parties, except for ProRail, research if busses can be modified such that, travellers with mobility tools (such as scooters, rollators) that are currently unable to use busses, are able to use busses safely in the future.

Article 14 talks about the removal and malfunctioning of essential facilities that are exclusively serving accessibility. In other words, Article 14 talks about elevators. Paragraph 2 states that the Parties have to try to restore facilities that are unable to be used, with priority and with an eye for the customer, within a reasonable time. Paragraph 3 talks about the duties of different Parties regarding the communication of the (non)functioning of essential facilities, as well as the communication of the time that is expected to restore the facility. Paragraph 4 states that if the removal or malfunctioning of an essential facility makes that a traveller is unable to complete their journey, in case the traveller could not have known beforehand that the facility was unable to be used, replacement travel has to be arranged for the traveller.

Article 15 talks about the attitude of PT personnel towards PwD. Paragraph 1 states that guidelines should be included in the concession agreements on how personnel should deal with PwD. Paragraph 3 states that decentral PT authorities should specify in their concession agreements how an appropriate attitude is achieved and how it can be improved if necessary.

Article 17 talks about travel assistance. Paragraph 1 defines travel assistance at train stations:

a. Offering assistance to PwD for entering and exiting the vehicle;
b. Accompanying PwD through the train station: either to the train or to the exit of the train station;
c. Guide the travel of the PwD in case of disruptions that have an impact on the booked travel assistance.

Paragraph 2 states that PwD have to request travel assistance at most 1 hour before the start of the journey and states that travel assistance shall be provided each day of the week, from the first to the last train. Paragraph 3 states that concession owners shall provide travel assistance on train stations, independent if they support grade level boarding for passengers. Paragraph 4 states that the Ministry has

the intention to integrate this as a n obligation in law. Paragraph 6 states that the Ministry researches the need for travel assistance at PT interchange points.

Article 18, paragraph 1 states that the Ministry will conduct research to paratransit services, namely where they drive, what the facilitators and barriers are and what alternative solutions could alleviate these barriers.

Article 23 states that all Parties can withdraw from this agreement within a period of one year after notification.

To conclude, a brief reflection is given on the agreement. First, some comments are made about the nature of the agreement. Secondly, a number of agreed upon issues are reflected upon in a brief matter.

To start with the last but indeed not least important Article that was discussed, namely Article 23: any party can withdraw from the agreement. It is not binding. Compared to the Decision Accessible PT that was discussed earlier, this agreement does not have a strong legal basis. That means, that if the agreement is enforced in a way that might harm the economic situation of any of the Parties, a Party might resign from the agreement entirely. In a way, Article 23 explains the existence of Article 2. Article 2 states that any changes made should be feasible for the Parties, considering the principle of proportionality. In other words, if accessibility costs too much money, it is not necessary.

Next, a number of issues are reflected upon briefly. The positive thing is that Articles 10, 11 and 12 provide a clear basis for improvement regarding guidance lines at interchange points and toilets. Article 14 stresses the need for information exchange regarding the functioning of elevators. But, at a number of places the regulation stays in the dark. Article 14 mentions that the repairment of elevators should get priority. But it does not define a clear timeline on when an elevator should be up and running after malfunction. Article 17 promotes research to travel assistance between different modalities. But it does not talk about travel assistance in bus, tram or metro networks.

A.3. Conclusion

Two policy documents have been highlighted more in-depth.

The Decision Accessible PT (Besluit toegankelijkheid van het openbaar vervoer) is a binding document, dating back to 2011. Unfortunately, its set goals have not been met so far. Additionally, there are some gaps, notably regarding travel assistance in cases where grade level boarding is possible and regarding the operability of digital devices for PwD. The latter point is covered by new legislation that will go into effect on the 28 of June, later this year at the time of writing. However, considering that the goals of the initial regulations have not been met, the question arises whether the new legislation will succeed.

The Governance agreement Accessible PT (Bestuursakkoord Toegankelijkheid Openbaar Vervoer 2022-2032) is a non binding document, dating back to 2022. Due to the nature of the document, no hard criteria are given as to improve accessibility. The document uses the principle of proportionality often. That means that one should try to improve accessibility, but only if the burden is low enough. Nevertheless, the document provides guidelines on otherwise untouched issues, such as information exchange on the functioning of elevators and travel assistance, even if grade level boarding is possible. Unfortunately, the non binding nature restricts hard guidelines or regulation, for example, regarding travel assistance between modalities or travel assistance in bus, tram or metro networks.

Appendix B

Literature research

From the literature, 57 measures were identified. In principle, the measures are ranked according to the number of times it is mentioned. Sometimes an exception is made, if two or more measures are overlapping or comparable. In table B.1 the full list of policy measures is given. The measures mentioned by J. Park et al. (2020) are not included in the overview, since their measures are directly derived from J. Park & Chowdhury (2018).

Table B.1: Measures to improve the accessibility of PT as identified by the literature

Category	Point	Measure	Mentioned by
Technology	1.1	Route-finding app for PwD	Bezyak et al. (2017); Carmien et al. (2005); Hidalgo et al. (2020); Sze & Christensen (2017)
	1.2	Digital travel assistant (either human operated or digital)	Carmien et al. (2005); Doukas et al. (2010); Risser et al. (2015)
Personal support	2.1	Driver assistance (e.g. ramp use, stopping close, etiquette)	Almada & Renner (2015); Bezyak et al. (2017); Carlsson (2004); Casey et al. (2013); Hidalgo et al. (2020); Hine & Mitchell (2001); Martens et al. (2019); J. Park & Chowdhury (2018); Putranto & Putri (2018); Remillard et al. (2021); Risser et al. (2015); Stjernborg (2019); Unsworth et al. (2019); Velho et al. (2016); Wayland et al. (2020)
	2.2	Physical human support	Doukas et al. (2010); Risser et al. (2015); Stjernborg (2019)
	2.3	Assistance on demand, on short notice	Remillard et al. (2021)
	2.4	Education of other passengers	Velho et al. (2016); Wayland et al. (2020) [1]
Information	3.1	Info on timetables, accessible vehicles	Bezyak et al. (2017); Carlsson (2004); Hidalgo et al. (2020); Hine & Mitchell (2001); J. Park & Chowdhury (2018); Risser et al. (2015); Stjernborg (2019); Verbich & El-Geneidy (2016)
	3.2	Readable and correct information signs	Carlsson (2004); Casey et al. (2013); J. Park & Chowdhury (2018); Stjernborg (2019); Sze & Christensen (2017); Unsworth et al. (2019)

Continued on next page

[1] Velho et al. (2016) state that other passengers can express unsocial behaviour towards PwD.

Category	Point	Measure	Mentioned by
	3.3	Audio stop announcement	Bezyak et al. (2017); Casey et al. (2013); Tennakoon et al. (2020) [2]
	3.4	Visual stop announcements	Bigby et al. (2017)
	3.5	Braille signboard	Enginöz & Şavli (2016)
	3.6	Training for PwD PT users	Risser et al. (2015)
Vehicle	4.1	Bus ramp / train bridge plates, kneeling bus	Almada & Renner (2015); Bezyak et al. (2017); Bruno et al. (2024); Carlsson (2004); Casey et al. (2013); Lubin & Deka (2012); J. Park & Chowdhury (2018); Sze & Christensen (2017); Unsworth et al. (2019)
	4.2	Accessible vehicles	Almada & Renner (2015); Bezyak et al. (2017); Cass et al. (2005); Church et al. (2000); Hine & Mitchell (2001); Jones & Lucas (2012); Martens et al. (2019); Tennakoon et al. (2020)
	4.3	Reduction of steps	Casey et al. (2013); J. Park & Chowdhury (2018)
	4.4	Seats for PwD	Almada & Renner (2015); Bruno et al. (2024); Carlsson (2004); Hidalgo et al. (2020); Jansuwan et al. (2013); Remillard et al. (2021); Stjernborg (2019); Velho et al. (2016); Verbich & El-Geneidy (2016)
	4.5	Uniform bus design	J. Park & Chowdhury (2018); Risser et al. (2015)
	4.6	Wider vehicle doors	Almada & Renner (2015); Sze & Christensen (2017)
	4.7	Automatic door opening	Carlsson (2004); Sze & Christensen (2017)
	4.8	Braille on bell pushes	Casey et al. (2013)
	4.9	Restrooms in vehicle	Remillard et al. (2021)
	4.10	Long enter/exit time	Carlsson (2004)
	4.11	Minimize crowdedness	Tennakoon et al. (2020)
	4.12	Clean vehicles	Mandhani et al. (2023)
	4.13	Seat belts	Almada & Renner (2015)
Station	5.1	Environment around stations (side walks, crossings, lights)	Almada & Renner (2015); Bezyak et al. (2017); Hidalgo et al. (2020); Hine & Mitchell (2001); Jones & Lucas (2012); Lubin & Deka (2012); Martens et al. (2019); J. Park & Chowdhury (2018); Putranto & Putri (2018); Risser et al. (2015); Sze & Christensen (2017); Unsworth et al. (2019)
	5.2	Lighting	Bigby et al. (2017); Mandhani et al. (2023); Risser et al. (2015); Stjernborg (2019); Tennakoon et al. (2020)
	5.3	Minimize crowdedness at station	Hidalgo et al. (2020); Hine & Mitchell (2001); Risser et al. (2015); Tennakoon et al. (2020)

Continued on next page

[2] Tennakoon et al. (2020) mentions audible signals at crossings specifically.

Category	Point	Measure	Mentioned by
	5.4	Elevators	Bezyak et al. (2017); Jones & Lucas (2012); Remillard et al. (2021); Stjernborg (2019); Sze & Christensen (2017)
	5.5	Ramps instead of steps	Unsworth et al. (2019)
	5.6	Escalators	Sze & Christensen (2017)
	5.7	Easy interchange within stations	Mandhani et al. (2023); Sze & Christensen (2017)
	5.8	Reductions of steps entering the station	Carlsson (2004)
	5.9	Colour contrasting handrails	Casey et al. (2013); Enginöz & Şavli (2016)
	5.10	Handrails next to steps	Carlsson (2004)
	5.11	Furniture to rest at stops	Hidalgo et al. (2020); Mandhani et al. (2023); Risser et al. (2015)
	5.12	Rain and wind shelter at stops	Hidalgo et al. (2020); Tennakoon et al. (2020); Unsworth et al. (2019)
	5.13	Guiding path for blind people	Enginöz & Şavli (2016); Sze & Christensen (2017)
	5.14	Priority for PwD in ticket queues	Hidalgo et al. (2020); Putranto & Putri (2018)
	5.15	Raised platform / curb	Jones & Lucas (2012); Sze & Christensen (2017)
	5.16	Wider platforms	Almada & Renner (2015); Sze & Christensen (2017)
	5.17	Maximum grading of platform	Sze & Christensen (2017)
	5.18	Braille floor plan	Sze & Christensen (2017)
	5.19	Accessible stations	Church et al. (2000)
	5.20	No cycle ways next to stop	Carlsson (2004)
	5.21	Less noise at stations (speech devices)	Bigby et al. (2017)
Service level	6.1	Smaller distance from destination to stop	Almada & Renner (2015); Hine & Mitchell (2001); Jansuwan et al. (2013); Lubin & Deka (2012); J. Park & Chowdhury (2018); Putranto & Putri (2018)
	6.2	All homes, work areas, care facilities near PT stop	Bruno et al. (2024); Church et al. (2000); Sze & Christensen (2017)
	6.3	Widen PT coverage area	Cass et al. (2005); Remillard et al. (2021)
	6.4	Minimum distance from home to bus stop	Bruno et al. (2024)
	6.5	Fare free / reduced fare PT for PwD	Church et al. (2000); Jansuwan et al. (2013); Lubin & Deka (2012); Remillard et al. (2021) [3]
	6.6	Minimize waiting time	Hine & Mitchell (2001); Jansuwan et al. (2013); Unsworth et al. (2019)
	6.7	Increase operating reliability	Hine & Mitchell (2001); Verbich & El-Geneidy (2016)

Continued on next page

[3] Papers state that PT can be too expensive for PwD

Category	Point	Measure	Mentioned by
	6.8	Increase operating speed	Verbich & El-Geneidy (2016)
	6.9	Increase operating frequency	J. Park & Chowdhury (2018)
	6.10	Minimize transfers	Jansuwan et al. (2013)
	6.11	Paratransit services	Bezyak et al. (2017)

B.1. First step aggregation

The list of measures has to be decreased, for not all 57 can be discussed with the experts. In the first aggregation step, this is done in three ways: fifteen measures are discarded, for being too vague, too specific or too general. Second, six sets of measures are merged together. Third, three measures are rewritten.

First, several measures are discarded right away. Two measures discarded for being too vague, four for being too specific and nine for being too general.

Two measures are too vague to provide meaningful recommendations from including it in the research. These measures are Easy interchange within stations and Accessible stations. For easy interchange, it is not clear how to define 'easy'. One might argue that cross-platform interchange is optimal. – Oftentimes this is impossible to provide at larger stations. - But elevators or ramps can provide interchange too.

Four measures are too specific. These measures are: Colour contrasting handrails, Handrails next to steps, Automatic door opening at stations and Wider platforms. The points have more to do with design and less with policy. That makes it difficult to compare them with 'broader' measures such as a digital travel assistant. The first point is relevant mostly for wayfinding. The colour of the handrails can indicate a route or platform. For people unfamiliar with the use of this measure, it might be hard to grasp the use in the short timespan of the survey. Handrails next to steps is clear but very specific. Automatic door opening at stations refers to the vehicle doors opening automatically so that passengers do not have to do this themselves.

Nine measures are discarded right away for being too general. These measures are: Minimize crowdedness at vehicle, Clean vehicles, Minimize crowdedness at station, Minimize waiting time, Increase operating reliability, Increase operating speed, Increase operating frequency and Minimize transfers. While all of these measures could enhance the transport experience of PwD and might even improve their accessibility, the measures are a rather basic list of PT operating goals. They are relevant to all passengers. While this author recognizes that accessibility is applicable to all part of the population, it has to be noted that the goal of this thesis is to study policies relevant to PwD specifically. One can write a book about any of these policy measures (Van Oort, 2011). Including such general policies in the PVE of this study has two risks. First, mostly the solution to the problem is to deploy more vehicles. That tends to be costly. Second, the policy being a general concern for travellers, makes non-disabled passengers possibly biased towards picking this option.

Second, six sets of measures are merged together.

The two technology related measures are merged into one, together with one information measure: Route-finding app for PwD, Digital travel assistant (either human operated or digital) and Information (on timetables, accessible vehicles. The new formulation will be: accessible PT app. This app can communicate about accessible routes and in this matter act as a digital travel assistant. Human operated travel assistants are still included as a separate point and will be discussed hereafter. The reason that Information is also merged into accessible PT app for PwD is because of clarity. It is quite vague to ask participants if they want 'improved information provision'. In that case, it is not clear where viable information is lacking and how the measure will provide more detailed information. In the Netherlands, most stops already show real-time information and a growing number of travellers use digital devices to plan their journeys (9292 Reisplanner OV + E-ticket - Apps Op Google Play, n.d.). This is especially

true for PwD, since they often have to plan their journey in advance because not all vehicles and trips are accessible. Thus, an app to plan your journey in advance and provide additional real-time information can be an important step to 'improve information provision'. For Personal support related measures, Physical human support and Assistance on demand, on short notice are merged into Travel assistance. Both touch upon the same issue, with the notion that the latter point stresses the short-term callability of the service. I would argue that Travel assistance has three main components. First, the number of stops where support can be given is important – in the Netherlands, only the NS offers travel assistance. Second, the short-term callability is important. In simpler terms: how long in advance does a PwD need to book it? Third, the degree of help offered. At big stations in the Netherlands, the NS travel assistance brings to from your train to your next mode of transportation. At smaller stations, travel assistance can only bring you to the exit of the station itself.

The information related measure Braille signboard is merged with the station related Braille floor plan. Braile signboard is the equivalent of a 'normal' signboard, but then in the language of braille. A braille floor plan is a physical map showing the routes – usually guidance lines – present at the station. The new formulation is Travel information in braille. Both points relate to physical guidance signs that can be read by blind people. They do not relate to Guiding paths. That are stripes on the ground to lead people who are blind to their destination within the building. Travel information in braille refers to signs, such as station names or station maps, that are 'written' in braille. For vehicle specific measures, three measures are merged, together with one measure related to the station. These measures are: Bus ramp / train bridge plates, bus kneels, Accessible vehicles, Reductions of steps entering the vehicle and Raised platform / curb. The new formulation will be Wheelchair accessible vehicles. All points have to do with people with walking impairments being able to enter the vehicle. The first and third point have to do with specific tools. The fourth point has to do with the platform of the stop being aligned with the vehicle. In order to achieve stepless vehicles, it is crucial that all stops have a comparable height of the platform. The formulation Wheelchair accessible vehicles has been chosen because a vehicle that is wheelchair accessible is generally also accessible to people who have a walking impairment but do not use a wheelchair. One notable exception is the mobility scooter, which is not always allowed to enter PT. An argument for this exclusion is that the mobility scooter is generally bigger than a wheelchair.

Two station specific measures are merged, namely Furniture to rest at stops and Rain and wind shelter at stops. The new formulation is Facilities at stops. Both points have to do with liveability and comfort at the station. In the PVE, facilities can be further explained to include furniture and shelter.

Regarding service level, four points are merged into one. This concerns: Smaller distance from destination to stop, All homes, (major) work areas and care facilities must have a PT stop within a specified distance, Widen the coverage area of PT and Every resident must have a bus stop within a minimum distance of their home. The new formulation will be More stops. All measures centre around the observation that PwD may experience difficulties reaching a stop. This is especially problematic if the traveller needs to reach an important destination such as a workplace or hospital. But, in the Netherlands it is not uncommon to have rural town without a PT stop at all. The formulation More stops is chosen, so that it included both more stops at important destinations and more stops in a more general sense.

Third, three measures rewritten as to better align the measures with current practises and possibilities.

First, Driver assistance is rewritten as Training of personnel. This study focuses on policies to improve the accessibility of PT. In this regard, measures included in the PVE have to be operatable. Driver assistance is hard to improve from a system level perspective. Training of personnel however, can be implemented and expanded upon. Second, Seats is rewritten to Wheelchair spaces in the vehicle. Seats refers to seating space in general, both space for wheelchairs and seats designated for people with reduced mobility. In some vehicles, there are seats branded as 'priority seats'. These seats are already designated mostly for PwD, elderly and other people with reduced mobility. A persistent issue however, is people noticing a PwD who wants to use this space. This can be addressed with measure Education of other passengers, to inform people how to recognize and deal with passengers with mobility needs. The part of seating referring to wheelchair space still remains as a separate point. Oftentimes vehicles have such des-

ignated space. But, it is often occupied by other passengers. Moreover, if multiple PwD travel together or travel at the same time, disappointment often arises. For there is usually only one spot designated for PwD.

Third and last, Restrooms in the vehicle is rewritten to Restrooms at the station. In the Netherlands, new trains already need to have restrooms, but this is not the case for smaller vehicles like busses, trams or metros (Ministerie van Infrastructuur en Waterstaat, 2022). Not all stations do have restrooms yet. This is especially the case for tram and metro stations and bus hubs. It is however, possible to install restrooms in these places. Therefore the PVE can provide useful information to assess whether it is worth to install restrooms in stations. The measure Restrooms at the station will be nested under the Station measures.

B.2. Second step aggregation

The second step is a more elaborated discussion of the remaining points. In table 2 the condensed list of measures is given. However, the list is still too long to include all measures in the PVE. So, all remaining measures presented in B.2 are discussed further on why they are, or are not, included.

Regarding technology, the only measure left, Accessible PT app, is included in the initial PVE design. The three original measures that are combined in the PT app are mentioned a lot in the literature. Moreover, an app that shows accessible journeys for any modality or operator does not exist in the Netherlands yet. A reason thereof could be that it is difficult to combine information from different sources into one, combined platform. That makes for a measure that is possible, indicated as important in the literature and not yet implemented. In other words, an ideal measure to compare upon in a PVE.

For Personal support related measures, all three measures left are included in the initial PVE.

Training of personnel is included. In the literature, the importance of driver's attitude and knowledge is the single most referenced point. Training is an intuitive way to improve the quality of assistance from a system level perspective.

Travel assistance is included, even though two objections can be made against it's inclusion. First, it is already in place in the Netherlands (Reizen Met Een Beperking | Reisinformatie | NS, n.d.). However, this is only true for the main railway operator. Smaller operators, including bus, tram and metro operators, do not offer travel assistance yet. This is set to change due to the implementation of the Governance agreement Accessible PT (Bestuursakkoord Toegankelijkheid Openbaar Vervoer 2022-2032). This agreement is discussed more in depth in the desk study section. The second to exclude travel assistance, is that it should not be necessary if the travel chain is fully accessible. Ideally all passengers can travel by themselves, without the need of external support. Nevertheless, such a scenario is implausible in the near future. For one, older vehicles, especially trains, are still in use that do not offer grade-level boarding. Moreover, some PwD will always have the need for company during their journey. An example is people with reduced memory, people with mental disabilities or people with multiple disabilities.

Education of other passengers is also included. Many researchers stressed the importance of the attitude of other passengers towards PwD. Oftentimes people do not cooperate when a PwD wants to sit in a designated spot, or people are simply rude or indifferent towards PwD, see for example Stjernborg (2019).

Four information related measures are discarded, while one is included.

Readable and correct information signs is discarded, because in the Netherlands, the signs have to be big as to be readable (wetten.nl - Regeling - Besluit Toegankelijkheid Van Het Openbaar Vervoer - BWBR0029974, 2015). The signs are predominantly digital as to display real-time information. In some rural areas this is not the case. In such a situation, an Accessible PT app could provide more information.

Audio stop announcements and Visual stop announcements are discarded, since they already need to be in-place in the Netherlands (wetten.nl - Regeling - Besluit Toegankelijkheid Van Het Openbaar Vervoer - BWBR0029974, 2015). One instance where information, especially visual information, is lacking is

in case of disruptions. Often the only information given are audio announcements. Take for example a vehicle with a disfunction so that all passengers have to exit the vehicle. In this case, visual real-time information is necessary for people with hearing impairments. However, the point is still discarded as it's only relevant in specific situations. Including it in the PVE might suggest that PT does not have announcements at all, which is not true.

Travel information in braille is included. It is reasoned that blind people will benefit from travel information in their language. However, this measure might be less relevant with the introduction of an Accessible PT app. For now, it is still included in the initial design of the PVE, since fully blind people might not be able to use the app on their mobile device independently.

Training for PwD PT users is discarded from the initial PVE. In Amsterdam, there already is a program to learn blind people how to navigate in the central station (OV-COACH, n.d.). These kind of trainings could be given in more places and to more types of PwD. But, the measure is similar to the Travel assistance measure, as well as the Accessible PT app measure. The program in Amsterdam provides for an online hearing application, based on a digital map of the station. This could also be incorporated into the app. More traditional forms of training, namely physical training, relate to personal travel assistance. If a PwD arrives at a station for the first time and calls travel assistance, perhaps the next time the individual knows the route. To remove the risk of including too similar measures in the PVE, this point is excluded.

For Vehicle related measures, two are included in the initial PVE while seven are discarded. Generally speaking, the discarded vehicle measures have more to do with design than with policy, making them less fit for a research such as this.

Wheelchair accessible vehicles is included. It combines similar measures that are focused on ensuring step-free vehicles. In the literature, it was stressed often that people with mobility impairments can only travel independently if they can enter the vehicle independently. Critics might argue that it is expensive to make all vehicles step-free and that it is expensive to prevent the platforms from subsiding. However, this only proves the relevance of including such a policy in the PVE. If the respondents fill out a traditional survey, oftentimes the aspect of money scarcity is not taken into account. In a PVE, a respondent can make judgements based on the resources needed for a specific measure.

Wheelchair spaces in the vehicle is also included as a policy measure in the PVE. More and more vehicles have designated seating space for PwD. However, oftentimes the space can also be occupied in other ways, for example by bikes, strollers, or simply people standing or sitting in the space. Moreover, often times a minimal amount of space is reserved for PwD. That makes it hard if not impossible for multiple PwD to travel together or travel at the same time.

Apply a similar design to all busses for recognizability is discarded. For, it is argued that most busses, trains, trams, metros have a mostly similar design already. Exceptions may be the in-check booth in busses, who can be both on the left and right side. But, this is a too specific issue to be included in the PVE.

Wider vehicle doors and Braille on bell pushes are discarded too. Most vehicles already have wide doors. Similarly, bell pushes in newer busses have braille language on them (wetten.nl - Regeling - Besluit Toegankelijkheid Van Het Openbaar Vervoer - BWBR0029974, 2015).

Long enter / exit time for vehicles is discarded. The literature points out that PwD may have difficulties entering and exiting the vehicle in a short period of time. But, implementing a longer stop time for all stops, even if there is no PwD present, might be unproportional.

Seat belts are discarded. Almada and Renner, 2015 refer to seat belts on wheelchair spots. In this regard, it can be considered a subpoint of seating space for PwD.

Four station related measures are included, while ten are discarded. Most measures that are discarded, are more design oriented than policy oriented. Even the policy measures that are included, tend to be quite design oriented.

Environment around stations is discarded. To limit the scope of the research, it is decided to only research measures that apply to the PT system itself. Critics might argue that a journey is only accessible if

the entire travel chain is accessible (Carlsson, 2004). However, practical considerations are more decisive in this particular instance. First, the environment around stations is not managed by PT operators, but often by municipalities. That makes it difficult for the experts consulted, who are national bodies, to make work of change on this issue. Second, including the environment around stations risks a 'camel nose' scenario. In other words: where do we stop? Is only the direct vicinity of a stop relevant? If a PwD needs to be one road further, they cannot reach their destination either way. If their destination requires stairs to enter, it might be a dead end. For these reasons, it is chosen to exclude the environment around stations in the research.

Lighting is discarded too. The needs around lighting are specific to the individual (Kennis Over Zien, 2023). Some people want as few lighting as possible while other might want the exact opposite. That makes it hard if not impossible to propose a generalized policy measure.

Elevators is included, while Ramps instead of steps is not. Two lines of reasoning can be given for this decision. First, an elevators sometimes is the only viable alternative. Ramps are often placed at smaller stations, for they are often the cheapest option. However, in most major stations there is no space for a ramp, so that an elevator is necessary. The second reason has to do with maintenance. Ramps do not require any special maintenance, but elevators do. Often, people see elevators as an image of accessible infrastructure. However, other people tend to see elevators as playgrounds, ideal to test the newest fireworks. Therefore, a lot of elevators break down often, so that they cannot be used. This impact is hard to overestimate. If one elevator is not working, oftentimes a whole journey chain becomes inaccessible. That can force people to take a different route in the best case scenario or leave people stranded in the worst. Both lines of reasoning make for a larger room for improvement in the case of the elevator. That makes the elevator the preferred option to be included in the PVE.

Escalators and Reductions of steps entering the station are both discarded. Both have to do with the reduction of stairs. Escalators is one way to do it, but it does not fulfil the needs of all PwD. People with more advanced mobility impairments are not able to use escalators. For them, elevators or ramps are the only alternatives. For this reason, only escalators are included in the PVE.

Guiding path for blind people is discarded from the initial PVE. For most blind people, it is only possible to travel through PT by means of guiding paths (Kennis Over Zien, 2023). In most stations, a guiding path already exists, and a digital map of all guiding paths is being tested (ProRail Test Indoor Navigatietechnieken Voor Reizigers Met Een Visuele Beperking, 2022). However, in some regional stations and stops, guiding paths are missing. An accessible journey is only as accessible as its weakest link. If a guiding path is absent, the entire journey chain becomes inaccessible. However, this measure is excluded from the initial design of the PVE, for it is already partially in place, especially in train stations (ProRail, 2017).

Priority for PwD regarding ticket queues is discarded, since there are few ticket counters left in the Netherlands. Since 2024 it is possible to pay with you bank card (OV-pay) (Trans Link Systems B.V., n.d.). That alleviates the need to stand in line for a physical ticket counter.

Facilities at stops is included in the initial design of the PVE. Critics could argue that it is a general concern for travellers to have rain and wind shelters and furniture to rest upon. However, it is defended that facilities are important, especially for PwD. This is mostly true for people who are not in a mobility device but do have a mobility impairment. These people oftentimes prefer to sit, both in the vehicle and waiting at the station.

Maximum grading of platform is discarded, since platforms are generally built without an incline, unless it is not possible otherwise.

No cycle ways next to stop is discarded. Even if it is beneficial for PwD, it will be difficult to implement such policy in the Netherlands.

Less noise at stations is discarded from the initial design of the PVE. Like cycle ways, it might be beneficial for PwD. However, it is hard to change the noise at the stations. One might implement a policy that everyone needs to be silent in PT, which is in place in Japan (Goree, 2011). Nevertheless, the author argues that a similar policy cannot count on support in a Western European country like the Netherlands, where individual freedom tends to be one of the highest virtues in society (Erasmus, 1524).

Restrooms at the station is included in the initial design of the PVE. Some people have difficulties holding up their bladder, so that they need to use a toilet as soon as possible (Mathews et al., 2021). In such a case, it is preferable to have a toilet both in the vehicle and at the station. Most newer trains do have an accessible toilet, while other vehicles such as busses or trams are perhaps less suitable for toilets. Stations are suitable for toilets, also wheelchair toilets. But not all station do have a wheelchair toilet yet. That makes a policy such as this particularly suitable to be included in the initial design of the PVE.

Regarding service level related measures, one is included while two are discarded.

More stops is discarded from the initial design of the PVE. Critics might point to the literature, where more stops is often identified as a decisive factor in accessibility. A lot of PwD have difficulties moving large distances. That means that if a PT stop is missing in their direct vicinity, PT is not option and they have to rely on paratransit systems. However, the trend in the last few years has been to get rid of stops, especially in rural areas (NOS, 2023). The reason is simple: money. It costs a lot to operate a line in a rural area through village after village. Therefore it is implausible that the tide will turn. In a PVE, it is useless to compare an alternative that has little perspective of being initiated.

Fare free / reduced PT for PwD is included. Critics might argue that PwD often have a job and should not be considered miserable. K. Park et al. (2022) found that the difference between PwD and non-PwD was greater for non-work trips than for work trips. However, PwD often have to travel longer because it takes more time to interchange [NS reisassistentie]. In this regard, it can be considered ‘unfair’ that PwD pay the same to travel the same distance in a longer period of time.

Paratransit services is discarded, for five reasons. First, it is argued that it is out of scope of this research. Of course, for some individuals paratransit are an irreplaceable part of their journey chain. But, if there would be adequate PT, paratransit services would not be necessary in the first place. Second, paratransit services in the Netherlands are operated by municipalities (Ministerie van Infrastructuur en Waterstaat, 2022). That makes for regional differences in service quality. Thus it is hard to compare them all at once. Third, oftentimes paratransit services are not operated on a concession basis (Ministerie van Infrastructuur en Waterstaat, 2022). That makes it hard to implement changes. Fourth, a similar point, paratransit vehicles are often not big enough to fall under the guidelines for PT vehicles, as they do not carry 22 passengers or more (Verordening - 2019/2144 - EN - EUR-Lex, n.d.). That removes the legal base for these vehicles to be accessible, at least from an European legal perspective. Fifth and last, the measure paratransit services is quite general. The question arises what can be improved regarding paratransit services. The vehicles can be made more comfortable, more reliable, faster, easier to book and so on. In a PVE, this makes for a fuzzy argument. Some people will choose paratransit services in the PVE because they have to book it too far in advance, others will choose the measure because they consider the comfort level unsatisfactory.

Table B.2: Accessibility Measures by Category

Category	Point(s)	Measure
Technology	1.1; 1.2; 3.1	Accessible PT app
Personal support	2.1	Training of personnel
	2.2; 2.3	Travel assistance
	2.4	Education of other passengers
Information	3.2	Readable and correct information signs
	3.3	Audio stop announcement
	3.4	Visual stop announcements
	3.5; 5.18	Travel information in braille
	3.6	Training for PwD PT users
Vehicle	4.1; 4.2; 4.3; 5.14	Wheelchair accessible vehicles
	4.4	Wheelchair spaces in the vehicle
	4.5	Apply a similar design to all busses for recognizability
	4.6	Wider vehicle doors
	4.8	Braille on bell pushes
	4.10	Long enter / exit time for vehicles
	4.13	Seat belts
Station	5.1	Environment around stations (sidewalks, crossings, streetlights)
	5.2	Lighting
	5.4	Elevators
	5.5	Ramps instead of steps
	5.6	Escalators
	5.8	Reductions of steps entering the station
	5.13	Guiding path for blind people
	5.14	Priority for PwD regarding ticket queues
	5.11; 5.12	Facilities at stops
	5.17	Maximum grading of platform
	5.20	No cycle ways next to stop
	5.21	Less noise at stations (relevant for people using speech generating devices)
	4.9	Restrooms at the station
Service level	6.1; 6.2; 6.3; 6.4	More stops
	6.5	Fare free / reduced PT for PwD
	6.11	Paratransit services

Appendix C

Expert interviews

C.1. Methodology

Expert interviews is the third method used to answer RQ 1. The first interviews focus mainly on defining the problem and policy options. In the later interviews the focus will shift towards the definition of policy options and the design of the actual PVE. After the actual interviews, some experts took the time to evaluate the attributes of the policy options and/or the design of the PVE. Again, many thanks to all experts for their willingness to help!

Semi-structured interviews are conducted. Semi-structured interviews are a frequently used method known to obtain detailed and structured information from the target group (Yin, 2003). The semi-structured questions are asked on a relaxed conversational tone. This allows participants to share their opinions and experiences more freely (Bryman & Bell, 2015).

In total, 11 people from 9 different organisations are interviewed. The goal is to interview an as diverse set of experts as possible, with people from the government, PT operators and (representatives of) PwD themselves. Four experts work for a government. Two work for a semi-governmental organisation. Five are representatives of PwD or PT users. Three have a disability themselves. First, the goal of the research was explained to the participants. Then the experts are asked about their experiences regarding the subject and a concept choice task was discussed. In table C.1 all experts are shown, including their corresponding organisation and link to the subject.

Table C.1: Overview of Experts and Their Expertise

Expert	Organisation	Expertise
Researcher	TU Delft (previously)	PhD alumnus on inclusive mobility. Studied, inter alia, the inclusivity of the Amsterdam Transport Region according to the TRSE framework.
Policy officer	Rover	Policy officer on, inter alia, accessible PT. Rover represents the travellers of public transport. They have the legal right to give advise to transport companies and (regional) governments about the functioning and future of PT.
Policy officer	Ministry of Infrastructure and Water	Policy officer responsible for accessible PT (train, bus, tram, metro). Member of the team National strategy implementation UN treaty Disability. Coordinator of the task force Governance agreement accessible PT.
Policy advisor and PwD representative	Municipality of Amsterdam	Policy advisor on traffic and public space. Active in a local PwD representative organisation.
Policy advisor	Municipality of Amsterdam	Policy advisor on public space, involved in the physical accessibility of public space.
Policy advisor	Municipality of Amsterdam	Policy advisor on public transport and social transport. Responsible for the accessibility of public transport stops in Amsterdam.
Policy advisor	VRA (Transport Region of Amsterdam)	Policy advisor on inclusive mobility. Experienced in the setup of projects aimed to improve accessibility. The VRA grants all PT concessions in and around Amsterdam.
Policy officer	Ieder(in)	Policy officer mobility and social security. Ieder(in) is the umbrella organisation for Dutch NGO's representing and/or supporting PwD.
Board member	ALS patient association (ALS patiëntenvereniging)	Contact person for PwD and experienced with a disability themselves. Investigates the accessibility of public places.
Project manager	ProRail	Project manager for stations. Responsible for, inter alia, the accessibility of train stations.
Members' council	Eye association (Oogvereniging)	Representative of people with a visual disability. Represented PwD in the discussion about various policy documents such as the Governance agreement accessible PT.

C.2. Main findings on each policy measure, per interview

In this section, an overview is given of the policy measures that were discussed with each interviewed organisation. The main takeaways on each policy measure are discussed. Note that not all measures were discussed with all experts.

Rover

Elevators
Most weak spot. But it is also very expensive. For failure prevention, money doesn't necessarily help. Travel info on lifts that are broken is now made public. Can also be included in journey planner. Escalators don't help everyone. Does make lifts less crowded.

Wheelchair accessible vehicles
Grade level boarding is long term. Upgrading old vehicles is very costly and unrealistic. But, making new vehicles wheelchair accessible is possible.

Travel assistance
Often outsourced. Additional recruitment of staff is needed. Travel assistance on demand could be at

larger stations.
At larger stations, blind people are helped to next transfer. You can always start doing that.

An Accessible PT app
NS has a separate app for accessible travel, but disruptions cannot yet be seen in it.
Money doesn't play a big role, mainly manpower. Since making stations and vehicles accessible is difficult, the best you can do is to give info about it as much as possible.

Wheelchair spaces in the vehicle
Now often icons on chairs for people who want to sit. But, is not always clear. Travellers are often willing to help, but the threshold to ask people can be high.

Guiding paths for blind people
-

Restrooms at the station
On trains, there are usually toilets. Also look at type of station/halt. Include hubs as well.

Automatic check-in and check-out
-

Facilities at stops
Appreciated by all. Especially relevant for smaller stations, where frequency is lower and there are fewer facilities.

Complaint handling
-

Travel information in Braille
Is often well regulated at stations. Travel info is not yet there in Braille, when it comes to disruptions etc. That's only called out now.

The training of personnel
There are no national training courses or guidelines now.

Paratransit services
-

More PT stops
-

The environment around stations
Money plays big role . Interesting though.

Fare free / reduced PT for PwD
Not the case nationwide now. Interesting to watch if the angle is: people get a discount when delayed.

Escalators
-

Improved lighting at stations
Very personal, some people want lots of light, others little.

Education of other passengers
In general, people are doing well. You mostly reach people with such a campaign who are already doing well.

Low signs and open door buttons
Not needed on trains, and is often already there on buses.

Ministry of Infrastructure and Water

Elevators
Travel info on broken lifts important. Also look at ramps.

Wheelchair accessible vehicles
Rail: 93% accessible stations, 560 mlj reserved. But 35% of platforms need maintenance because the track is subsiding. By 2030, all stations should be accessible.
Bus and tram stops are big challenge, at least 800 and 115 mlj respectively needed for it. But no one from the chamber wants to spend money on it now.

Travel assistance
Specify: more stations, more often. It takes people.

An Accessible PT app
Open question is interesting: what do people want in it?
Big need to have all info in one place. Now missing that. Difficult to realise, as all parties need to align.
People want to have info in case of disruptions.

Wheelchair spaces in the vehicle
Concerns mainly bus/tram/metro

Guiding paths for blind people
-

Restrooms at the station
If there is a toilet, it must be accessible.

Automatic check-in and check-out
-

Facilities at stops
-

Complaint handling
-

Travel information in Braille
Accessibility directive taking effect on 28 June also addresses this.

The training of personnel
Can vary per PT operator.

Paratransit services
Formally no PT. Often no concession either. That makes it difficult to make changes.

More PT stops
-

The environment around stations
-

Fare free / reduced PT for PwD
Not necessarily “fair”. In fact, you can argue that PwD should pay more.
They use services that are costly. So, it is much more expensive to let a PwD travel by PT than a non-PwD.
Currently, all travellers pay for these services.

Escalators
Escalator is not an accessibility measure. Not all PwD can use it.

Improved lighting at stations
-

Education of other passengers
-

Low signs and open door buttons
-

Municipality of Amsterdam

Elevators
Lifts work 97% of the time. Percentage is ok. But impact is big when lift fails is unacceptable.
Better communication when lift is broken!
A lift is very expensive: a lift at a 'simple' location can cost up to one million, while a lift in a difficult location, such as Schiphol, can cost more than double that per lift.

Wheelchair accessible vehicles
In principle, all metros are wheelchair accessible. But stops are not. There will always be a small gap between vehicle and station. Safety.
Bus stops owner is Municipality, VRA owns tram/metro stops. GVB does maintenance for them. Last year plan to speed up making stops accessible. The expert sent this via mail after the interview.
If a stop is not accessible, it is often due to lack of space. Tram: inaccessible because different trams have different heights.
You're not going to make it with 800 mlj for buses and 115 mlj for trams.

Travel assistance
OV Coach was founded by VRA at Amsterdam central. To teach people to transfer.

An Accessible PT app
Provide real-time info, breakdowns, whether a trip is frequently (in)accessible. 1 app is as expensive as 1 lift.

Wheelchair spaces in the vehicle
-

Guiding paths for blind people
Navilens on Amsterdam Central station is a digital guiding path.

Restrooms at the station
-

Automatic check-in and check-out
-

Facilities at stops
Specify.

Complaint handling
-

Travel information in Braille
Isn't there in the metro, where which stop, which lift etc.

The training of personnel
Important: piece of awareness, e.g. slower acceleration. Seeing people.

Paratransit services
-

More PT stops
Especially important to have shorter walking distances.

The environment around stations
Important for pre- and post-transport. Parking bike, walking route, benches.
There is a need for accessible bike parking. Sometimes, the bike parking of a stop is on the first floor or below ground, which can make it difficult or impossible to enter for PwD.

Fare free / reduced PT for PwD
-

Escalators
-

Improved lighting at stations
-

Education of other passengers
-

Low signs and open door buttons
-

VRA

Elevators
VRA is working on this. Info on whether lifts do it or not is also very important.

Wheelchair accessible vehicles
All stops accessible is not possible. Contributes greatly to independence, though.
You can also mention barrier-free entrance. If someone is not in a wheelchair, they might not care.

Travel assistance
VRA is working on this.

An Accessible PT app
Provide info in case of disruptions, e.g. an alternative route.

Wheelchair spaces in the vehicle
Clear point. Applies, for example, when ordering new trams.
Now one and the same spot has to be used by cyclists or people with prams. If there are two friends in wheelchairs, they cannot travel together.

Guiding paths for blind people
Navilens exists. That is good.
But, currently it is only there at Amsterdam CS.

Restrooms at the station
-

Automatic check-in and check-out
Small buttons or touchscreens make ticket machines inaccessible.

Facilities at stops
-

Complaint handling
-

Travel information in Braille
Public address systems you have, but not always used. Signage is important.

The training of personnel
Can certainly help: slower acceleration, awareness. Important.
Can be added to code 95 in bus driver training. Is now in the concession.

Paratransit services
A goal of VRA is to let people use PT who currently use paratransit.

More PT stops
-

The environment around stations
Increases independence.

Fare free / reduced PT for PwD
-

Escalators
-

Improved lighting at stations
-

Education of other passengers
-

Low signs and open door buttons
-

Ieder(in)

Elevators
Appears in governance agreement.
Info on lifts should be more integrated. Difficult to put all info together.
Ramp is not an alternative for part of PwD. But it does help. Lifts are very expensive.

Wheelchair accessible vehicles
P76 norm: gap train platform. Now it is not really level. Future it might be. Then it is mainly about track.
Now sometimes part of the platform has subsided. Then the whole platform is classified as inaccessible. More precise info is needed.
The 'doorsteps' of new NS trains at doors for wheelchair users seeks the platform. That minimizes the gap between the train and the platform.
Important: what are you talking about: train or community bus.

Travel assistance
Regional transporters say: we don't have to, because we have accessible boarding.
What can improve:

1. faster
2. more vehicles (in more places)
3. between different modes & more at major hubs, stations under renovation etc.

'Better conditions'

An Accessible PT app
There is still much to be gained here. NS is working on it [is this mainly about integration lift data?].
Until 2045, we have inaccessible trains at NS.

Wheelchair spaces in the vehicle
-

Guiding paths for blind people
-

Restrooms at the station
-

Automatic check-in and check-out
-

Facilities at stops
-

Complaint handling
Important, have one 'Ombudsman' for accessibility.

Travel information in Braille
-

The training of personnel
-

Paratransit services
-

More PT stops
Important, necessary to have a stop every 100 to 300 metres at max.
Especially relevant for hospitals.

The environment around stations
Even pavement appears in the governance agreement.
What is missing: accessible bicycle parking.

Fare free / reduced PT for PwD
Don't do it.

Escalators
-

Improved lighting at stations
-

Education of other passengers
-

Low signs and open door buttons
-

ALS

Elevators
Most inconvenienced when lift is broken. NS is working on more communication about this.
Ramps are a good alternative. Escalators are not. Villages often have ramp.
'More' lifts: 1 lift is already enough.

Wheelchair accessible vehicles
This is the most important, but it also takes the longest.

Travel assistance
The expert has participated in wheelchair skills training given by the local Municipality.
On regional trains, no travel assistance needed. On intercity trains you cannot yet travel independently. You have to call 1h in advance with NS, 8h with Valys. In case of disruptions, they call you. Then e.g. a taxi can be arranged as replacement transport.

An Accessible PT app
The expert would use this for sure.

Wheelchair spaces in the vehicle
-

Guiding paths for blind people
-

Restrooms at the station
The expert has never used a toilet in the vehicle.
But, at stations it is convenient, important.

Automatic check-in and check-out
-

Facilities at stops
-

Complaint handling
-

Travel information in Braille
-

The training of personnel
Less relevant: the people that the expert has encountered were very nice.
That is not the case for everyone. Other members of ALS have had unpleasant encounters with personnel. For example because people did not understand them.
It also differs per PT operator.

Paratransit services
Is part of the PT travel chain. But do not make your research too broad.

More PT stops
-

The environment around stations
Never had any problems.

Fare free / reduced PT for PwD
PT is very cheap.

Escalators
Escalators are no alternative to elevators.

Improved lighting at stations
-

Education of other passengers
-

Low signs and open door buttons
-

ProRail

Elevators
Alternative to a lift is a ramp.
ProRail prefers a ramp as it is cheaper. However, this is not possible with a middle platform. Also not if the difference in height is too great. Mostly they apply 6 metres height difference as the maximum for a ramp.
By 2030, all platforms will have either a lift or a ramp.
Lifts are repaired based on maintenance contracts. It is difficult to really improve this. On trainpositions.nl they have created a dashboard for lifts. NS is working to implement this information in their app as well.

Wheelchair accessible vehicles
In 2030 all trainstations are wheelchair accessible.

Travel assistance
Travel assistance will be provided by NS. Also provided by regional carriers at stations by the end of the year.
1 step further scheme: be accompanied from your train to your next modality (e.g. bus). But not vice versa.
Travel assistance is not going to expanded.

An Accessible PT app
Good to have 1 app for all wayfinding.
But money is not an issue. It's harder to have an app with everything included than to raise money.

Wheelchair spaces in the vehicle
-

Guiding paths for blind people
Part of accessible station. ProRail has created a "digital twin" of all guide lines.
Digital wayfinding can be further extended. Also wayfinding with sound.

Restrooms at the station
ProRail is working on this. If a station has a toilet, then it must have a wheelchair toilet.

Automatic check-in and check-out
-

Facilities at stops
-

Complaint handling
-

Travel information in Braille
Information provision should be the same for every carrier.
On trains, there are often no announcements for stops because a KPI is comfort and announcements are seen as uncomfortable.

The training of personnel
-

Paratransit services
Focus on travel chain is important: first and last part of the journey is often paratransit.

More PT stops
-

The environment around stations
-

Fare free / reduced PT for PwD
-

Escalators
-

Improved lighting at stations
-

Education of other passengers
-

Low signs and open door buttons
-

Oogvereniging

Elevators
Also important for people with a visual impairment.
Broad elevators are useful.

Wheelchair accessible vehicles
With some mobility devices [f.e. a mobility scooter], you can use public transport in one region and not in another.
90% of the platforms are at height. But the track is subsiding. About 50% are actually usable.
ProRail has a programme and has money to get it at height. But not to keep it at height. That's the hard part.

Travel assistance
Travel assistance is required. Three categories:
1. In and out of vehicle. No level boarding on all trains until 2045.
2. Across station: important for blind people. Be guided to another track or to the entrance or exit.
3. Monitor journey on chain journey: make sure transfer succeeds. NS has regulated it, other train operators will do it by the end of the year. But it is not yet a rule, because the administrative agreement is not binding. Now it is regulated per modality, but should be for whole chain.

Point 1 is generally well regulated (at NS), points 2 and 3 are not. That makes regiotaxi/Valys [paratransit] necessary.
Point 3: there is research now on travel assistance at complex hubs from modality to modality: '1 step

further'. Now at 27 stations.
Only 1 direction: from train to bus/tram/metro/taxi/Valys/AOV etc.
Chain journey is as accessible as least accessible chain. For people with visual impairment, the weakest link is between vehicles.

An Accessible PT app
What is accessible: ground-level entry is less important for visually impaired.
Navilens now in force during Amsterdam CS renovation.

Wheelchair spaces in the vehicle
Often there is only one space in the bus.
Then you cannot sit cosily next to each other.

Guiding paths for blind people
ProRail has unique system in the world. Good. That has been applied to all stations in the Netherlands.
Bus/tram/metro stations are not yet equipped.
Switching at complex hubs is often difficult. Different systems for different modalities/PT operators.
Again, it should be implemented as one.

Restrooms at the station
-

Automatic check-in and check-out
Touchscreens cannot be used.
Payment system in and of itself is a high barrier. Then many people choose paratransit.
Check-in bollards are hard to find at stations. On each bus, they are at different places.
Reduced boarding fare is special product for people with visual impairment. Travel books have been cut.
The reduced boarding fare works like this: you are 'forgiven' more instances of wrongly checking in or out. But, even that is not ideal.
This year the Ovpay app is launched. You can then also get confirmation when checking in and out.

Buses are being investigated for automatic check-in and check-out. Now at Arriva in Limburg [bus], Brabant [Transdev] with the MobiU app. Transdev has also agreed to apply it in the new Goeree-Overflakkee concession.

Facilities at stops
-

Complaint handling
-

Travel information in Braille
Wayfinding is important for all PwD.

The training of personnel
Very important, with regard to treatment. The expert sometimes asks a bus driver: which line are you, and he says: look on the front.
Initiatives like the sunflower keycord are also important, which increases visibility. The organisation also provides training to staff.

Paratransit services
Money spent on PT is money spent on paratransit.
Valys [long-distance paratransit] is the responsibility of VWS, regiotaxi [local paratransit] of the municipality, PT of the state and the provinces. There is no cooperation between them.
Combination paratransit with PT is complicated.

More PT stops
Logical measure, but goes against years-long trend.

The environment around stations
-

Fare free / reduced PT for PwD
The Oogvereniging is not in favour of free PT for PwD. But, it is most important that PwD do not pay more than the 'normal travellers'.

Escalators
-

Improved lighting at stations
-

Education of other passengers
-

Low signs and open door buttons
-

Appendix D

Policy descriptions

The descriptions of each measure are presented.

1. **Make vehicles more wheelchair accessible**

   Not all vehicles are now wheelchair or mobility scooter accessible. Sometimes this is because the vehicles are old. But sometimes there is a gap between the vehicle and the platform or pavement. For example, because the platform has subsided.

   What is your advice?
   Do you move the slider to the right?
   Then you advise making vehicles more wheelchair accessible.

   What could that mean?
   The government should make all new trains, buses, trams, and metros wheelchair-friendly. This is already happening in many places.
   Old vehicles should be made wheelchair-friendly step by step.
   Platforms at stops should be well maintained. That way, the gap between vehicle and platform is as small as possible.

2. **More wheelchair toilets at stations and regional stops**

   Now every station that has a toilet must also have a wheelchair toilet. But, smaller railway stations or bus, tram or metro stops often do not yet have toilets.

   What is your advice?
   Do you move the slider to the right?
   Then you recommend more wheelchair toilets.

   What could that mean?
   The government should install wheelchair toilets at smaller train stations.
   The government should install wheelchair toilets at busy bus, tram and metro stops.

3. **More money to repair broken lifts**

   By 2030, every platform at every railway station should have a lift or ramp. Sometimes a lift malfunctions or is broken. Then people who cannot use the stairs have to make a detour to get to their destination. Or they travel by substitute transport.

   What is your advice?
   Do you move the slider to the right?
   Then you advise making more money available to ensure that lifts work as often as possible.

   What could that mean?
   The government should do more to prevent lift breakdowns.
   The government makes sure more money is available to repair lifts quickly.

4. **More travel assistance**

   Now you can request travel assistance for NS stations. You have to do that at least one hour before your journey. Other train operators will offer travel assistance by the end of this year at the latest. For people with visual impairments, there is 1-step further travel assistance at 27 major train stations. This

can help with transferring from the train to the bus, tram or metro. But, the travel assistance does not help if you want to change from bus/tram/metro to train.

What is your advice?
Do you move the slider to the right?
Then you advise deploying extra staff to assist people during their journey.

What could that mean?
The government provides travel assistance at more train stations.
The government provides more travel assistance during transfers between different modes of transport, such as bus, tram, metro and train.

5. **Develop an accessible travel app**

   Now the NS provides information on accessibility for train travel in its app. To plan an accessible journey for bus, tram or metro, you have to go to another app. Also, it is not always clear how to travel when there is a disruption.

   What is your advice?
   Do you move the slider to the right?
   Then you advise creating an app that displays all accessible journeys from the train, bus, tram and metro.

   What could that mean?
   The government provides an app that shows where and how you can travel accessible by train, bus, tram and metro.
   The app can also give advice if there is a disruption. For example, if a lift does not work.

6. **More wheelchair spaces in vehicles**

   Now, most trains, buses, trams and metros already have a special spot for people in wheelchairs or mobility scooters. But, sometimes that space is already used by other passengers.

   What is your advice?
   Do you move the slider to the right?
   Then you advise making more room for wheelchair spaces in vehicles.

   What could that mean?
   There should be more space where people in wheelchairs or mobility scooters can sit in trains, buses, trams and metro.

7. **More training for staff about people with disabilities**

   Now there is not always special training for public transport staff on how to deal with people with disabilities. As a result, they sometimes do not know how best to support someone who has a disability.

   What is your advice?
   Do you move the slider to the right?
   Then you recommend training public transport staff on how to deal with people with disabilities.

   What could that mean?
   Dealing with people with disabilities should become part of mandatory training for staff.

8. **More guiding paths for visually impaired people**

   Guiding paths are thick lines on the ground. Visually impaired people can use them to know how to walk. Now there are already guiding paths at stations. But, at bus, tram and metro stops, this is not always the case yet.

   What is your advice?
   Do you move the slider to the right?
   Then you advise installing guiding paths.

What could that mean?
The government makes sure there are guiding paths in more places.
Also at less busy stops.

9. **Make automatic check-in and check-out available for people with visual impairments**

   Now you can use your bank card to pay with OVpay, as well as use your OV-chip card to check in and out. For people with a visual impairment, it can be difficult to find the check-in and check-out posts.

   What is your advice?
   Do you move the slider to the right?
   Then you recommend finding solutions to make automatic check-in and check-out available to people with disabilities.

   What could that mean?
   Research is being conducted into automatic check-in and check-out in buses and trams, for example. Based on the research, solutions will be put into practice.

Appendix E

Policy preferences per socio-demographic characteristic

In this appendix, the policy preferences as elicited in the choice task are shown per socio-demographic category.

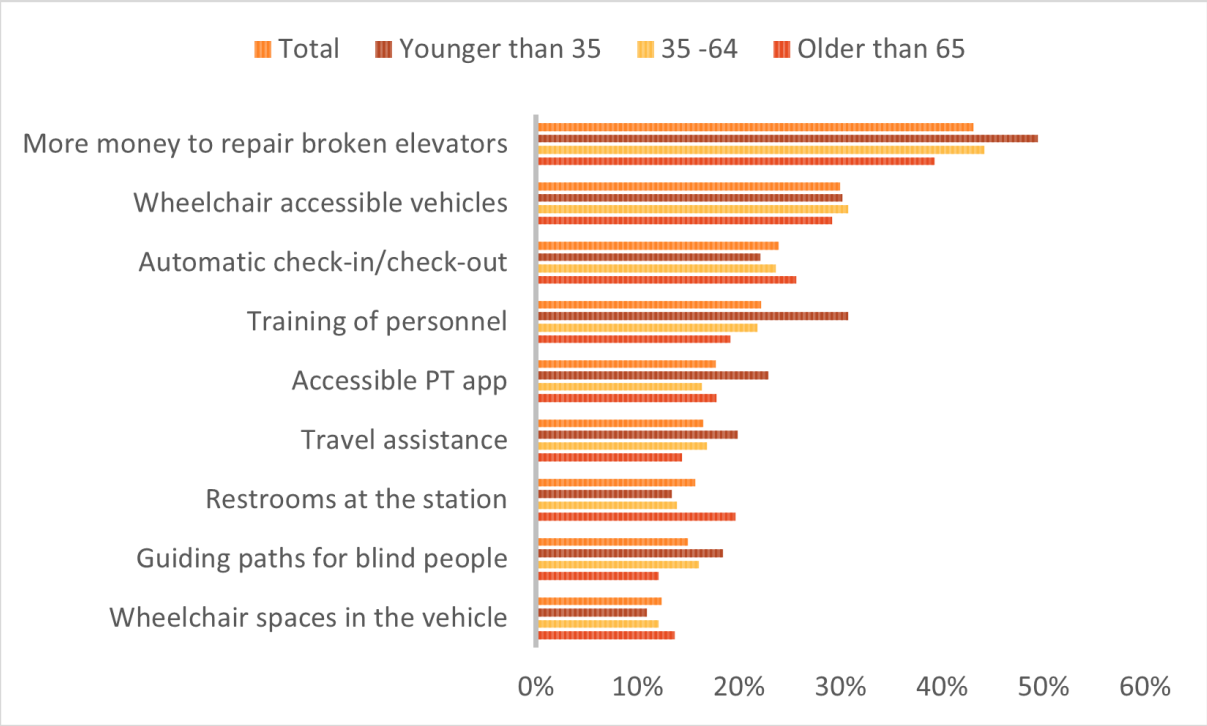

Figure E.1: The elicited preferences in the choice task, broken down to age group.

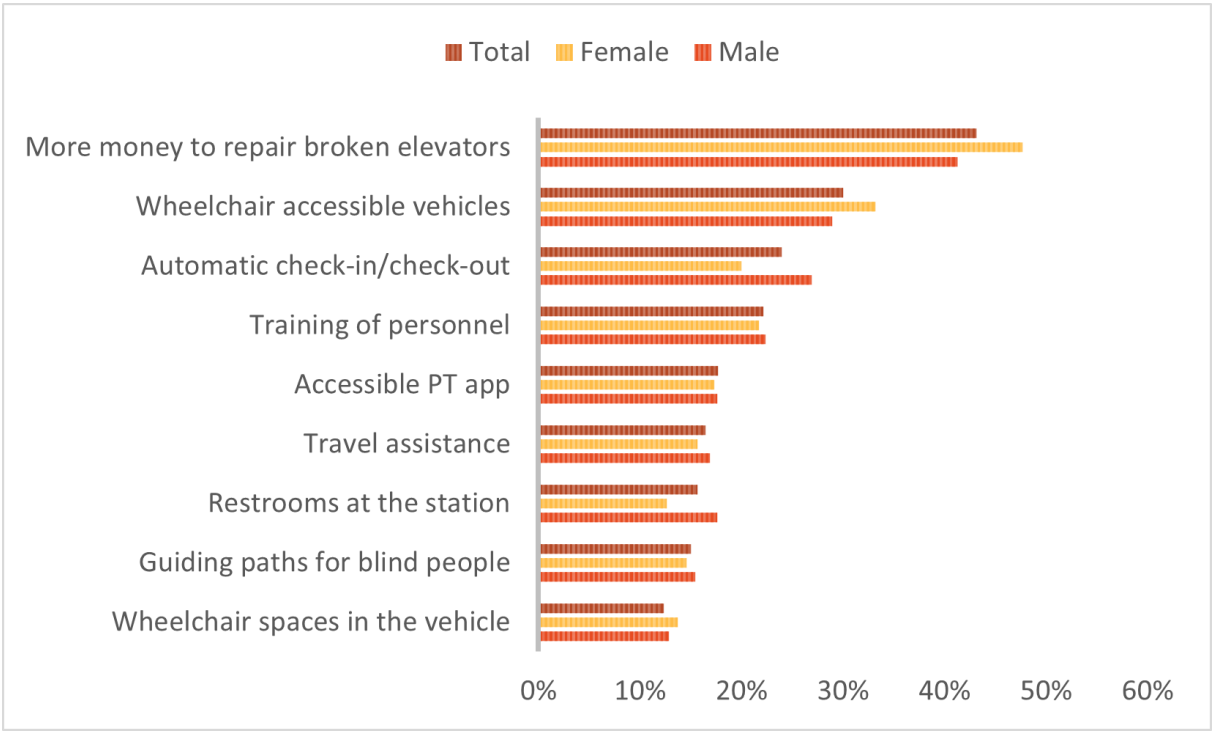

Figure E.2: The elicited preferences in the choice task, broken down to gender.

Figure E.3: The elicited preferences in the choice task, broken down to education.

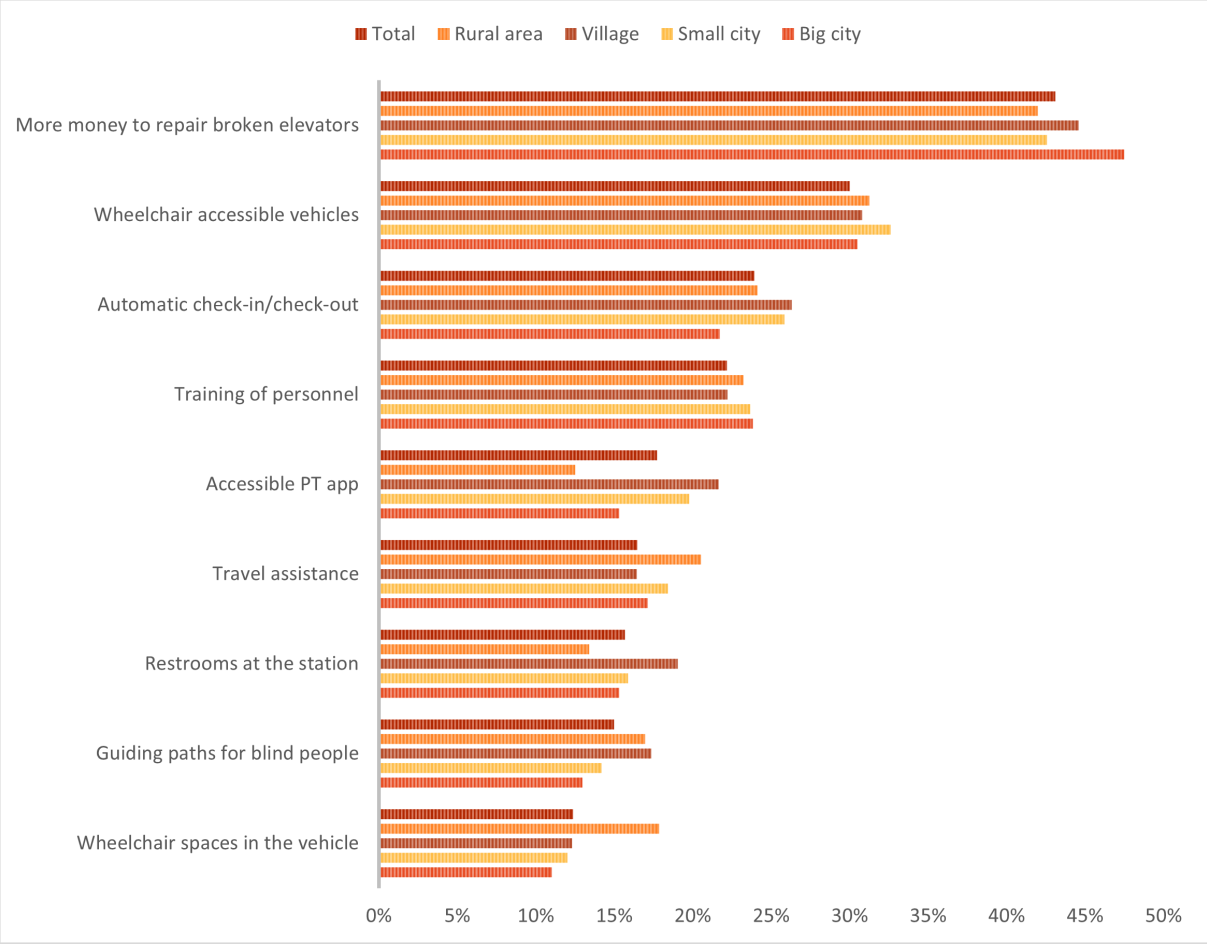

Figure E.4: The elicited preferences in the choice task, broken down to living area.

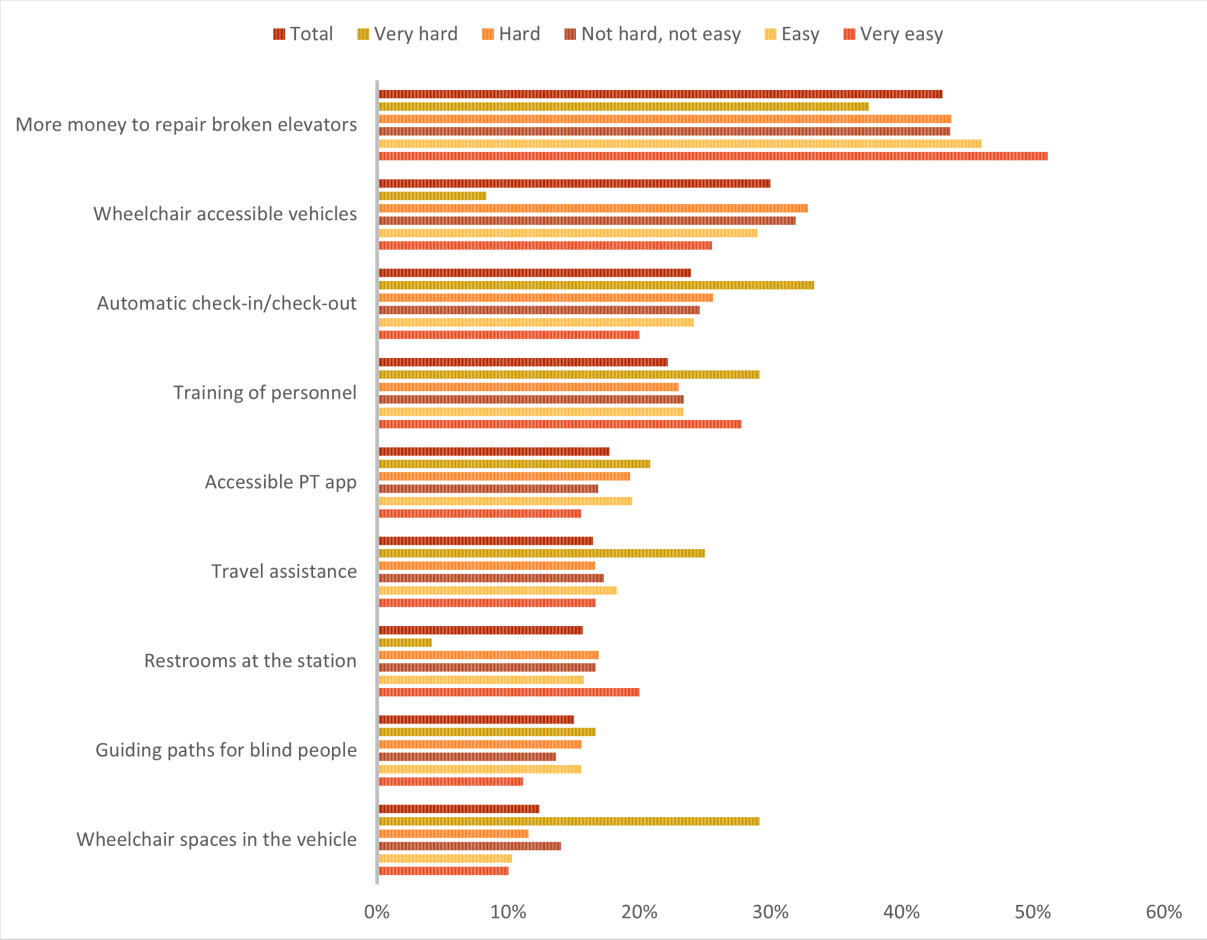

Figure E.5: The elicited preferences in the choice task, broken down to the ease of making ends meet.

Appendix F

Motivations for and against each policy

In this appendix, the motivations of participants to choose or not choose a certain policy measure are analysed. 1 Star indicates that the argument was given little: less than 10% of motivations mentioned this argument. 2 Stars indicate that the argument was given relatively much: between 10% and 20% of motivations mention this argument. 3 Stars indicate that the argument was given often: more than 20% of motivations mention this argument.

Waarom kiezen deelnemers (meer) voor een optie? (Meest genoemde argumenten. Hoe meer sterretjes hoe vaker genoemd)

Argumenten voor 'Meer geld om kapotte liften te repareren'	Frequentie	Argumenten tegen 'Meer geld om kapotte liften te repareren'	Frequentie
Liften zijn vaak (langdurig) buiten werking	★★★	Niet alleen een kwestie van geld, maar ook prioriteit, materiaal, vandalisme	★★
Mensen met een beperking zijn afhankelijk van liften om te reizen	★★★	Kapotte liften zijn geen probleem	★
Mensen moeten erop kunnen vertrouwen dat een lift werkt	★	Onderhoud van liften hoort bij een verantwoorde exploitatie	★
Liften zijn voor iedereen belangrijk: senioren, ouders met een kinderwagen en mensen met koffers	★		
Het is niet altijd duidelijk dat een lift defect is	★		
Bevordert zelfstandigheid	★		

Illustratieve quotes van deelnemers

"Het gebeurt regelmatig dat liften het niet doen, waardoor wij alsnog met de trap moeten. Dat lukt met mijn zus wel, maar is wel altijd complex om te doen."

"Als de lift het niet doet ben je dubbel gehandicapt"

"Meer toezicht is veel beter. Liften worden vaak slachtoffer door verkeerd gebruik of vandalisme."

"Bij ons station is die al weken kapot. Reizigers moeten doorreizen naar volgend station, trein terug nemen en lift op andere perron gebruiken. Dat is niet erg klantvriendelijk"

"Op liften moet je kunnen vertrouwen als je onderweg bent"

"Liften moeten het gewoon doen, ook voor mensen met veel bagage, een kinderwagen of een fiets. Dat is niet alleen een kwestie van geld, maar ook van prioriteit."

"Ik kom haast nooit kapotte liften tegen."

"Als je lift continu stuk is, heb je ook niets aan het vervoer."

"Ook is niet duidelijk dat op aankomst station lift defect is en je in rolstoel perron niet kunt verlaten. Dus dat is belangrijke informatie om te hebben."

Waarom kiezen deelnemers (meer) voor een optie? (Meest genoemde argumenten. Hoe meer sterretjes hoe vaker genoemd)

Argumenten voor 'Meer voertuigen rolstoeltoegankelijk maken'	Frequentie	Argumenten tegen 'Meer voertuigen rolstoeltoegankelijk maken'	Frequentie
Voertuigen zijn niet voldoende rolstoeltoegankelijk	★★★	Voertuigen zijn al rolstoeltoegankelijk	★★
Maatregel bevordert zelfstandigheid	★★★	Er wordt al veel aandacht aan geschonken	★
Voor iedereen belangrijk	★	Kosten wegen niet op tegen de baten	★
Bussen en treinen	★	Rolstoelers maken geen gebruik van het OV	★
Door vergrijzing zijn rolstoeltoegankelijke voertuigen meer nodig	★		

Illustratieve quotes van deelnemers

"Zonder deze investering hebben andere maatregelen niet zo veel zin."

"Dit is een extreem duur voorstel, waarbij speciaal (rolstoelpassagiers)vervoer bijna altijd beter en goedkoper is. Het OV kent zoveel geledingen: bus, trein, metro, en zoveel overstap momenten, dat het zelden meer geëigend is dan speciaal vervoer."

"Dit is nog een ding, zeker bij bussen"

"Er zijn best veel voertuigen die volgens mij niet rolstoeltoegankelijk zijn, of niet makkelijk. Dat is een drempel"

"Dit is niet alleen voor rolstoelgebruikers, maar voor iedere gebruiker een verbetering. Dus ook de mensen met grote bagagestukken, kinderwagens of rollatorgebruikers. Tevens voor mensen die moeite hebben met traplopen door verschillende oorzaken."

"ik ben van mening dat het ten opzichte van vele andere landen al heel goed geregeld is"

"Ja als dat gemakkelijker zou zijn heb je ook minder assistentie nodig en is men zelfredzamer."

Waarom kiezen deelnemers (meer) voor een optie? (Meest genoemde argumenten. Hoe meer sterretjes hoe vaker genoemd)

Argumenten voor 'Maak automatisch in- en uitchecken beschikbaar voor mensen met een visuele beperking'	Frequentie	Argumenten tegen 'Maak automatisch in- en uitchecken beschikbaar voor mensen met een visuele beperking	Frequentie
Zo kunnen mensen sneller en eenvoudiger in en uitstappen	★★	In en uit checken is al goed genoeg geregeld	★★
Maatregel is effectief	★★	Andere maatregelen hebben meer prioriteit	★★
Iedereen heeft hier baat bij	★	Handig voor iedereen	★
Kosten efficiënte maatregel	★	Ik weet niet of dit nodig is	★
Maatregel bevordert zelfstandigheid	★	Andere maatregelen werken beter om het probleem op te lossen	★

Illustratieve quotes van deelnemers

"Lijkt mij een kleine moeite/aanpassing met aardig effect. In- en uitstappen wordt voor iedereen sneller."

"Dit klinkt sympathiek en handig. Echter als techneut voorzie ik een flinke technische uitdaging om deze oplossing daadwerkelijk in de praktijk te regelen. Er is sprake van een grote kans op fouten hetgeen overlast zal veroorzaken bij de visueel beperkte reiziger."

"Lijkt me belangrijk"

"De kaartzutomaten zijn moeilijk te lezen vooral sls zon verkeerd dtaat

De tv dchrmen ook morilijk lersbaar met tr klrine letterd"

"In en uitchecken is nu goed geregeld."

"Dit is zeker een goed idee. Maak het voor iedereen beschikbaar, maar zeker voor mensen die anders minutenlang zitten te kloten met hun pasje."

"Geeft meer zelfstandigheid"

"als dit met een RFID kan is dat een verbetering"

"Ik denk dat andere maatregelen meer mensen helpen."

Waarom kiezen deelnemers (meer) voor een optie? (Meest genoemde argumenten. Hoe meer sterretjes hoe vaker genoemd)

Argumenten voor 'Meer training voor personeel over mensen met een beperking'	Frequentie	Argumenten tegen 'Meer training voor personeel over mensen met een beperking'	Frequentie
Personeel helpt nu onvoldoende	★★	Het personeel doet haar best	★★
Maatregel helpt mensen met een beperking om te reizen	★★	Er is al genoeg training voor personeel.	★★
Het is voor het personeel goed als zij meer weten over mensen met een beperking	★★	Andere maatregelen hebben meer prioriteit	★
Kosten efficiënte maatregel	★	Is niet nodig als het ov toegankelijker wordt	★

Illustratieve quotes van deelnemers

"Meer begrip is belangrijk"

"Lijkt me onzin. Ik vervoer (vrijwilligerswerk) o.a. demente bejaarden. Met een beetje gezond verstand heb je helemaal geen training nodig. Als het om rolstoelen gaat, moet je wel weten hoe je die moet tillen, maar ik weet niet of de huidige training te kort schiet."

"Er wordt nog te vaak gedacht dat mensen met een fysieke beperking ook mentaal wat mankeren. Er wordt te vaak over hen hoofden heen gepraat."

"Ja, dit is keihard nodig, maar de medewerkers van de vervoersbedrijven doen hun best. Ze komen om van de trainingen. Jammer genoeg is het personeelsbestand vaak te klein om mensen met een beperking goed te kunnen accommoderen."

"als men weet hoe men met de diverse beperkingen die er zijn moet en kan omgaan, is het werk veel leuker, nuutiger en wordt men daadwerkelijk geholpen. je wordt gezien, gewaardeerd, blijft men als mens met beperking. Voor personeel zo dankbaar werk."

"Dit is echt heel hard nodig. Personeel begrijpt er vaak weinig van. Ik krijg rare opmerkingen als ik bijvoorbeeld vraag van welke lijn een bus is."

Waarom kiezen deelnemers (meer) voor een optie? (Meest genoemde argumenten. Hoe meer sterretjes hoe vaker genoemd)

Argumenten voor 'Ontwikkel een toegankelijk reizen app'	Frequentie	Argumenten tegen 'Ontwikkel een toegankelijk reizen app'	Frequentie
Een app is handig	★★★	Het is al voldoende beschikbaar	★★
Nu is het lastig je weg te vinden	★★	Een app is geen oplossing	★★
Maatregel is handig voor iedereen	★	Andere maatregelen hebben meer prioriteit	★
Kosten efficiënte maatregel	★	Een app is geen oplossing	★
Maatregel bevordert zelfstandigheid	★	Zou niet nodig hoeven te zijn	★

Illustratieve quotes van deelnemers

"Waarop goed te ontdekken is hoe en waar je zelfstandig kunt reizen (bijv. actuele informatie over kapotte liften.....) en waar je hulp nodig hebt."

"er zijn al zoveel apps."

"Wederom, de wirwar aan apps is een verschrikking. Eentje waar alles duidelijk in staat (dus ook de toegankelijkheid) zou voor iedereen handig zijn."

"Hoeft niet want dat is voor mij als bejaarde veel te ingewikkeld."

"Het is fijn om thuis je reis samen te stellen"

"Volgens mij zijn er al apps en tools voor, in elk geval voor visueel beperkte mensen. Liever goed toegankelijk openbaar vervoer dan een app die laat zien welke voertuigen je (niet) kunt nemen."

"ov9292 website werkt prima voor mij"

"Ja dit lijkt mij zo logisch. En belangrijk voor doelgroep. Scheelt mogelijk ook met reisassistentie."

"Er zijn al zoveel apps. Beter is een bestaande app uit te breiden voor mensen met een beperking."

Waarom kiezen deelnemers (meer) voor een optie? (Meest genoemde argumenten. Hoe meer sterretjes hoe vaker genoemd)

Argumenten voor 'Meer reisassistentie'	Frequentie	Argumenten tegen 'Meer reisassistentie'	Frequentie
Mensen met een beperking zijn afhankelijk van reisassistentie om te reizen	★★	Het is al voldoende geregeld	★★
De huidige reisassistentie schiet tekort	★★	Niet nodig als mensen zelfstandig kunnen reizen	★★
Menselijk contact is heel belangrijk	★★	Andere maatregelen hebben meer prioriteit	★★
		Er zijn vaak behulpzame medepassagiers	★

Illustratieve quotes van deelnemers

"Ik zou niet weten hoe ik kan bepalen of ik op perron 6a, b, of 7a of b ben"

"als alles goed toegankelijk is heb je geen/minder assistentie nodig"

"Met meer reisassistentie tussen modaliteiten wordt het voor mij mogelijk om veel vaker een ketenreis te maken."

"Een camagne om medereizigers assistentie te laten uitvoeren, echter alleen op verzoek van de hulpbehoevende reiziger."

"mensen die advies en hulp kunnen bieden op stations evt ook vrijwilligers"

"Het is voor medewerkers vaak niet duidelijk dat ik iemand nodig heb die even rustig uitlegt wat ik niet begrijp. Ik zie er niet uit als iemand die hulp nodig heeft en dus irriteert het mensen als ik niet onmiddellijk begrijp wat ze bedoelen (technische informatie en/of informatie die je op internet of m.b.v. een computer, mobiele telefoon en/of app moet kunnen vinden)."

"Als ik iemand een persoon zie helpen ziet dit er uit dat het met veel liefde en kennis gaat. Lijkt mij voldoende op pijl"

Waarom kiezen deelnemers (meer) voor een optie? (Meest genoemde argumenten. Hoe meer sterretjes hoe vaker genoemd)

Argumenten voor 'Meer rolstoeltoiletten op stations'	Frequentie	Argumenten tegen 'Meer rolstoeltoiletten op stations'	Frequentie
Er zijn nu sowieso te weinig toiletten	★★	Andere maatregelen hebben meer prioriteit	★★
De huidige rolstoeltoiletten schieten tekort	★★	Er zijn al voldoende toiletten	★★
Rolstoeltoiletten zijn noodzakelijk voor mensen met een beperking als ze reizen	★★	Dit is voor iedereen een probleem	★★
Toiletten moeten standaard rolstoeltoegankelijk worden	★	Toiletten moeten vooral goed onderhouden worden	★
		Ik ga niet naar het toilet op het station	★

Illustratieve quotes van deelnemers

"Wenselijk gelet omdat niet in elk vervoermiddel toiletten zit."

"Hoeft niet. Er zijn voldoende"

"hier zijner echt te weinig van, zeker op het platteland"

"Te weinig toiletten is een euvel dat iedereen treft.

Niet alleen gehandicapten."

"Het is wel belangrijk deze voorziening te verzorgen, zeker op de minder grote stations. De beschikbare toiletten zijn vaak smerig of buiten gebruik."

"Er moeten überhaupt veel meer toiletten komen. Nederland is een achterlijk land waar het de beschikbaarheid van openbare toiletten betreft."

"dit was duur"

"Sowieso meer toiletren en maak ze dan gelijk rolstoel toegankelijk"

"Wat er nu is is veel te weinig en de meeste toiletten zijn niet meteen toegankelijk, er moet eerst een sleutel gehaald worden of er moet betaald worden. Maak dit gratis"

Waarom kiezen deelnemers (meer) voor een optie? (Meest genoemde argumenten. Hoe meer sterretjes hoe vaker genoemd)

Argumenten voor 'Geleidelijnen voor mensen met een visuele beperking'	Frequentie	Argumenten tegen 'Geleidelijnen voor mensen met een visuele beperking'	Frequentie
Er zijn nu te weinig geleidelijnen	★★	Het is al voldoende beschikbaar	★★★
Maatregel bevordert zelfstandigheid	★	Andere maatregelen hebben meer prioriteit	★★
Geleidelijnen worden nu niet goed onderhouden	★	Ik weet niet of dit nodig is	★
Kosten efficiënte maatregel	★	Dit is niet de verantwoordelijkheid van ov vervoerders	★

Illustratieve quotes van deelnemers

"Geeft mensen met een visuele beperking meer zelfstandigheid"

"Lijkt me goed zoals het nu is. Wel bijhouden uiteraard en er op toezien dat de geleidelijnen vrij blijven. Ik heb geen signalen dat er nu niet genoeg geleidelijnen zouden zijn."

"Geen flauw idee of dat er al voldoende zijn of niet.""Kleine investering, grote verbetering."

"Handig in gebruik en ook zorgen dat de looplijnen vrij blijven door andere gebruikers erop te wijzen om ze vrij te houden"

"Dit is niet alleen een probleem in het openbaar vervoer: lijkt me dat dit (ook) uit een ander potje kan komen."

"bij renovatie worden oude gewoon verwijderd"

"Als gebruiker van een geleidehond maak ik minder gebruik van geleidelijnen. Geleidehonden maken geen gebruik van geleidelijnen.

Op OV-knooppunten is meer standaardisatie van geleidelijnen nodig. ProRail heeft binnen het eigen domein een standaard toegepast op alle stations. Buiten dat domein is het vaak een zooitje."

Waarom kiezen deelnemers (meer) voor een optie? (Meest genoemde argumenten. Hoe meer sterretjes hoe vaker genoemd)

Argumenten voor 'Meer rolstoelplekken in de voertuigen'	Frequentie	Argumenten tegen 'Meer rolstoelplekken in de voertuigen'	Frequentie
Er zijn nu te weinig pekken	★★	Het zijn al voldoende plekken	★★★
Als er meer rolstoelplekken zijn, kunnen ook meer mensen met een beperking met het ov reizen	★★	Andere maatregelen hebben meer prioriteit	★★★
Vaak zijn plekken al bezet door andere gebruikers	★	Kost ruimte, zo is er minder ruimte voor andere reizigers	★
		Moeilijk te realiseren	★

Illustratieve quotes van deelnemers

"Ik ben een tijdje afhankelijk gewwest van een rolstoel en dat beperkt je mobiliteit enorm. De rolstoelruimte kan in piekuren benut worden voor staplaatsen."

"er is al zo weinig plek in de OV voertuigen, meer rolstoelplekken zijn uiteraard wenselijk, maar waar moeten de overige passagiers dan zitten?"

"Aantal rolstoelgebonden mensen neemt in de toekomst alleen maar toe"

"Ik zie genoeg plekken voor de rolstoelgebruikers. Het probleem zitmeer in de houding van andere reigers om deze plaatsen vrij te maken wanneer deze nodig zijn. Geldt ook voor gezinnenmet een kinderwagen"

"er kunnen nu geen groepjes tegelijk reizen"

"Het aantal rolstoelplekken is tot nu toe voor mij nooit een probleem geweest. Het in- en uit het ov komen is voor mij een veel groter obstakel"

"De plekken worden steeds vaker ingenomen door kinderwagens en door mensen met rollators. Er is behoefte aan meer ruimte voor roelstoelgebruikers"

Appendix G

LCCA clustering results

In this appendix, three additional LCCA results are presented. First, the significance of the indicators is presented, as well as the prioritization per cluster. Second, the personal characteristics per cluster are shown. Third, the presence of various subgroups of PwD in each cluster is examined.

G.1. Indicators

G.1.1. Indicator significance

In table G.1 the p-values are given for each indicator. The 0, 0.5 and 1 references the slider positions each participants could choose between: *same as now, more priority and much more priority*. All indicators were significant at the 0.05 level. That proves that the model can account for heterogeneity between the clusters with respect to the indicators.

Table G.1: Significance levels of the indicators (policy measures)

Attribute	**Level**	**Wald**	**p-value**
More money to repair elevators	0 0.5 1	92.3341	8.90E-21
Wheelchair accessible vehicles	0 0.5 1	17.3589	1.70E-04
Automatic check-in and check-out	0 0.5 1	141.4970	1.90E-31
Training of personnel	0 0.5 1	156.2281	1.20E-34
Accessible PT app	0 0.5 1	145.7343	2.30E-32
Travel assistance	0 0.5 1	163.9834	2.50E-36
Restrooms at the station	0 0.5 1	118.4053	1.90E-26
Guiding paths for blind people	0 0.5 1	143.4925	6.90E-32
Wheelchair spaces in the vehicle	0 0.5 1	197.7195	1.20E-43

G.1.2. Indicator prioritization per cluster

Table G.2: LCCA Indicator prioritization per cluster

	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Overall
Cluster Size	0.2947	0.2721	0.2380	0.1952	
Automatic check-in and check-out					
0	0.5955	0.4907	0.5191	0.7097	0.5554
0.5	0.3716	0.4506	0.4303	0.2751	0.4011
1	0.0329	0.0587	0.0506	0.0151	0.0435
Mean	0.2187	0.2840	0.2658	0.1527	0.2440
Wheelchair accessible vehicles					
0	0.0426	0.9986	0.4314	0.0870	0.4370
0.5	0.8455	0.0014	0.5637	0.8567	0.5174
1	0.1119	0.0000	0.0049	0.0563	0.0457
Mean	0.5346	0.0007	0.2868	0.4846	0.3043
More money to repair elevators					
0	0.0418	0.0081	0.9936	0.1483	0.2772
0.5	0.8277	0.6173	0.0064	0.8159	0.5587
1	0.1305	0.3746	0.0000	0.0358	0.1641
Mean	0.5444	0.6833	0.0032	0.4437	0.4435
Wheelchair spaces in the vehicle					
0	0.7462	0.7311	0.6774	0.9984	0.7489
0.5	0.2461	0.2602	0.3092	0.0016	0.2424
1	0.0077	0.0088	0.0134	0.0000	0.0087
Mean	0.1308	0.1389	0.1680	0.0008	0.1299
Travel assistance					
0	0.7670	0.6074	0.6062	0.9927	0.7000
0.5	0.2197	0.3501	0.3510	0.0073	0.2717
1	0.0132	0.0425	0.0428	0.0000	0.0283
Mean	0.1231	0.2175	0.2183	0.0036	0.1641
Guiding paths for blind people					
0	0.7262	0.6416	0.7213	0.8719	0.7130
0.5	0.2611	0.3348	0.2655	0.1257	0.2717
1	0.0127	0.0237	0.0132	0.0025	0.0152
Mean	0.1432	0.1911	0.1460	0.0653	0.1511
Restrooms at the station					
0	0.9995	0.6382	0.5985	0.0425	0.6967
0.5	0.0005	0.3607	0.4001	0.8635	0.2935
1	0.0000	0.0011	0.0014	0.0941	0.0098

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Attribute	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Overall
Mean	0.0002	0.1814	0.2015	0.5258	0.1565
Training of personnel					
0	0.6822	0.4382	0.5731	0.8422	0.5957
0.5	0.2925	0.4629	0.3768	0.1522	0.3522
1	0.0254	0.0989	0.0501	0.0056	0.0522
Mean	0.1716	0.3304	0.2385	0.0817	0.2283
Accessible PT app					
0	0.7399	0.5578	0.6028	0.9986	0.6750
0.5	0.2492	0.4040	0.3678	0.0014	0.3022
1	0.0110	0.0382	0.0293	0.0000	0.0228
Mean	0.1355	0.2402	0.2132	0.0007	0.1739

G.2. Personal characteristics per cluster

Table G.3: LCCA personal characteristics (covariates) per cluster

Covariate	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Overall
Age					
Younger than 35	0.1739	0.1794	0.0991	0.0890	0.1489
35 to 64 years	0.5657	0.4968	0.4607	0.4412	0.5065
Older than 64	0.2604	0.3238	0.4402	0.4698	0.3446
Gender					
Female	0.5113	0.6283	0.6979	0.6244	0.6044
Male	0.4887	0.3717	0.3021	0.3756	0.3956
PwD affiliation					
Has a disability	0.1423	0.4216	0.2884	0.3959	0.3026
Knows somebody with a disability	0.6283	0.4351	0.5314	0.4831	0.5244
Does not have a disability nor know somebody with a disability	0.2294	0.1433	0.1801	0.1209	0.1731
PT usage					
Frequent PT user	0.5942	0.6700	0.4402	0.7651	0.6115
Sporadic PT user	0.4058	0.3300	0.5598	0.2349	0.3885
Education level					
High	0.7668	0.7865	0.7878	0.8252	0.7837
Intermediate	0.2091	0.1761	0.1594	0.1447	0.1804
Low	0.0242	0.0374	0.0528	0.0301	0.0359
Type of living environment					
Not answered	0.0062	0.0112	0.0051	0.0083	0.0077
I live in a village	0.3033	0.2528	0.3056	0.2687	0.2833
I live in a large city	0.3263	0.3747	0.3181	0.4165	0.3551
I live in a small city	0.3117	0.3107	0.3077	0.2318	0.2949
I live in a rural area	0.0486	0.0506	0.0635	0.0742	0.0577
Prefer not to say / Don't know	0.0039	0.0000	0.0000	0.0006	0.0013
Financial situation					
Not answered	0.0041	0.0060	0.0047	0.0060	0.0051
Easy	0.4223	0.4138	0.4385	0.3462	0.4090
Difficult	0.0217	0.0558	0.0340	0.0582	0.0410
Neither easy nor difficult	0.2124	0.2515	0.2595	0.2734	0.2462
Prefer not to say / Don't know	0.0112	0.0326	0.0139	0.0257	0.0205
Very easy	0.3150	0.2364	0.2435	0.2708	0.2679
Very difficult	0.0133	0.0039	0.0060	0.0197	0.0103

G.3. Presence of PwD in the LCCA clusters

In this section, the presence of various subgroups of PwD in the LCCA clusters established in section 5.3. are presented. The clusters are shown in figure G.1. Additionally, table G.4 presents the amount of people that have or know a disability in each cluster.

The distribution of PwD amongst the clusters is relatively even. Only cluster 1 has few PwD. For people with walking impairments, a significant share is classified as cluster 2. Interestingly, the people that know somebody with a walking impairment are mostly classified as cluster 1.

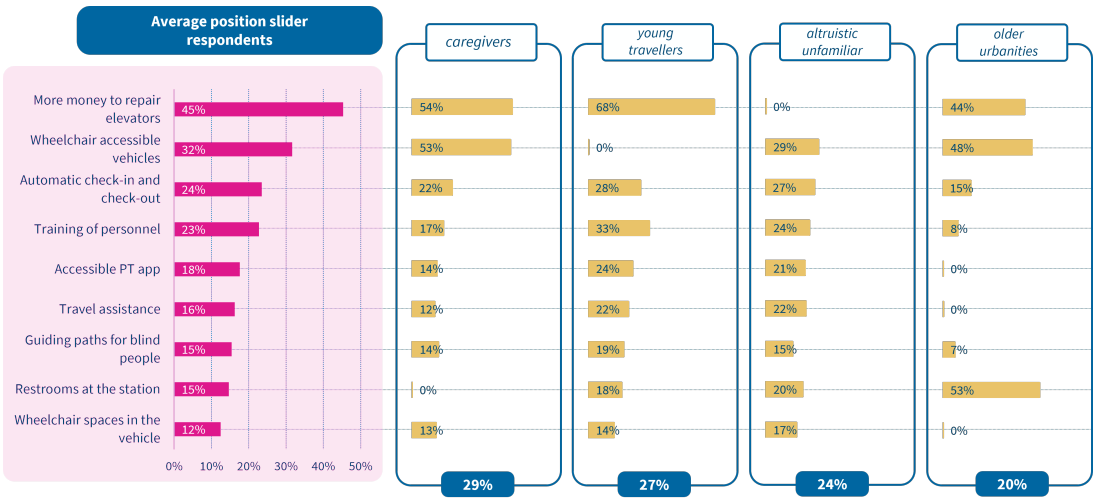

Figure G.1: The elicited preferences of the four clusters with their respective cluster sizes.

Table G.4: Amount of respondents that have a disability or know somebody with a disability, per cluster

	Cluster 1	**Cluster 2**	**Cluster 3**	**Cluster 4**
People with a disability				
Walking	12	70	35	43
Standing / energy	2	9	0	5
Seeing	4	9	14	11
Hearing	2	11	15	16
Speaking	1	3	2	4
Cognitive abilities	5	5	7	6
Stimuli	3	5	3	4
People that know somebody with a disability				
Walking	123	79	71	65
Seeing	53	29	17	65
Hearing	53	29	17	18
Speaking	22	9	7	5
Cognitive abilities	63	40	33	22

Appendix H

PwD descriptive statistics

In this appendix, the occurrence of each PwD subgroup is presented in table H.1. The diagonal represents the amount of people that indicated to have only that disability. All other cells represent how many people have both disabilities. For example, 16 respondents indicated to have trouble with walking *and* seeing. Note that the total of each column represents the total amount of respondents that indicated to have that disability. The total is not necessarily a sum of the above, since some PwD have two or more disabilities.

Table H.1: The occurrence of PwD that have multiple disabilities

	Walking	Standing / energy	Seeing	Hearing	Speaking	Cognitive abilities	Sensitive to stimuli
Walking	**171**	7	16	17	11	13	2
Standing / energy	7	**7**	1	4	1	2	4
Seeing	16	1	**23**	14	3	3	0
Hearing	17	4	14	**34**	2	2	1
Speaking	11	1	3	2	**1**	7	2
Cognitive abilities	13	2	3	2	7	**11**	5
Sensitive to stimuli	2	4	0	1	2	5	**12**
Total	219	21	48	63	15	29	23

Appendix I

Scientific paper

I.1. Abstract

People with a Disability (PwD) often rely on public transport, towards their need for accessibility policies. Knowledge about the user's perspective on accessibility policies is crucial to decide what is most urgent, yet remains limited. Hence, this study researches what accessibility policies people with a disability and citizens in general prefer. The preferences of citizens are relevant, for they illustrate public support for different accessibility measures. To fill this knowledge gap, Participatory Value Evaluation (PVE) is performed in the Netherlands. 1254 respondents, of whom 328 had a disability, advised policymakers on which accessibility policies are most urgent. In the PVE, participants could indicate for nine policy measures whether they should get more priority, subject to an effort constraint. The results show that both PwD and citizens prioritised the repair of broken elevators most, followed by wheelchair accessible vehicles. These policies were prioritised despite the high effort required. The results show great homogeneity of results amongst different disabilities. Participants prioritised policies because of their perceived necessity and effectiveness in helping people with a disability use public transport. The research suggests that people prioritise more expensive, long-term policies that facilitate independent travel for most PwD, over less expensive measures that do not improve independence in the long term. Policymakers and scholars are recommended to focus on the necessity and effectiveness of accessibility policies, prioritising long-term improvements.

I.2. Introduction

Public transport accessibility for people with a disability falls short on a multitude of levels (Mwaka et al., 2024), risking social exclusion (Bruno et al., 2024) and reduced quality of life (Aarhaug & Elvebakk, 2015). The UN recently urged the Netherlands that urgent measures are necessary to improve the accessibility of Public Transport for People with a Disability (UN CRPD, 2024). J. Park & Chowdhury (2021) advise to ask PwD what accessibility improvements *they* would make, for it would help policymakers, practitioners and planners to prioritise projects that focus on inclusiveness.

Multiple studies consulted people with a disability (PwD) regarding the accessibility of public transport (PT) (Almada & Renner, 2015; J. Park & Chowdhury, 2018; Pyer & Tucker, 2014; Bezyak et al., 2019; Edwards et al., 2001; Chiscano, 2021; J. Park et al., 2020). Common methods are interviews (Almada & Renner, 2015; J. Park & Chowdhury, 2018; Pyer & Tucker, 2014) and focus groups (Chiscano, 2021), which allow participants to express what issues they deem important and why. However, many of these studies are plagued by small sample sizes. That makes them less practically useful (Kapsalis et al., 2022). Surveys (Bezyak et al., 2017, 2019; Edwards et al., 2001) and MCA (J. Park et al., 2020) facilitate large response rates but do not offer a detailed overview of why participants made a specific choice. Moreover, they do not always consider monetary or resource constraints.

It is good practise to not just consult minority groups like PwD about their experiences, but include them in the design of accessibility solutions as well (Del Hoyo et al., 2021; Chiscano, 2021). For this purpose, it is vital to apply a method that considers resource constraints. J. Park & Chowdhury (2021) argued that these constraints are the major factor that not all accessibility policies necessary are executed. When considering resources from the common good, not just PwD are relevant. The opinions of the broader public are important as well, for any investment in accessibility needs public support, assuming a democratic decision-making process. Hence, a knowledge gap is identified in the accessibility policies that people with a disability and citizens in general would prefer.

To answer this knowledge gap, our main research question is: *What policies do PwD and citizens in general prefer most with regard to the accessibility of Public Transport for People with a Disability?* Filling this knowledge gap can better inform policymakers, practitioners and planners when prioritising projects that focus on inclusiveness (J. Park & Chowdhury, 2021).

Recognizing this gap, this study proposes a Participatory Value Evaluation (PVE) (Mouter et al., 2021) to be conducted. The PVE has successfully been used to let a large group of respondents prioritise their preferred policies, motivate their choices, all while considering monetary and resource constraints (Bahamonde-Birke et al., 2024; Mouter et al., 2021; Mulderij et al., 2021). Participants can allocate resources to a set of alternatives. Since the resources are scarce, they have to make a trade-off. Next, participants are able to explain their choices. This is the methods strength. It sketches a picture of all considerations and nuances relevant to the policy evaluation (Mouter et al., 2021).

However, a PVE is a novel method when applied to accessibility research in the transport environment. Therefore, part of this research is dedicated to explore the strengths and weaknesses of PVE in the appraisal of accessibility policies. The secondary research question is: *How adequate is a PVE for determining the preferred policies of different subgroups of People with a Disability on Public Transport accessibility?* This research question will be answered by studying the face validity of a PVE. Taherdoost (2016) defines face validity as: *"the degree to which a measure appears to be related to a specific construct."* In other words, the degree to which participants perceive the PVE to be beneficial in the discussion about accessible PT.

I.3. Methods

The main method of this research is a PVE. Bouwmeester (2021) defines five steps in performing a PVE, as presented in figure I.1. The first three steps are conducted by a desk research, literature research and expert interviews, to define the PVEs scope, policy options and design.

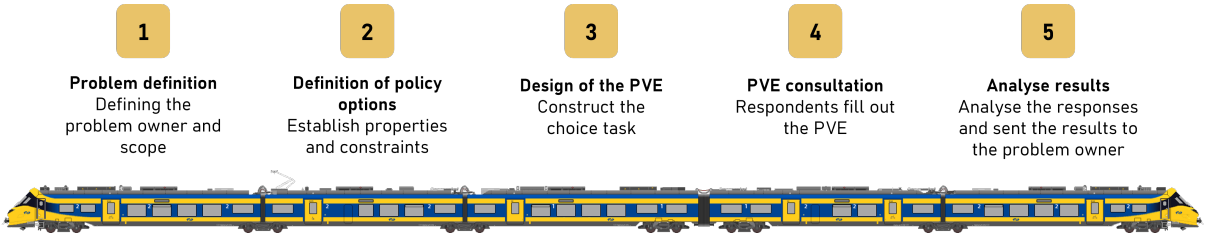

Figure I.1: The five steps of a PVE as proposed by (Bouwmeester, 2021).

I.3.1. Desk research

The desk research has two main goals. First, it is conducted to study the policies that have already been in place in the Netherlands on the accessibility of PT. If effective measures are already taken in one field, it might not be necessary to include this measure in the PVE. Second, the desk research aims to identify topics that are considered important by policymakers. Combining these two sets of information creates an insight in topics that are relevant but are not yet targeted by adequate measures.

I.3.2. Literature research

The literature research helps to define the problem, but its main goal is to obtain an overview of policies that *could* be proposed to the respondents. This ensures consistency of this thesis with the literature. The literature identified 57 policy measures that could be included in the PVE. After two steps of discarding policy measures, 11 measures remain. This shortlist of policies will be brought up during the interviews to discuss further.

I.3.3. Expert interviews

Expert interviews are a common method to determine what policies are relevant in a PVE (Bahamonde-Birke et al., 2024; Golan, 2023). Pfadenhauer (2009) states that expert interviews are suited to complement a literature review. In total, 11 experts from 9 different organisations are interviewed: 4 experts work for a government, 2 work for a semi-governmental organisation, 5 are representatives of PwD or PT users, 3 have a disability themselves. First, the goal of the research was explained to the participants. Then the experts are asked about their vision on the subject and on relevant policies. The experts' opinions were combined as to create a list of policies to be included in the PVE. This list is shown in table I.3.3.. Next, the experts were asked about the resource constraints that hindered the implementation of more accessibility policies. This process is explained more in-depth in the next paragraph.

Table I.1: Overview of Accessibility Improvement Options and Required Effort

Option	**Effort Score (total=100)**	**Simplified Effort**
Make vehicles more wheelchair accessible	21	***
More wheelchair toilets at stations and regional stops	17	***
More money to repair broken elevators	15	***
More travel assistance	11	**
Develop an accessible travel app	11	**
More wheelchair spaces in vehicles	10	**
More training for staff about people with disabilities	7	*
More guiding paths for people with visual impairments	4	*
Make automatic check-in and check-out available for people with visual impairments	4	*

I.3.4. Effort constraint

In the PVE, a constraint variable limited the amount of policies that participants could prioritise, comparable to real-world circumstances. After consultations with the experts, the constraint variable *effort* was preferred over *cost*, for effort also captures non-monetary costs. The precise formulation used in the PVE is: *effort required of the government and PT operators*. It is defined as a combination of:

i. How much money a measure costs

ii. How difficult it is to implement a policy (due to required cooperation, governance, etc.)

To determine the effort required for each policy, three experts provided an estimation: one expert of the Municipality of Amsterdam, one of the Traffic Region of Amsterdam (VRA) and one of ProRail, the owner of the railway tracks in the Netherlands. First, an average was taken of the three experts' estimations. Second, the effort required for the 'cheapest' measures was increased, so that not too many policy measures can get more priority simultaneously and so that the differences between the impacts of one measure and another measure are as small as possible. Consequently, each measure has a minimum impact of 4. Third, the visual representation of the effort required is simplified. For participants, the exact impact is not strictly relevant and can be distracting. Therefore the impacts are simplified into three categories: *low impact, medium impact and high impact*. The maximum effort to be 'spend' is 30. That forces participants to make a trade-off and prioritise policies according to their preferences.

I.3.5. Pilot testing

A draft version of the PVE was tested by 10 people. Three members of the test panel have a disability. Five are interviewed experts. The other five people had never seen a draft of the PVE before. Based

on their feedback, the usability of the PVE was improved, specifically for blind people, as well as the understandability of formulations, length of the survey and correctness of information.

I.3.6. Data collection

The PVE was shared through four means: social organisations representing PwD, the Populytics panel, social media and word of mouth. In total, 1835 responses were given, of which 1254 completed the policy trade-off. To identify different socio-demographic groups, participants received questions about disability status, travel behaviour and personal characteristics such as age, gender, education, income and living area.

I.3.7. Quantitative data analysis

The elicited preferences of different groups will be determined. For each policy measure, participants could indicate that the *effort of the government and PT operators* dedicated to this policy should be the *same as now*, that they should dedicate *more priority* or *much more priority*. These options have corresponding values $\{0, 0.5, 1\}$. Next, for each policy measure m the share of respondents s that gave priority value v was calculated. Next, the average prioritisation a_m can be calculated as $a_m = \sum_v s_{vm} v = \frac{1}{2} s_{0.5,m} + s_{1,m}$.

I.3.8. Latent Cluster Class analysis (LCCA)

A Latent Cluster Class analysis (LCCA) is used to split the respondents in a number of groups that have similar preferences. This is relevant, for it analyses heterogeneity amongst participants. It is useful for policymakers to know which policies can count on consensus and which on disagreement. For the conduction of the LCCA, latent gold is used (Vermunt & Magidson, 2016). Before any analysis, the dataset is filtered as to only include respondents that answered the three socio-demographic questions gender, age and education. Additionally, all answer categories with less than 30 respondents are excluded. A number of PVE questions are combined to create tighter data formats. The questions regarding travel behaviour are summarized into one variable: *PT usage*. Similarly, the questions about disability are aggregated into *PwD affiliation*. This variable splits respondents into three groups, those who have a disability, those who know somebody with a disability and those who do not have nor know somebody with a disability. We compared 2–5 cluster models based on BIC, ultimately preferring a 4-cluster model for interpretability. This model is run on a dataset with only 'complete' answers on the active covariates.

I.3.9. Qualitative data analysis

To understand *why* participants did (not) give a policy priority, 100 random motivations were read per policy. The motivations were categorised into groups, consisting of similar motivations for or against a policy. To understand *how* participants evaluate the PVE, a blank space is provided at the end of the survey where participants can leave additional remarks. "All answers were read manually and categorised into groups consisting of similar responses.

I.4. Results

I.4.1. Descriptive statistics

The sample is not fully representative of the population, as shown in I.2. The answers of respondents are compared to the numbers provided by the Dutch institute of statistics (CBS, 2024, 2025)[1]. The sample is overrepresented by males and highly educated people, while it is under-represented by people younger than 35 and people living in rural areas. Most respondents indicated that it was easy for them to make ends

[1]The CBS uses the age category *15 to 35*. In this research, only people over 16 years or older where able to participate.

meet. It has to be noted that a significant proportion of respondents did not answer all socio-demographic questions. A possible explanation is that respondents did not consider the characteristics to be important. One respondent said the following in the comments at the end of the PVE: *'I find personal questions irrelevant: it's all about opinion'*.

The sample was reweighted on gender, age and education to make the results more generalizable. Having a disability is not considered as a variable to reweight on. Clear data lacks in the Netherlands on the frequency of disabilities. The reweighting method used is Iterative Proportional Fitting (IPF), or 'multiplicatief wegen' in Dutch (CBS, 2008). A general rule of thumb is that it can only be applied if all categories of relevant socio-demographics (for example low, middle and high educated) have at least 30 observations. That is true for this research. To apply reweighting, only respondents that gave an answer to the three socio-demographic questions (gender, age, education) are considered, which are 1002 respondents in total.

Table I.2: Objective socio-demographic characteristics: gender, age, education, province

Question option	Respondents	Percentage	Expected
Gender			
Woman	405	39.74%	50.28%
Man	614	60.26%	49.72%
Other	15		
Prefer not to say	9		
Not answered	211		
Age			
Younger than 35 years	179	14.35%	25.52%
35 to 64 years	658	52.77%	38.86%
Older than 64 years	410	32.88%	20.49%
Prefer not to say	1		
Not answered	6		
Education level			
High	811	78.51%	36.11%
Intermediate	189	18.30%	35.95%
Low	33	3.19%	27.94%
Don't know / Prefer not to say	9		
Not answered	212		
What kind of area do you live in?			
I live in a large city	359	28.63%	
I live in a small city	296	23.60%	
I live in a village	268	21.37%	
I live in a rural area	56	4.47%	
Don't know / Prefer not to say	2	0.16%	
Not answered	273	21.77%	
How easy or difficult is it to make ends meet?			
Very easy	257	20.49%	
Easy	394	31.42%	
Neither easy nor difficult	246	19.62%	
Difficult	45	3.59%	
Very difficult	12	0.96%	
Don't know / Prefer not to say	27	2.15%	
Not answered	273	21.77%	

I.4.2. Policy preferences of citizens in general

The reweighted results of the choice task show that participants dedicated effort to all policies, but a few measures get significantly more priority as presented in figure I.2.

The repair of broken elevators was the top priority for respondents. Notably, over 15% of partici-

pants stated that this policy should get *much more priority*, a significant share of the sample population. Wheelchair accessible vehicles [2] is the second most prioritised policy and can therefore be marked as crucial. A large amount of the respondents gave more priority to automatic check-in and check-out and training of personnel. The latter was indicated more often as deserving *much more priority*.

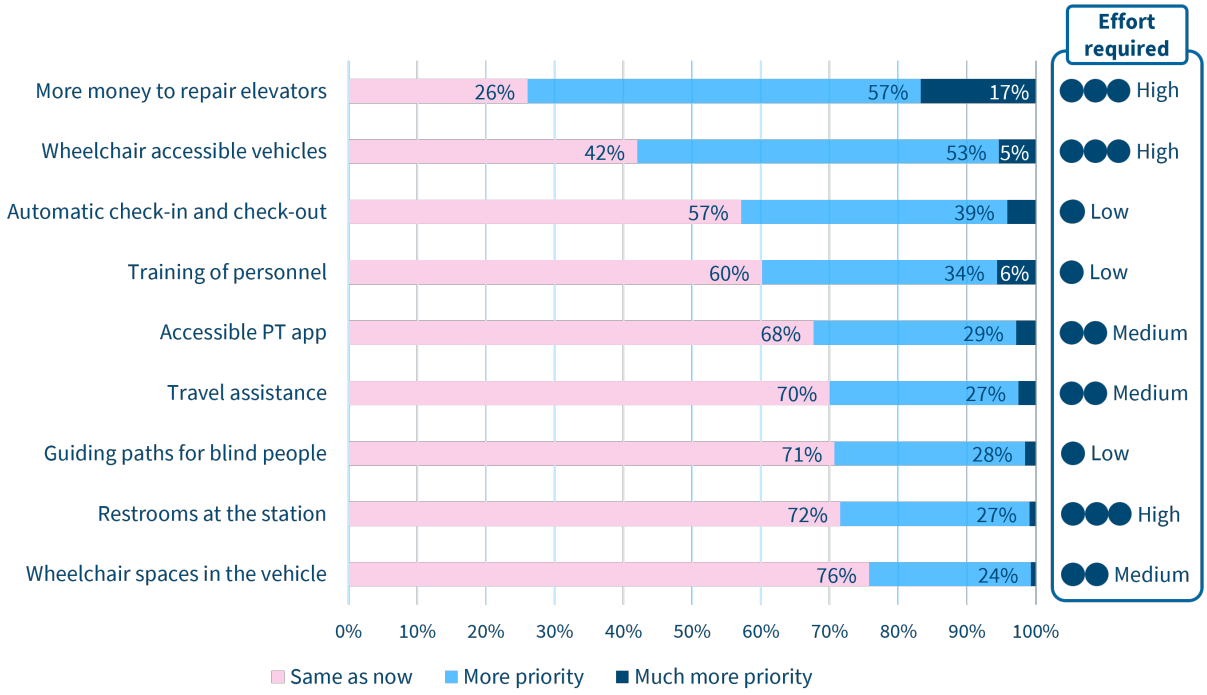

Figure I.2: The elicited preferences of participants in the choice task

The outcome of the choice task can be partially explained by the required effort of each policy measure. More money to repair elevators and wheelchair accessible vehicles are chosen by participants, *despite* requiring the most effort. Both automatic check-in and check-out and training of personnel cost little effort, which might explain why a large share of people gave priority to these measures. Regarding the policies that require a mediocre amount of effort, the accessible PT app was considered to be most urgent.

I.4.3. Policy preferences of PwD

The elicited preferences per subgroup of PwD are discussed. Note that some people have multiple disabilities. In this case, their preferences are shown for each of the disabilities they indicated to face.

In figure I.3 the preferences of people with difficulties walking, standing, low energy levels, seeing and hearing are presented. The first thing to note is that their preferences do not vary greatly. Moreover, all groups give all measures at least some extra priority. The biggest difference is the prioritisation of training for personnel. People who have difficulties standing or have low energy levels in general prioritise it 11 percentage points more than the general population. Likewise, they give more priority to travel assistance. This indicates that this group does benefit from assistance but does not necessarily feel heard by PT staff. The last thing to note is that people that have difficulties seeing give less priority to wheelchair accessible vehicles but more priority to automatic check-in and check-out and guiding paths for blind people.

In figure I.4 the preferences of people with difficulties speaking, cognitive disabilities or difficulties coping with stimuli are presented. Additionally, the preferences of people who indicated to not have

[2] Note that wheelchair accessible vehicles not only encompasses the accessibility of the vehicle itself, but also the platform or stop.

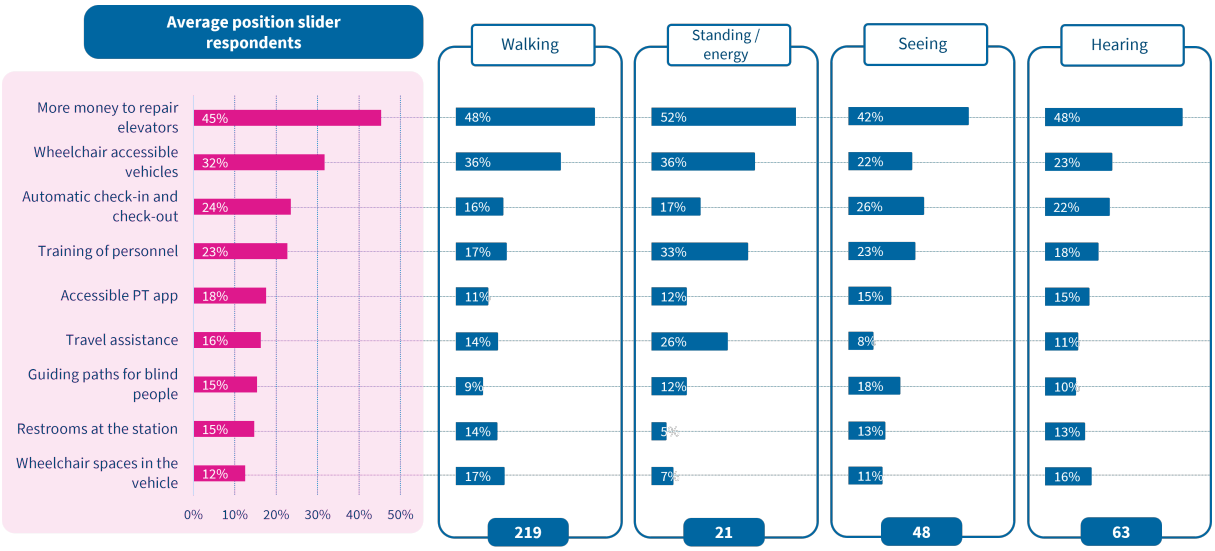

Figure I.3: The elicited preferences in the choice task, broken down to disability type. On the left, the general preferences of citizens are shown. The bottom boxes indicate the amount of individuals that self identified to have this disability.

any disability are shown. Again, all groups give elevators the most priority. But, people with reduced cognitive abilities and people sensitive to stimuli devote much effort to travel assistance and the training of personnel. It shows that these group, just like people with low energy levels, does not necessarily feel heard by PT staff. Additionally, people with reduced cognitive abilities prioritise an accessible PT app more. People sensitive to stimuli prioritised an app less, indicating that this might not be a solution for them. Lastly, people with difficulty speaking prioritised elevators, wheelchair accessible vehicles, wheelchair spaces and guiding paths. The measures this group focused on are aimed to let PwD travel independently. Regarding wheelchair spaces, this group might prefer them to be empty, so that they do not have to 'speak up' to claim their spot.

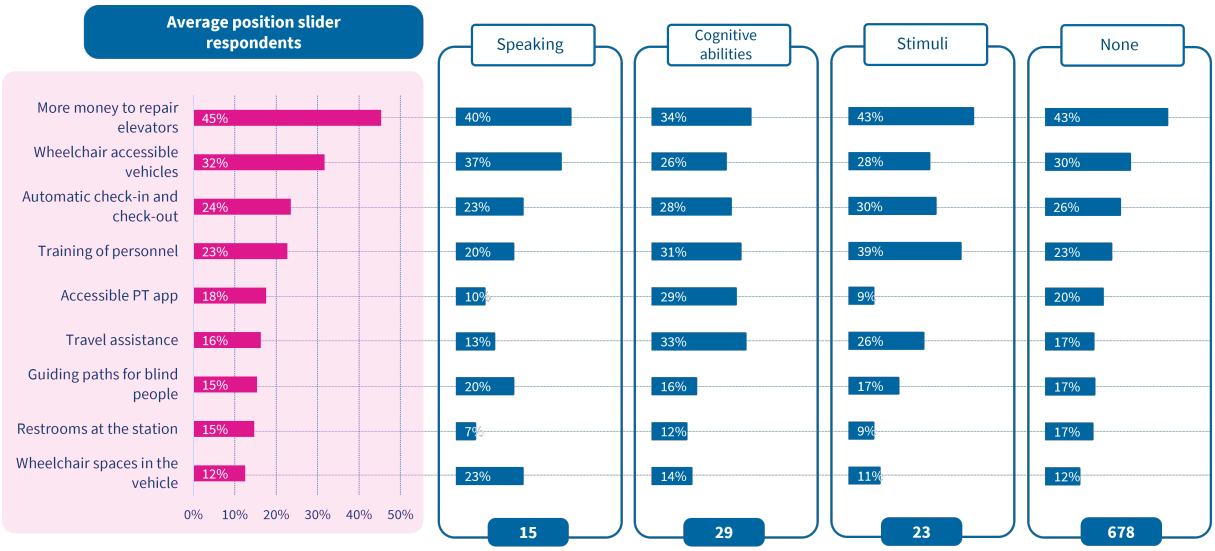

Figure I.4: The elicited preferences in the choice task, broken down to disability type. On the left, the general preferences of citizens are shown. The bottom boxes indicate the amount of individuals that self identified to have this disability.

I.4.4. Latent Cluster Class analysis (LCCA)

All policy measures are significant at the 0.05 level, as shown in table I.3. Of all personal characteristics, or covariates, considered, only four are significant: *gender* and *age*, *PwD affiliation* and *PT usage*.

Table I.3: Significance levels of the covariates (personal characteristics)

Covariate	**Wald**	**p-value**
Age	22.7251	0.00089
Younger than 35		
35 to 64		
Older than 64		
Gender	19.7284	0.00019
male		
female		
PwD affiliation	17.7039	0.007
Has a disability		
Knows somebody with a disability		
Does not have a disability nor knows somebody with a disability		
PT usage	12.0728	0.0071
Frequent PT user		
Sporadic PT user		

In figure I.5, the results of the LCCA are shown. Note that the clusters are never black and white. People cannot simply be distributed amongst a set of 'types' for each participant makes their choices on a unique set of experiences. Nevertheless, the clusters could provide insights into the types of answers people gave in the PVE survey. Clusters are mostly formed based on the indicator values. Three indicators, or policy measures, are most striking. Elevators and wheelchair accessible vehicles are given more priority by the majority of cluster 1, while they get no priority in cluster 3 and 2 respectively. Restrooms at the station, the third policy that requires high effort, is given the most priority by cluster 4, while it received no priority from cluster 1.

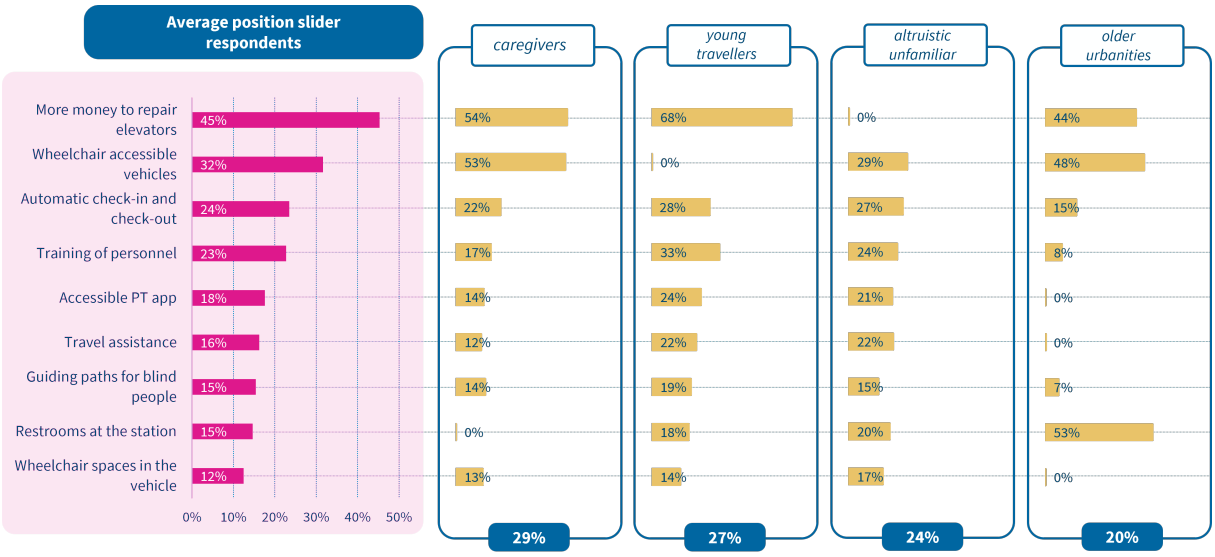

Figure I.5: The elicited preferences of the four clusters with their respective cluster sizes.

Cluster 1, nicknamed *caregivers*, mostly gives priority to wheelchair accessible vehicles and broken elevators. Almost nobody of this cluster gave priority to wheelchair accessible toilets. The cluster consists of relatively few PwD, but relatively many people that know somebody with a disability. Furthermore, the cluster consists of relatively few older people. Cluster 2, nicknamed *young travellers*, opted for elevators

and not for wheelchair accessible vehicles. This cluster did not strive to make PT 'fully accessible'. Instead, it prioritised a set of measures that can quickly help PwD to use PT, such as reliable elevators, the training of personnel and automatic check-in and check-out. This cluster consists of relatively many PwD, frequent PT users and young people. Cluster 3, nicknamed *altruistic unfamiliar*, did not choose to spend money on elevators. Instead, it distributed the available effort relatively evenly over all other policies. They want to address as many issues as possible. The cluster consists of many sporadic PT users. It consists of less PwD than clusters 2 and 4, but of more PwD compared to cluster 1. It consists of relatively many older people, males and people with a low education. Cluster 4, nicknamed *older urbanities*, choose three policies predominantly: the repair of elevators, wheelchair accessible vehicles and restrooms at the stations. It has many frequent PT users and PwD. Most are older people and most live in a big city. There are relatively few young people in this group. When contrasting cluster 4 to cluster 1, one can see that PwD that opt for wheelchair accessible vehicles, often opt for wheelchair accessible restrooms as well.

I.4.5. Motivations

In this section, the types of motivations that respondents gave are presented. First, the motivations given *for* the policies are discussed. Second the motivations *against* are deliberated upon.

Two types of motivations are given most often as a justification *for* a policy. First, most respondents chose a policy because they considered the status quo to be unacceptable on that point. Second, a lot of motivations to prioritise a policy can be summarized as: 'it helps PwD to use PT'. A related argument is that a policy increases the independence of PwD. Interestingly, the argument that a policy helps other travellers as well was not given as often. It indicates that people do not primarily select policies based on self-interest, but rather focus on the interests of the focus group, in this case PwD.

Three types of motivations are given most often *against* a policy. First, the most common argument is that something is already sufficient in the status quo. To give training of personnel as example: a lot of people said that personnel already did their best, or that there is already enough training for personnel. Secondly, an often cited reason to not prioritise a policy is that other policies should get more priority instead. The third most cited motivation against a policy is that the given measure is not effective or infeasible. Required effort or 'fairness' are cited way less often. That suggest a consensus on the need of accessibility policies, but disagreement on which problems are the most urgent.

I.4.6. PVE validity

In this section, the face validity of the PVE is discussed. This is done in three ways. First, the critiques respondents gave on the research are discussed. Second, the responses to the face validity statements are reviewed.

The average grade given to this PVE by respondents was a 6.94. The PVE survey gets a 'generous pass', meaning that most respondents were positive about the research. Naturally, some respondents were less positive. Four topics are touched upon that came up several times. First, a large number of people criticized the effort constraint, arguing that such a constraint is 'unethical'. Second, a smaller group did not agree with the focus of the research on policies aimed to help PwD. They argued that accessibility for PwD is not important at all or less important than other problems society faces. Third, the scope of the research was debated, more specifically the absence of a number of accessibility policies. Three policies were considered to be missing: the coverage area of PT, the cost of PT and paratransit. Fourth, the possibility of people without a disability participating in this research was debated. Interestingly, most people that commented on this point were the people without a disability themselves. They felt like they were not able to make proper judgements because they did not know enough about the subject.

The answers to the five face validity statements are discussed. In table I.4 the responses are shown. In the first statement, The 60% of participants stated that they *were able to express their opinion*. 16% of respondents did not feel this way, for example because they did not like the constraint variable. Second, the statement with the most positive response was *I think this is an important topic*, 75% (strongly)

agreed. Third, only 6% of participants indicated that the PVE was *difficult to understand*. It shows that the PVE is able to simplify a problem enough so that citizens can give their opinion in a short amount of time. Fourth, 67% of respondents believes that *this tool should be used more often to make policies about accessibility*. This does show that a wide majority of respondents believe that a PVE is a valid way to advise policymakers about accessibility. Lastly, 44% indicated that they learned something about the choices that need to be made and about the topic.

Table I.4: Responses to face validity statements (%)

Statement	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	Don't know / Prefer not to say	Total
I was able to express my opinion.	14%	46%	23%	12%	4%	1%	100%
I think this is an important topic.	30%	45%	19%	3%	1%	1%	100%
I found the material difficult to understand.	2%	3%	10%	36%	48%	0%	100%
This tool should be used more often.	22%	45%	25%	4%	2%	2%	100%
I learned something about the choices and the topic.	6%	38%	36%	14%	5%	2%	100%

I.5. Conclusions, discussion and recommendations

A Participatory Value Evaluation (PVE) is performed in the Netherlands to identify the accessibility policies that people with a disability and citizens in general prefer. In total, 1254 participants completed the policy trade-off in the PVE, of which 328 have a disability.

I.5.1. Main findings

We found that repairing broken elevators was found to be the top priority to make PT more accessible for PwD, answering the primary research question. It was cited as crucial by all subgroups of PwD and by non-PwD, across socio-demographics and across different travel patterns. Other studies also cited broken elevators as a barrier towards the use of PT (Stjernborg, 2019; Pyer & Tucker, 2014). However, this study stands out for identifying broken elevators as the top priority for PwD travellers. Literature studies Mwaka et al. (2024) and Unsworth et al. (2019) did not identify elevators as the main barrier of PT. Bezyak et al. (2017) found that 'only' 17% of respondents (consisting of PwD from various subgroups) encountered problems with elevators. The findings of this study imply that in the Netherlands, a much bigger group faces issues due to elevators being out of order.

The policy measure that respondents gave the second most priority is wheelchair accessible vehicles. All subgroups of PwD indicated that this is one of the most urgent policies. Only people with visual and hearing impairments prioritised it lower, albeit still relatively high. The importance of wheelchair accessible vehicles is in line with previous research (Bezyak et al., 2017; Mwaka et al., 2024; Friman & Olsson, 2023; Almada & Renner, 2015).

Participants gave policies priority because of their perceived *necessity* and *effectiveness*. Necessity means that participants considered the status quo to be unacceptable. Effectiveness means that a policy

measure could help PwD to use PT. In the PVE, respondents show altruistic and moral considerations, in line with previous findings in other fields (Mouter et al., 2021). For example, the different subgroups of PwD also select policies that do not benefit them directly.

This study is the first to apply a PVE to the field of accessibility. Respondents can prioritise what they deemed most important, under scarcity. J. Park & Chowdhury (2021) argued that this scarcity is the major factor that not all accessibility policies necessary are executed. A PVE can therefore help policymakers to determine what policies are most urgent. A PVE is able to accommodate large sample sizes, also among PwD, maximizing its practical usefulness (Kapsalis et al., 2022). Moreover, a large majority of respondents supported the use of PVEs for future decision-making processes, in the field of accessible PT for PwD.

I.5.2. Limitations and future research recommendations

Scholars are encouraged to build upon the findings of this research, while keeping in mind its limitations. First a general limitation is given. Next, three limitations are discussed and future research directions are proposed.

First, this research studies *perceived* accessibility, which is inherently distinct from *objective* accessibility (Moleman & Kroesen, 2024). The results do not provide an objective metric on which components of PT are accessible. But it does show which policies are believed to improve accessibility for PwD. This is relevant, since perceived accessibility determines peoples decision to travel.

Second, a number of respondents criticised the limited scope of the research. Specifically, the coverage area of PT, the cost of PT and paratransit were cited to be relevant, yet not investigated in this research. Future research could apply a broader scope that exceeds PwD accessibility policies alone. In this case, it is advisable to narrow down the geographical scope, for geographical exclusion and the quality of paratransit are both location specific. Thus scholars could apply the PVE method, a proven user-centric approach, to accessibility policies at a local level.

Third, respondents self-identified as two novel subgroups of PwD that were not included in the initial design of the PVE: people who are extra sensitive to stimuli and people who have low energy levels. These groups have distinct preferences and thus distinct needs. However, this research also found that a lot of PwD have multiple disabilities, suggesting the need for an integrated, intersectional (Crenshaw, 1991) approach.

Fourth, this research was not fully accessible for people with a visual impairment. The approach did allow for a 48 people with a visual impairment to participate. Nevertheless, future research should test the accessibility professionally, for all types of PwD. Additionally, surveys could be offered via calling or on paper.

I.5.3. Policy implications

The repair of broken elevators was as a top priority for PwD and citizens in general. All subgroups of PwD expressed that reliable elevators are the most urgent measure, *despite* its high cost. The main way to increase the uptime of elevators is to spend more money on maintenance contracts. Additionally, preventing vandalism could be effective.

Wheelchair accessible vehicles are the second most urgent measure. Many respondents rather prioritised this policy than prioritising multiple, less expensive policies. Participants preferred more expensive, long-term policies that facilitate independent travel for most PwD, over less expensive measures that do not improve independence in the long term. Based on these findings, policymakers are urged to accelerate the transition towards fully accessible vehicles, platforms and stops.

Automatic check-in and check-out is a promising innovation that can make it easier and quicker for PwD to use PT, especially for people with a visual impairment. Policymakers are urged to implement this measure in the Netherlands.