More Than a Traffic Jam

Understanding Commuter Segmentation and the Daily Challenges of Corporate Mobility in the Netherlands

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Executive Summary

With increasing pressure on corporations to meet sustainability goals and mitigate regional traffic congestion, understanding and influencing employee commuting behavior has become an important management challenge. Standard mobility policies often fail to produce the desired results due to the complex and diverse nature of commuter motivations. To move beyond the ineffective 'one-size-fits-all' solutions and to develop more people-focused policies, it is first necessary to understand exactly how different groups of employees perceive their travel options. Therefore, this research answers the main research question:

"To what extent do different employee segments in the Netherlands vary in the enablers and barriers they perceive when making commuting decisions?"

To answer this question, a mixed method approach was implemented. The quantitative analysis was performed on the Landelijk Reizigersonderzoek (LRO) dataset. This large-scale, national dataset was chosen for its broad scope, providing a representative sample of commuters across the Netherlands and thus making the findings more generalizable. Latent Class Analysis (LCA) was selected as the method to identify the different segments because, unlike other clustering techniques, it handles categorical survey data well and identifies segments based on similar response patterns, leading to more robust and interpretable commuter profiles. This quantitative part was complemented by a qualitative case study at ASML. Semi-structured interviews were conducted to explore the daily commuting experiences in depth. This method allowed for flexible, confidential conversations, allowing for a good understanding of the contextual factors and personal motivations behind travel decisions.

The quantitative analysis identified distinct commuter segments for car, public transport, and bicycle users, each with a different profile. Beyond finding two overarching types of "habitual" and "responsive" commuters, the study revealed more differences within each transport mode. For example, within the car-only commuters, segments ranged from those highly sensitive to costs and the practical barriers to other modes, to convenience-oriented drivers and a disengaged group who appeared to be driving out of routine. Similarly, public transport users included financially driven long distance commuters as well as convenience focused travelers. Finally, the bicycle-user segment showed a strong focus on practical facilities, with a secure bike storage being the highest rated enabler for cyclists overall. This demonstrates that motivations vary significantly among users of the same transport mode, showing the need for targeted policies.

The qualitative case study revealed the complex daily realities of commuting. Notably, the research identified the last mile problem as a major barrier to public transport, where an inefficient final connection to the office can severely reduce the attractiveness of the entire commute option. The commute itself was shown to have an important psychological function, serving as a mental buffer between work and home. This positive experience, especially for cyclist enjoying a scenic route, contrasts with the stress of traffic congestion. Employees show behavior to manage this stress by starting their journey very early to avoid peak-hour traffic. The availability of parking and the stress of finding a spot were also major factors influencing daily travel decisions. Lastly, social influences such as the network effect and financial considerations (though context dependent) also shape commute behavior.

The research demonstrates that creating effective mobility strategies requires a deep, segmented understanding of the workforce. The findings indicate that commuter attitudes and values are good predictors of behavior, suggesting a move towards policy design based on these factors rather than on demographic categories alone. Furthermore, the study shows that the effectiveness of incentives depends on the complete door-to-door commute, as an inconvenience in one part of the commute can undermine a major policy. More broadly, the acceptance of any new mobility policy is strongly linked to employee perceptions of its fairness and the availability of good alternatives. Lastly, the research

shows that commuting decisions are a complex trade-off between practical needs, financial considerations and the desire for a predictable, low-stress experience.

Based on the findings from this research, several recommendations are proposed for the case company and other large organizations facing similar mobility challenges. First, to address the last mile problem, a two-sided approach is recommended, to continue and strengthen collaboration with governmental bodies and municipalities to improve public transport services to the main campus and explore the potential of other remote office hubs to reduce the frequency of long-distance commutes. The approach to financial incentives should be one of optimization. It is recommended to maintain high-value subsidies like the free public transport pass, while understanding that for smaller incentives, like mileage reimbursements, their impact is limited to being a minor benefit for existing commuters, with their potential to enable a mode shift for others remaining an open question.

A new approach to parking is also suggested, implementing a fair and managed system to regulate demand. This should be paired with making facilities for sustainable alternatives visibly superior, for example by expanding the premium carpool spots and supplying them the facilities needed. These investments should be prioritized over the construction of more general parking spaces as this was proven to only lead to more car usage. Finally, to unlock the potential of promising alternatives like carpooling, it is important to address key barriers, for example by exploring a 'Mobility Guarantee' to increase flexibility.

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List of Abbreviations

Abbreviation	**Definition**
AI	Artificial Intelligence
ASML	Advanced Semiconductor Materials Lithography
BIC	Bayesian Information Criterion
BVRs	Bivariate Residuals
CSDD	Corporate Sustainability Due Dilligence
CSRD	Corporate Sustainability Reporting Directive
EU	European Union
EV	Electric Vehicle
GHG	Greenhouse gas
LL	Log-Likelihood
PT	Public Transport

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1
Introduction

About one quarter of global greenhouse gas (GHG) emissions are accredited to the transport sector, and in developing countries this number is estimated to be even higher: around 30% (United Nations, 2021). Looking further into this number, 75.2% of the total transportation sector emissions are caused by road transport (Statista, 2023). This is further supported by the European Environment Agency, (2024), reporting that road transport emitted 73.2% of all EU's transport GHG-emissions. Within road transport, about sixty percent stem from passenger travel; cars, motorcycles and buses (Ritchie, 2020)

Commuting plays a significant role in these emissions. In 2016, 18% of the road transport in the UK was estimated to be due to commuting, with 68% of all business journeys being made by car (Sutton-Parker, 2021) . Given that roughly 50% of the EU population owns a car, car dependency remains deeply embedded in mobility patterns (CBS, 2019). Additionally, the spatial impact of automobility is substantial. Cars are parked for 95% of the time and occupy roughly 8-12 m^2 per parking space (Shoup, 1997). Without intervention, these trends are unlikely to change, particularly as urban populations and mobility continue to grow.

Businesses and policymakers play a key role in enabling the shift away from commuting by car as corporate mobility policies can directly influence employee commuting behavior. Understanding how these policies influence commuting mode choices is important for designing effective measures that promote sustainable alternatives.

1.1 Background and Context

On a global scale, as urban populations continue to grow and work locations become more centralized, businesses and policymakers are making efforts to decarbonize transport systems. These efforts include the electrification of vehicles, improving public transport, and expanding cycling infrastructure. However, despite these investments, a paradox emerged as car dependent commuting behavior has proven resistant to change (Cass & Faulconbridge, 2016; Mattioli et al., 2020). This resistance is shaped by a complex interplay of societal and economic barriers that reinforce car dependency (Batty et al., 2015). Furthermore, many corporate mobility policies fall short because they often overlook deeper behavioral factors, particularly the impact of deep embedded commuting habits (Farahmand et al., 2021).

This paradox is also visible in the Netherlands. Although internationally the country is recognized for its cycling infrastructure (and culture), a large portion of work-related travel is still made by car. Data from Landelijk Reizigersonderzoek (2024) highlights the continued car dependency. Total car vehicle kilometers increased by 1%, peak hour traffic intensity rose by 3.8% and vehicle delay hours increased by 9% compared to 2023. Commuting related CO2-emissions decreased by 0.8%, however this was mainly due to improved vehicle efficiency, rather than behavioral change. Simultaneously, fewer employees met physical activity guidelines via commuting, demonstrating the health aspect of this problem.

Beyond the broader societal and environmental consequences, the daily commute also has effects on both employees and the organizations they work for. Long or unpredictable commutes have been linked to higher stress, lower job satisfaction and reduced workplace performance (Chatterjee et al., 2020; Wener & Evans, 2011). These outcomes can contribute to higher absenteeism, lower employee retention and increased organizational costs. Therefore, commuting is not only an environmental issue, but also a factor influencing employee wellbeing and business performance.

To address commuting-related emissions, mobility policies often rely on "push" and "pull" measures. Push measures aim to discourage car usage through for example higher parking fees, less parking availability, restricted access and increased car-use taxes (Melkonyan et al., 2022). Pull measures on the other hand aim to make sustainable options more attractive. This can be done for example through improved cycling infrastructure, reduced public transport fares or park-and-ride facilities (Zarabi et al., 2024). Although push measures have proven to be effective, they often face opposition due to perceived constraints on individual freedom and more coercive nature (Keizer et al., 2019; Wicki et al., 2019). Pull measures however are generally more accepted. This especially holds when they are combined with educational campaigns and viable alternatives which led to a more lasting change in behavior (Zarabi et al., 2024).

In addition to these policy tools, a wide set of factors have been found to influence commuting mode decisions. Studies often include the roles of socio-demographics (e.g. age, income, gender), built environment (e.g. distance to work, proximity of public transport stops), workplace incentives (e.g. parking facilities, financial reimbursements), and psychological influences (e.g. habits, social norms) (Ko et al., 2019; Lo et al., 2016; L. Yang et al., 2015). However, the results in the literature vary. Fraser & Lock (2011) and Muñoz et al. (2016) claim that men cycle more than women, whereas Heinen et al. (2010) found that women are found to cycle more often than men. Similarly, van Wijk et al. (2017) found that higher education level is linked to higher cycling levels, whereas Muñoz et al. (2016) reported mixed results.

However, not all commuters react to these factors in the same way. Commuter segmentation deals with this by grouping individuals together based on shared characteristics to identify subgroups. These subgroups often differ in their commuting behavior, motivations and barriers (De Angelis et al., 2021; Molin et al., 2016). For the purpose of this research, a 'segment', 'subgroup' or 'cluster' is therefore defined not just by simple demographics, but by a combination of shared attitudes, motivations and barriers. The existence of these distinct, attitudinally driven segments reinforces that a one-size-fits-all approach is unlikely to be effective and that instead targeted efforts or segmentation strategies are needed to support behavioral change (Haustein et al., 2024; Hopkinson, 2022). Notably, research shows that within certain clusters, change is possible. For example, research has shown that even within a behaviorally defined group like 'car-only drivers', distinct segments exist, such as a group that is willing to change modes if public transport quality improved (Farber & Marino, 2017). Identifying and understanding cluster-specific needs can uncover opportunities for a change in commute mode.

Although governments are typically responsible for regulation and infrastructure, businesses increasingly face expectations to align with environmental sustainability goals. A significant, though often indirect, part of a company's environmental footprint is generated by its employee commuting (European Comission, n.d.). This aspect of corporate sustainability is gaining attention through both voluntary measures and new regulatory initiatives. For example, the Corporate Sustainability Reporting Directive (CSRD) and Corporate Sustainability Due Dilligence Directive (CSDD). These require companies to assess, report and reduce their environmental impacts, which can include those from employee travel (European Commision, n.d., 2021).

Corporate mobility policies have the ability to shape employee travel decisions directly through kilometer allowances, parking availability or bike facilities but also indirectly through flexibility in working hours or locations. Petrunoff et al. (2015) showed that parking management strategies (such as parking pricing, access restrictions and supply controls), when combined with incentives for active travel, led to a reduction in car commuting. Continuing on this, next to parking management, Van Malderen et al. (2012) found that the provision of cycling facilities such as changing rooms and storage as well as financial incentives also play an important role in shaping mobility. The indirect effects of workplace policies were shown by Kalasová et al. (2024) who found that adjusting work hours and enabling remote work can significantly reduce peak-hour car usage.

ASML, a rapidly growing company in the semiconductor industry based in the Netherlands, provides a relevant case for this study. The company already promotes sustainable commuting through various measures; a €0.35/km allowance for cycling, free public transport passes, bike purchase subsidies but also good biking facilities such as parking and shower facilities. Despite the amount of company (lease) cars being negligible small, commuting at ASML is heavily car-oriented with a daily average of about 52% of the employees coming to the office by car. With thousands of new employees expected to join in the coming years, understanding how to improve the impact of the mobility policy is an important case (BNR, 2025; NOS, 2024). As mentioned before, the matter is not only an environmental or infrastructural issue, but also for employee wellbeing, operational efficiency and long-term strategy (Chatterjee et al., 2020; Wener & Evans, 2011).

Although existing research provides some insights into mode-specific attitudes, there is limited understanding of how these attitudes differ across employee segments and withing an organizational context. General patterns can be observed based on large-scale data, but they often lack the personal characteristics, perceptions and circumstances. This research aims to address that gap by looking at how different employee segments perceive enablers and barriers to each commute mode, and by using a case study to explore this interplay in more context.

1.2 Problem Statement

The persistence of car-dependent commuting, as described in the previous section, creates significant real-world problems. For society, it leads to increased traffic congestion, environmental pollution and related public health issues. For businesses, this issue is two sided. First, resources are being allocated to mobility policies that are not well aligned with the actual needs and motivations of their diverse workforce, and thus leading to ineffective results. Secondly, stressful commutes can negatively impact employee well-being and the company's ability to retain talent. This issue is further challenged by new, stricter, regulatory pressure for companies to reduce their environmental footprint, a goal which current commuting patterns make it difficult to achieve.

This situation leaves corporate policymakers in a difficult position. Although there is a growing understanding that general 'one-size-fits-all' solutions often fail to achieve the desired result, this awareness is not always widespread. And even for those policy- or decisionmakers who do recognize this, they often lack detailed in-depth understanding of their diverse employee population that is needed to design more targeted and effective measures. Without specific knowledge of what motivates or presents a barrier to different groups of employees, creating policies that are both effective and well received can be challenging.

Therefore, the main problem is the large mismatch between general policies that companies often use and the very personal and diverse reasons that shape how employees decide to commute. Because of this, a policy might solve a problem for one group of commuters, while offering a service that does not matter to another. This difficulty in creating targeted, more personal, policies for different types of commuters is a challenge that is holding back a shift towards more sustainable corporate mobility.

1.3 Knowledge Gaps

Despite extensive research on commuting behavior and corporate mobility policies, some notable gaps remain in the existing literature:

Although individual commuting determinants such as socio-demographic characteristics, infrastructure quality, and policy incentives have been studied extensively, few studies investigate how combinations of these factors interact and influence commuting decisions across distinct commuter segments. The existing research often identifies general enablers and barriers, but provides limited insight into which specific groups of commuters are most affected by them. Therefore, a knowledge gap remains in understanding how different commuter groups experience specific barriers and enablers differently.

While commuter segmentation methods have been applied in several studies within the Dutch context, they often stop at identifying clusters based on quantitative variables used. There is a lack of follow-up qualitative research that investigates these segments more deeply to understand the story behind the numbers. Without this qualitative exploration, the underlying motivations, daily experiences and context specific barriers of these segments remain unclear, limiting the practical value of the segmentation. This research addresses this gap directly by complementing a quantitative segmentation with a qualitative case study, aiming to make the findings more actionable for organizational decision makers.

This research addresses these gaps by integrating quantitative segmentation from the LRO-data with qualitative insights from a case study at ASML. The national-level segmentation provides a broad view of mode specific attitudinal indicators, while the ASML case study enables a deeper understanding of how employee segments experience specific enablers and barriers in practice.

1.4 Research Objectives

This research aims to provide insights that can help businesses and decision-makers create more effective mobility policies. To do this, the research uses a mixed-methods approach that combines a quantitative analysis with a qualitative analysis. The first part uses a large scale quantitative analysis to identify what different commuter segments exist on a national level. The second part uses a qualitative case study to explore the daily experiences and contextual factors that help to explain the choices of these segments. By combining the wide view of the quantitative data with the insights from the interviews, this research seeks to provide a more complete and practical understanding of employee commuting. To guide this process, the following objectives have been set:

1. To identify and characterize different commuter segments within the Netherlands by quantitatively analyzing their perceived barriers and enablers, socio-demographics and commuting context.
2. To use a qualitative case study to explore the daily experiences and contextual factors that help explain the commuting decisions of the identified segments.
3. To combine the quantitative and qualitative findings in order to provide practical insights that can support the development of more effective and people-focused corporate mobility policies.

1.5 Main Research Question and Sub-Questions

To address the main problem of this thesis, the following main research question has been formulated:

To what extent do different employee segments in the Netherlands vary in the enablers and barriers they perceive when making commuting decisions?

To address this question, the main question is broken down into three sub-questions that guide the structure of this thesis:

SQ1: What insights does the existing literature reveal about employee segmentation based on commuting behavior, perceived enablers and barriers, and responsiveness to employer mobility policies?

Answering this question will help to create the theoretical basis for the thesis. The insights from the literature review will later be used to put the findings from this research into perspective with the current academic research.

SQ2: Which distinct commuter segments can be identified in the Netherlands based on perceived commuting mode enablers and barriers, socio-demographic factors, commuting distance and mode availability?

This question will be answered by analyzing the national Landelijk Reizigersonderzoek (LRO) dataset to identify and characterize different commuter segments. The goal is to create a clear set of commuter profiles based on their shared attitudes and to evaluate these segments to determine which groups are the highest priority for interventions.

SQ3: What contextual factors and daily experiences help to explain the commuting decisions of the identified segments?
This final sub question is designed to provide the deep context that the quantitative data cannot show, by exploring the daily experiences and personal motivations that drive the behavior of the identified segments.

1.6 Case Study Context

The growth in global technology sectors like Artificial Intelligence (AI) and electric vehicles (EV) is driving a very high demand for semiconductor chips, with the entire semiconductor industry projected to continue its rapid growth (Semiconductor Industry Association, 2025). As a leading supplier of lithography machines, the machines needed to produce semiconductor chips, ASML is a key part of this growth and is also planning for a growth in its workforce. This expansion is projected to take place at its main campus, creating big and growing traffic congestion and mobility pressure in the surrounding Brainport Eindhoven region (BNR, 2025; NOS, 2024). This makes it a very relevant and urgent case for this study.

ASML is actively trying to manage this pressure and has set a clear goal of achieving a more balanced modal split for its commuters by 2030 (ASML, n.d.). To do this, the company already promotes sustainable commuting through various measures, such as a free public transport pass and an increased mileage reimbursement for cyclists. However, commuting remains heavily car-oriented and thus there is room for improvement. This thesis therefore uses ASML as a case study to provide helpful insights. The interviews with its employees are used to explore how national-level segments apply to a specific company and to understand the real barriers that need to be overcome.

1.7 Relevance to Society and Science

As companies face more pressure to reduce their environmental footprint and support employee wellbeing, commuting policies have become an increasingly more important point of interest. This research provides practical insights that are relevant for both corporate and societal stakeholders. For employers, the study supports the design of more effective, targeted mobility policies that better align with the needs of a diverse workforce. By improving the daily commuting experience, these policies can contribute directly to higher employee well-being, which in turn can lead to tangible business benefits such as reduced absenteeism and improved employee retention. On a broader, societal level, the successful implementation of such policies helps to address press public challenges, including the reduction of traffic congestion and transport related GHG emissions.

From a scientific perspective, the research contributes to the commuting behavior literature by moving beyond identifying segments. While previous studies often stopped at segmenting groups based on mobility patterns, this study combines attitudinal and behavioral data and complements it with qualitative insights from a real-world organizational case. This approach enables richer segment profiles and bridges the gap between large scale travel data and the practical implementation of mobility policies within organizations.

1.8 Link to the MOT Program

The relevance of this research withing the Management of Technology (MOT) program is done through the following criteria:

- *The work reports on a scientific study in a technological context (e.g. technology and strategy, managing knowledge processes, research & product development management, innovation processes, entrepreneurship)*

- *The work shows an understanding of technology as a corporate resource or is done from a corporate perspective.*
- *Students use scientific methods and techniques to analyze a problem as put forward in the MOT curriculum.*

The research takes place in a technological context, as it is conducted in a collaboration with ASML. It addresses the strategic design of the mobility policy of the company. In the context of Management of Technology, it shows how organizations can use data-supported policy to influence sustainable employee behavior.

The research uses a scientific method to research a real-world problem related to commuting and internal company policy. Using both quantitative and qualitative techniques, it offers insights into employee behavior and policy effectiveness. Additionally, this supports efforts to reduce car usage and with that can contribute to more sustainable commuting practices over time.

1.9 Structure of the Thesis

This thesis is structured into seven chapters. Chapter 2 presents the theoretical background by reviewing relevant literature on commuting behavior, enablers and barriers that influence commute mode choice and segmentation approaches. Based on this literature, the chapter finishes with a conceptualization of the clustering that guides the quantitative part of the research. Chapter 3 describes the research methodology, including the data sources, the segmentation approach and the interview design. Chapter 4 presents the quantitative results of the national-level analysis. It outlines the identified commuter segments, their behavioral and demographic characteristics, and patterns in their responsiveness to corporate mobility policies. The chapter also provides two frameworks to give more insights into the underlying relations between the clusters. Chapter 5 reports the qualitative findings from interviews conducted at ASML. It includes thematic insights, segment-level enablers and barriers, and employee perspectives on the effectiveness and acceptance of current mobility policies. Chapter 6 integrates the national and case study insights and discusses their implications for both corporate mobility policy and academic literature. It also reflects on the methodology and outlines directions for future research. Finally, Chapter 7 provides answers to the research questions, and offers policy recommendations and a concluding remark.

2
Theoretical Background

Chapter 2 presents the theoretical background for the research. It begins by outlining the strategy used for the systematic literature review, after which several key themes related to commuting behavior are covered. The focus will be on push and pull measures, determinants of commuting mode choice, commuter segmentation and the perceived enablers and barriers that influence travel decisions. The chapter concludes with a synthesis of the key insights from the literature, followed by the presentation of the conceptual framework that forms the basis for the quantitative part of this research.

2.1 Literature Review Strategy

This section outlines the approach used for the literature review conducted in this thesis. The goal is to understand what is already known, what findings are usable and how these can inform this research. It also helps to compare existing insights with the outcomes of this research. A systematic approach was used, based on the four phases of identification, screening, eligibility and inclusion. Gathering the literature was done via Google Scholar, offering broad access to reviewed sources. The results were sorted based on relevance.

The identification phase began with the following keyword queries, which were used to gather the initial literature:

Query 1: commute mode choice OR "commuting mode choice" OR "commute travel behavior" AND (determinants OR factors OR influences) AND (socio-demographic OR "built environment" OR "workplace policies" OR "employer policies" OR organization OR "trip characteristics" OR "travel characteristics" OR psychological OR social) AND Europe

Query 2: "enablers" AND "barriers" AND (commuting OR traveling OR mobility) AND (attitudes OR perceptions OR norms OR motivations OR values OR behavior OR drivers) AND (employees OR workers OR commuters)

Query 3: ("push measures" OR "pull measures") AND (change OR shift) AND ("travel behavior" OR "travel behaviour") AND ("employer policy" OR "mobility policy" OR "workplace travel plan") AND effectiveness AND ("mode choice" OR "modal shift") AND organization

Query 4: "commute" OR "travel behavior" AND ("segmentation" OR "clustering" OR "clusters" OR "classes" OR "groups" OR "latent class") AND ("barriers" OR "enablers" OR "motivations" OR "drivers" OR "sticks" OR "carrots" OR "preferences" OR "perceptions" OR "beliefs") AND ("workplace policies" OR "employer incentives" OR "corporate mobility" OR "organizational context" OR "policy") AND Europe

As these queries yielded a high number of results, with the lowest number for a single query being 73, a full review of all articles was impractical. Therefore, to narrow down the initial list of articles from these queries, several additional screening steps were taken. First, the top-ranked article from each query was automatically included in the selection due to its possible high relevance. For the remaining articles, the review was limited to the first two pages of the search results, and from this subset, a final filter requiring a minimum number of citations was applied. This completed the identification phase of the systematic literature review.

This initial list of articles was then systematically assessed for relevance through the screening, eligibility and inclusion phases. In this final inclusion phase, some articles contained other relevant research. Adding these articles is referred to as 'snowballing', this resulted in eight articles on top of the findings from the queries and a final total of 22. The figure below visually shows how the search process was performed.

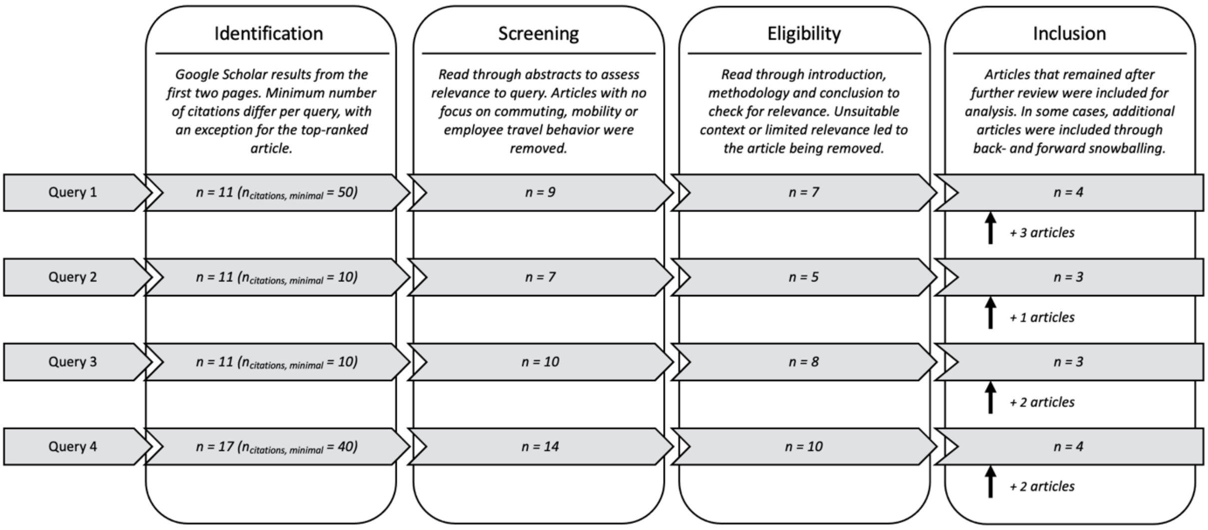

Figure 2.3.1.1: Overview of the Systematic Literature Review

2.2 Determinants of Commuting Mode Choice

Commuting mode choice is influenced by a wide set of determinants, often divided into socio-demographic factors, social and psychological factors, characteristics of the built environment, trip characteristics and workplace policies. Across studies, income, gender, age, education and car availability all were found to influence commuting preferences (Dai et al., 2016; Ji et al., 2018; Ko et al., 2019). Younger and lower income employees tend to be more responsive to behavioral change (Farahmand et al., 2021). Household context also plays a key role; individuals in families with young children are more likely to commute by car, often because of logistical needs and greater car dependency (Commins & Nolan, 2011; Lin, 2018). Patterns like this show how commuting behavior is incorporated in broader personal contexts.

The impact of social and psychological variables was found to be important yet contextually dependent. According to Lo et al. (2016), attitudes towards commute modes, perceived norms and behaviors play significant roles in shaping commuting decisions. However, it is stressed that these influences may vary significantly based on regional or organizational contexts. A key example of this interplay is neighborhood dissonance, a concept introduced by Schwanen and Mokhtarian (2005), which describes how individuals whose residential area does not match their personal preferences may choose travel modes more aligned with their ideals than their physical surroundings. Similarly, Ramezani et al. (2018) showed that attitudes can also amplify or offset the effects of urban design. Their findings suggest that targeting perceptions, such as cost sensitivity or peer pressure on the importance of sustainable travel, can improve mode choice outcomes.

The built environment also has a strong influence on commuting. According to Naess (2012), urban form is a critical determinant of commuting mode choice. Higher urban density and central home- and work-locations, decrease the travel distance and lead to a more attractive sustainable commute. Similarly, Yang et al. (2015) found that having a public transport stop nearby significantly increases the probability of using this mode. Commins & Nolan (2011) strengthened this by adding access to park-and-ride facilities as a factor increasing the likelihood of using public transport. However, the influence of the built environment is not only influenced by physical infrastructure. As highlighted by the concept of neighborhood dissonance, how people perceive and experience their environment is also critical.

Attitudes and personal preferences interact with the built environment in shaping commuting choices (Ramezani et al., 2018). Lastly, characteristics of both home and work neighborhoods play a role. Especially when these are combined with supportive employer policies such as incentives and good bike storage facilities (L. Yang et al., 2015).

Travel or trip characteristics, especially commuting distance and time, remain to have a big impact on commute mode choice. Ko et al. (2019) demonstrated the direct impact of commuting distance on the extent to which active modes were chosen, with longer distances disfavoring walking and cycling. This was also supported by Yang et al. (2015) and Heinen et al. (2013). Similarly, in the context of a workplace relocation, Yang highlighted how longer distances resulted in more car usage. The side-effects of longer commutes differ in the research; according to Stutzer & Frey (2004), a longer commute is associated with a lower reported well-being, but according to Friman et al. (2013) and Novaco & Gonzalez (2009) commuting can also improve well-being by providing privacy and a buffer from home and work.

Workplace policies have shown a strong impact on commuting mode choice. According to Yang et al. (2015), the influence of discounted or free public transport passes, and bike storage facilities positively influenced public transport and bike commuting, respectively. In line with this, Dong et al. (2016) found that employer-provided financial incentives, especially parking costs and public transport passes, could be very efficient in encouraging sustainable commuting. Cumming et al. (2019) adds carpooling programs and educational campaigns on sustainable commuting as promising strategies to change commuting behavior. These findings are supported by Heinen et al. (2013) who showed that in the Netherlands, not only practical factors like cycling infrastructure matter, but also workplace culture and the expectations of colleagues and managers. Access to changing rooms, and travel compensation schemes also influenced the decision to cycle to work. Figure 2.3.1.1 summarizes the variables encountered in the literature read, sorted per category.

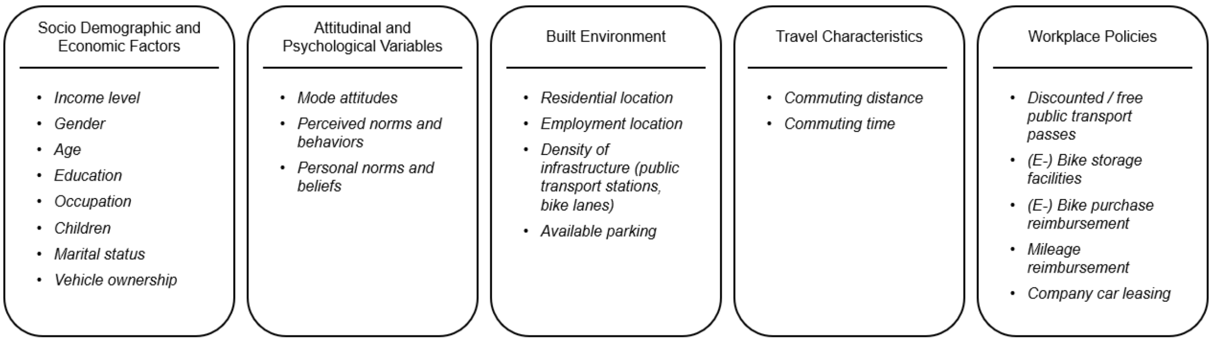

Figure 2.3.1.1: Overview of Determinants of Mode Choice

Despite all the research, findings vary in steadiness across determinants. High-income groups are consistently found to prefer commuting by car due to higher car ownership and more valuation of comfort (Ko et al., 2019; Lo et al., 2016; L. Yang et al., 2015; X. Yang et al., 2017). On the other hand, psychological determinants show different results: Lo et al. (2016) highlight their significance, where Ko et al. (2019) suggest socio-demographic and built environment factors might outweigh their influence. This variation shows the need for tailored approaches rather than assuming a perfect solution, or in Santos et al. (2013) their words; there is no 'one-size-fits-all' solution. Mobility needs vary across segments and contexts, and thus policies should combine multiple measures, adjusted to the needs and motivations of specific groups (Rowangould et al., 2024; C. Yang et al., 2009). There is no 'silver bullet' to changing commuting behavior.

2.3 Enablers, Barriers and Policy Interventions

Continuing on the findings that commuters differ in their psychological profiles, preferences and travel needs, it follows that the enablers and barriers they experience can vary as well. Understanding mode specific enablers and barriers helps in explaining behavior of a cluster and shape mobility measures to support more sustainable commuting across diverse groups (de Wilde, 2023). These enablers and barriers are often influenced by policy interventions, which can be categorized using a common framework.

2.3.1 The Policy Framework: Push and Pull measures

To develop more sustainable transport systems, many policy frameworks have been proposed. One widely adopted framework is the Avoid-Shift-Improve (ASI) framework by Farzaneh et al., (2019), which is shown in Figure 2.3.1.1. The ASI framework promotes three strategies: Avoid unnecessary travel, shift to more sustainable modes of transport and Improve existing transport technologies to reduce emissions. Within the Shift strategy, 'push' and 'pull' measures are the most common policy instruments used by employers to influence commute behavior.

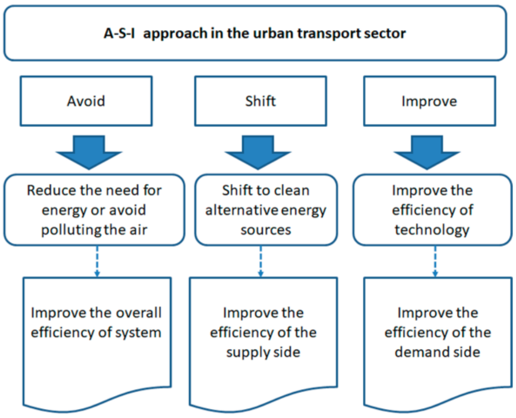

Figure 2.3.1.1: ASI-Framework by Farzaneh et al. (2019)

Push measures involve strategies to discourage private car usage, such as reduced parking availability, increased car-use taxes and increased parking prices (Lin, 2018; Melkonyan et al., 2022). Commuters frequently view these measures, such as increased parking prices, as a constraint on personal freedom and therefore do not appreciate them. Although the context in which the research was done differ, push measures are more acceptable when the personal behavioral costs, or sacrifice, are seen as moderate and when the individual has no alternative option (Keizer et al., 2019; Melkonyan et al., 2022). However, acceptability significantly decreases when commuters perceive a high personal cost associated with changing their behavior, which can create resistance to implementation.

Pull measures on the other hand aim to attract commuters towards more sustainable modes of transport by increasing their attractiveness (Lin, 2018; Möser & Bamberg, 2008; O'Fallon et al., 2004; Schade & Schlag, 2003). Examples are reduced public transport fares, improved cycling infrastructure and park and ride facilities (Bardal et al., 2020; Tori et al., 2025; Zarabi et al., 2024). These measures tend to receive more public support due to their less coercive nature and lower perceived personal cost (Wicki et al., 2019). Not only did these measures gain greater acceptability, but their effectiveness also increases when they are combined with targeted education and awareness campaigns, resulting in more sustained behavioral change (Cairns et al., 2004; Wicki et al., 2019; Zarabi et al., 2024).

Employers play a central role in implementing both push and pull measures through workplace mobility policies. In the context of companies or organizations, pull strategies often involve financial incentives such as mobility budgets, travel allowances and access to alternative transport options such as cycling facilities or public transport passes (de Wilde, 2023; Van Malderen et al., 2012). Push strategies often focus on parking restrictions such as introducing parking fees or preferential parking places for car sharers (Petrunoff et al., 2015). However, de Wilde (2023) highlights that the diversity in preferences and beliefs among employees influence the effectiveness of measures taken.

Evidence shows that combing both push and pull measures works better than using either one alone. Bardal et al. (2020) found that cities that combine active mobility investments (pull) with pricing policies (push) achieved higher acceptance. Lin (2018) argues that only improving the infrastructure is not sufficient to reduce car usage, complementary disincentives for car usage are needed as well. The examples show that a mix of measures that support each other are more effective than single actions.

2.3.2 Commuting by Car

Since 2019, each year the Dutch Ministry of Infrastructure and Water Management requests the Landelijk Reizigersonderzoek (LRO), research that uses national survey data to analyze trends in mobility, with a focus on work-commuting. According to Ipsos I&O and Goudappel, (2024), several main enablers for commuting by car were identified, including car ownership (private or company-lease), and a lack of viable alternatives. A key enabler of commuting by car is free parking at work, which otherwise can be seen as a push measure. Car use is also strongly influenced by non-financial factors such as comfort, security and flexibility, which can act as a barrier to shifting modes (Tori et al., 2025).

The main barriers discouraging car use function as push measures. These include paid parking at work, poor infrastructure, and inconsistent travel times due to congestion. This is in line with research from Guzmics & Kutzner, (2025), who studied young professionals in a corporate environment. The results showed that for employees with environmental concern, practical barriers such as infrastructure and time inefficiencies, often outweigh sustainability intentions.

2.3.3 Commuting by Public Transport

For public transport, the enablers function as pull measures. These include a good connection between home and work, proximity to a station, a direct route and financial compensation for travel. In this field, Tori et al. (2025), found that unreliable public transport was a top obstacle for people trying to reduce car use, and noted that incentives like free passes are particularly effective because they can disrupt established driving patterns.

On the other hand, the decision not to use public transport is often due to weak or absent pull measures. The absence of good connections, a lack of nearby stops, transfer requirements, waiting times and unreliable travel due to delays or service disruptions all acts as barriers. In the context of investments in public transport infrastructure, like free bus services, Lin (2018) found that despite these investments being made, many still relied on private cars and motorbikes. The reason often lay in job-related responsibilities, inflexible travel patterns or trip chaining. Even well supported pull measures may fail if they do not align with commuters’ practical needs.

2.3.4 Commuting by Bicycle

Important enablers for cycling, which serve as pull measures, include access to secure bike storage, financial incentives and active encouragement by employers. As Walsh et al. (2024) found, end of trip facilities such as showers are also crucial. They also found mental wellbeing to be another key motivator of cycling as it helped participants to prepare or offload from work, however mental wellbeing itself cannot directly be supported or created by policy.

Barriers to cycling include weather conditions, longer distances and unsafe or underdeveloped cycling infrastructure. To overcome the gap of longer distances, Bretones et al. (2023) found that e-bikes effectively enabled longer distance trips. The lower physical effort makes them more appealing to commuters who otherwise find cycling too physically demanding. However, this can introduce new barriers such as high purchase costs, safe storage and a social stigma around e-mobility which may hinder adoption if not addressed by supportive policies.

2.4 Commuter Segmentation

A rather popular strategy to identify patterns in commuter populations is to define segments or clusters, where individuals are grouped based on common characteristics. As mentioned by Diana & Pronello (2010), the main advantage lies in its flexibility, since it allows for control of a wide variety of input variables. This makes it particularly useful when various factors influence travel choices. Segmentation helps to identify different types of travelers based on the variables taken into account. This makes models easier to understand and allows policies to be tailored to each group.

As mentioned before, a common method for segmentation is k-means clustering. Haustein & Hunecke (2013) used a more attitude-based segmentation instead of traditional socio-demographic segmentation. Their results showed that psychological factors like environmental concern and perceived behavioral control display strong predictive power for travel mode choice. (Chatziathanasiou et al., 2024) used the same method of k-means clustering to identify psychographic clusters in the context of active mobility. The clusters found included individuals responsive to digital interventions and flexibility, individuals motivated by environmental values, and individuals who valued rational planning and comfort. Similarly, Haustein (2012) segmented elderly travelers specifically to demonstrate that even within a smaller age group, behavioral diversity can be found. Preferences for different modes were included, along with more contextual factors such as car availability. In this more focused context, the findings showed high behavioral differences (e.g. attitudes towards independence) linked to both psychological and situational differences (e.g. car availability). Once again, showing that effective policies or measures need more than just demographic targeting.

Other studies used latent class analysis (LCA) to segment individuals based on combinations of variables. Vallée et al. (2024) used LCA to segment public transport users in Germany based on psychological variables such as environmental norms and privacy concerns. The findings showed that environmental concern (over privacy concern amongst others) was the strongest predictor of actual public transport use. Similarly, Ardeshiri and Vij (2019) used LCA as well and found that younger individuals were more often classified as multimodal, but still most participants fell into the car-dependent group, showing the importance of including lifestyle preferences and land use over generational assumptions. Molin et al. (2016) applied the same method on a dataset containing self-reported mode usage along with socio-demographic and attitudinal variables. The results showed five multimodal clusters, revealing that mode use generally aligns with attitudes, but they also found that the cluster that used public transport often had positive attitudes towards car use, suggesting that these might change mode as they age and can afford car use.

Fraboni et al. (2022) used a two-step cluster analysis across different cities and included variables such as trip purpose, cycling frequency and perceived comfort. The results showed that both individual perceptions as well as cultural or infrastructural contexts, such as country of residence, influence cycling behavior. Instead of focusing on segmentation alone, Paulssen et al., (2014) used a hierarchical latent variable model to explore how personal values influenced mode-specific attitudes and with that mode decisions. More specifically, the study found that the choices individuals make between travel modes (e.g. choosing to drive or take PT), were more strongly influenced by their attitudes toward comfort, flexibility and ownership, than by traditional factors like travel time and cost. Similarly, Muñoz et al., (2016) used factor analysis to identify key attitudinal dimensions. The results showed that existing non-commuting cycling habits and subjective norm were strong predictors of cycling to work.

Together, the findings show that segmentation can reveal distinct travel profiles that are relevant for policy and planning. While the methods used differ, travel mode decisions were found to be influenced by a combination of psychological, contextual and structural factors. The need for differentiated approaches is displayed as a one-size-fits-all strategy is unlikely to be effective.

2.5 Synthesis of the Literature

In the previous sections key themes influencing commuting behavior were discussed. When these are integrated, several insights become clear form the literature.

Firstly, enablers and barriers to commuting are not experienced uniformly across commuter groups. Although access to a car or free parking serve as motivators, others may be more influenced by other factors such as mental wellbeing or financial cost. For certain employees time predictability may be influential, whereas for others shower facilities or flexibility in working hours are more important. Even among individuals with strong environmental values, practical barriers such as a lack of infrastructure can overtake sustainability intentions (Guzmics & Kutzner, 2025). Commuting is not only shaped by rational considerations but is involved in situational contexts.

The combination of push and pull strategies are argued to be more effective than one of the two. Meyer (1999) and Piatkowski et al. (2017) emphasize that discouraging car use and simultaneously enhance sustainable alternatives leads to more lasting changes in commuting behavior. This is reinforced in more recent studies that show how a mix of infrastructure investments and pricing policies support each other (Bardal et al., 2020; Lin, 2018). However, the effectiveness of these measures does depend on how they are designed, aligned with needs and perceived in terms of personal impact and the flexibility commuters have to adapt.

This leads up to the importance of understanding why people choose the modes they do. Cumming et al. (2019) stress that including socio-demographic variables into mode choice models improves predictive accuracy, while Dong et al. (2015) highlight the influence of employer provided incentives. As mentioned earlier, commuting decisions are rarely influenced by a single factor, but more so they are affected by a combination of personal characteristics, workplace conditions and the wider travel context. Income and commute distance, but also perceived norms and travel attitudes influence commuting decisions as well. Additionally, X. Yang et al. (2017) found that there is a difference between intended and actual behavior, showing the need to focus on what people actually do instead of what they claim to intend.

To better capture diversity in travel behavior, segmentation has become a known approach. Clustering methods allow researchers to identify groups of commuters who share characteristics, travel patterns or attitudes. This allows for more precise targeting of policies. The focus of most segmentation literature is on quantitative analysis and behavioral prediction, with fewer studies using qualitative methods to further understand the realities behind the identified segments.

Together, the insights show that in order to influence commuting behavior more than good alternatives or increased parking costs are needed. An understanding of which measures work for which groups is needed. Commuters respond differently to measures depending on their routines, needs and values. Personal context and workplace policies both play a role. Based on the key concepts and relationships identified in this literature review, a conceptual model is developed in the following section to support the quantitative part of this research.

2.6 Conceptualization

The literature reviewed above forms the basis for the conceptualization of this research. Since the review highlights that attitudes and perceptions are of influence on travel behavior, the primary goal of the segmentation is to identify groups based on these factors. Therefore, the attitudinal variables, which describe the perceived enablers and barriers of each mode, were chosen as the indicators. These variables are assumed to be direct reflections of an individual's underlying latent class membership. For example, a person within a car enthusiast segment may rate 'free parking' as an important factor.

Next, objective characteristics like socio-demographics (age, gender, education) and commute distance were included as active covariates. These are factors that are assumed to predict or influence which segment a person belongs to. For example, commuting distance has a clear, one-way relationship with segment membership. The distance a person lives from work can influence whether they fit the profile of a car-dependent commuter, but the attitudes that place them in that profile cannot change the physical distance between their home and workplace. Including these types of predictive variables helps to create a richer and more detailed profile for each segment.

Finally, variables that could have a two-way relationship with attitudes, such as mode availability and the use of specific employer policies, were included as inactive covariates. For example, owning a bicycle makes it more likely for someone to be in a cyclist segment, but having a 'cyclist' attitude also makes it more likely they will buy a bicycle. To prevent this two-way influence from affecting the cluster formation, these variables are treated as inactive. This means the segments are created based on attitudes alone, and the relationship with these variables is then examined in a separate step. This provides additional insights without disturbing the initial segmentation. Figure 2.3.4.1 displays this conceptual model, illustrating the different roles of the variables.

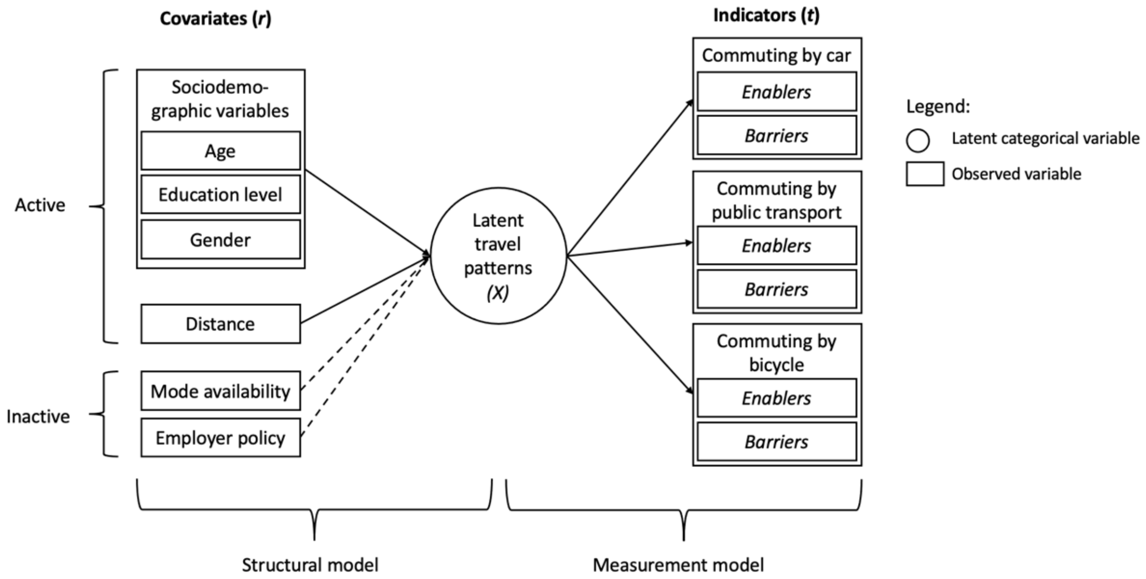

Figure 2.3.4.1: Conceptualization of the Latent Class Model

3 Methodology

This chapter covers the research design and the methodological approach to discover how different segments in the Netherlands experience commuting enablers and barriers. The research first uses quantitative data from the LRO to identify commuter segments, after which qualitative data is gathered through semi-structured interviews to explore how employees within these segments perceive and respond to commuting related factors. This chapter will outline the overall research approach before detailing the data sources, sampling methods and analysis strategies.

3.1 Research Approach

This research uses a mixed-methods research design to answer the research questions, with each part of the research being designed to address a specific sub-question.

The first part of this research, the literature review presented in the previous chapter, addresses sub-question 1. The chapter provided an overview of what is already known about commuter segmentation and mobility policies and concluded by presenting the conceptual model that forms the basis for the quantitative part of this research.

The second part is quantitative and is designed to answer sub-question 2. By applying a Latent Class Analysis to the national LRO dataset, this part of the research identifies distinct commuter segments. The outcome is an overview of what different segments exist in the Netherlands, and what they look like in terms of their shared attitudes and characteristics. As the outcome of this clustering yields a high number of identified clusters, two frameworks are introduced to visually display how the distinct clusters relate to another based on certain shared characteristics.

The third part of the research is qualitative and answers sub-question 3, continuing on the findings from the previous step. Using a case study with semi-structured interviews, this part explores the real-world context behind the identified segments. Its purpose is to provide a rich, detailed understanding of the daily experiences and personal motivations that explain why these segments commute the way they do.

By integrating the insights from the theoretical background, the quantitative segmentation and the qualitative context, the thesis is able to provide a comprehensive answer to the main research question.

3.2 Quantitative Method

3.2.1 Data Source: Landelijk Reizigersonderzoek data

The Landelijk Reizigersonderzoek is an annual national survey, by request of the Dutch Ministry of Infrastructure and Water management, and is conducted in collaboration with research agencies Goudappel and Ipsos I&O. The study began in 2019 and was conducted for the sixth time in 2024. The primary goals consist of gaining insights into changes in commuting behavior, and translating these trends into relevant policy outcomes related to accessibility, livability and safety.

The respondents were selected through a randomly drawn sample, to ensure statistical representativeness and reliability. All participants are required to verify their background data at least once per year. Those who don't comply are contacted to do so and inactive profiles are removed from the pool eligible for future participation. The data collection period started on the 16th of October and ended on the 13th of November, with the majority of the respondents being collected between October 20 and 27th. The questions asked refer to the travel behavior a week prior to the moment of filling in the survey.

In 2024, a total of 15.885 respondents completed the survey. After filtering out incomplete responses, internally inconsistent answers and overly short completion times, a total of 12.080 responses remained. Additionally, several other data cleaning steps were taken such as outlier removal, zip-code corrections and creating estimates for home-to-work distances using Google Maps API. To ensure generalizability of the Dutch working population, the dataset was weighted on several key characteristics: gender, age, education level, urbanization level, geographical region and employment sector. All of this was already done by Goudappel and Ipsos I&O, prior to receiving the data for the purpose of this research. The data received was thus already 'clean'.

3.2.2 Sampling and Data Preparation

This research aims to take the influence of employer mobility incentives into account as well. In the survey sent to the participants, only those under contract with a company are asked: "Which employer policy incentives do you use for your commute?". Therefore, a filter was applied to include only those under contract with a company. Freelancers, self-employed and those without a job, are thus removed. This resulted in a dataset containing 7085 participants.

The LRO dataset is structured in a way that adjusts its follow up questions based on earlier responses. Respondents are asked how often they commute by car, public transport or bicycle per week. If a mode is used at least once a week, the respondent gets asked "To what extent do the following aspects influence your decision to commute by car/public transport/bike to work?". This question represents the enablers for each mode. If a mode is not used, the respondent gets asked "To what extent do the following aspects influence your decision to not commute by car/public transport/bike to work?". This question represents the barriers for each mode. Together, these enablers and barriers are referred to as the attitudinal indicators. Based on the respondents' answers, the survey directs them to one of eight paths, which are shown in the table below.

Table 3.2.2.1: Potential Paths in the LRO Survey

	Path 1	Path 2	Path 3	Path 4	Path 5	Path 6	Path 7	Path 8
Car used at least once a week	Yes	Yes	Yes	Yes	No	No	No	No
Public Transport used at least once a week	Yes	No	Yes	No	Yes	No	Yes	No
Bicycle used at least once a week	Yes	Yes	No	No	Yes	Yes	No	No
Total Respondents	11	399	126	**3186**	45	**935**	**513**	244

Not all combinations yield enough respondents to support reliable analysis. To make sure the results from the latent class analysis would be meaningful, only combinations with a large enough sample size were used. As a result, only paths 4, 6 and 7 are included in this research. These represent the following types of commuter groups:

- Car-only commuters (Path 4)
- Bike-only commuters (Path 6)
- PT-only commuters (Path 7)

3.2.3 Model Specification and Justification

While several clustering methods exist, Latent Class Analysis was specifically chosen for this research due to its suitability for the data and research question. A more common alternative, k-means clustering, present several significant limitations in this context. First, k-means is a distance-based method, which is not appropriate for the ordinal Likert-scale data used here. This is because although the 7-point scale shows the order of importance, it does not guarantee that the intervals between the points are equal. For example, the perceived difference between 1 (no role) and 2 (a small role) may not be the same as the difference between a 6 (very important) and a 7 (decisive). K-means incorrectly treats these gaps as identical mathematical distances, which can lead to inaccurate groupings. Secondly, k-means assigns each person to only one group, even if they don't fit in perfectly, creating a false sense of certainty. Finally, the methods offers no clear statistical rules on deciding the optimal number of clusters, making the choice difficult to justify.

LCA deals with these issues by using response patterns instead of distances as a way of identifying groups of people who answer similarly. Instead of placing a person into one fixed group, LCA gives a probability of belonging to each group, showing how likely it is that someone belongs to a cluster. This makes the method more flexible and realistic. It also provides statistical tools like BIC, AIC and Entropy R^2 to help choose the best number of clusters. Other advantages are that it does not require data standardization and that it handles mixed data types well (Magidson & Vermunt, 2002). It also allows for covariates to be included directly in the model, making classification and explanation possible simultaneously (Magidson & Vermunt, 2004).

Variable Selection

With the three path combinations mentioned in Section 3.2.2, all the possible reasons for using or not using a certain mode are covered. Coming back to the question of "To what extent do the following aspects influence your decision to commute by car/public transport/bike to work?", on average 7 aspects are mentioned. However, including all those aspects will trouble the latent class analysis and hence a selection of the aspects had to be made. Some aspects had a partly overlapping meaning, some had limited relevance to the case study and some correlated highly with other aspects. A full overview of the selection criteria, correlations and variable definitions is provided in Appendix A. After the selection, the following attitudinal indicators were included:

- **Car-related enablers:**
    - Free parking at work, combining activities, reimbursement of travel costs
- **Car-related barriers:**
    - Paid parking at work, unreliable travel time due to congestion, no reimbursement of travel costs
- **Public transport enablers:**
    - Stop near work location, direct connection, reimbursement of travel costs
- **Public transport barriers:**
    - No stop near work location, transfers and waiting times, no reimbursement of travel costs
- **Bicycle related enablers:**
    - Secure bike storage, reimbursement travel costs, shower facilities
- **Bicycle related barriers:**
    - Weather conditions, no (good) bike storage, no reimbursement of travel costs

In addition to the attitudinal indicators, several background variables were included as active covariates in the analysis. These variables were not used to define the latent segments themselves, but they are important in the interpretation and description of the resulting profiles. The inclusion makes it possible to discover how being part of a segment relates to conditions such as commuting distance, socio-demographics and employer related conditions. A more detailed explanation of the model, including the rationale for selecting variables either as indicators or covariates is provided in Section 2.7. The following covariates were included in the model:

- **Commuting distance**
  Travel distances between home and work were grouped into six categories: <5.000,00 m; 5.000,00-29.999,99 m; 30.000,00-54.999,99 m; 55.000-79.999,99 m; 80.000-104.999,99 m; >105.000 m.
  These distances were created to further simplify interpretation and to better distinguish between short-, medium- and long-distance commutes.
- **Age**
  Respondents were already grouped in the following categories:
  18-34, 35-49, 50-64, 65+
- **Education level**
  Education level was already classified prior to receiving the dataset into 'low', 'middle' and 'high' educated.
- **Gender**
  Included as a binary variable, male or female, to explore possible gender-related patterns in commuting attitudes.

Furthermore, several employer policy variables were included as inactive covariates. These are thus not used in clustering stages but used to give insights into how the organizational support measures relate to segment characteristics. These variables were selected based on their relevance to the qualitative phase and include:

- **Mode availability**
  The dataset covers information about the different modes that participants have access to. In the original dataset, the modes are covered extensively. For example, bicycle, e-bicycle and speed-pedelec are three separate options. To align the modes available with the perceived attitudes, the options are simplified to car, bicycle and public transport. For car, only the original car values are used, for bicycle the values from bicycle, e-bicycle and speed-pedelec are combined and for public transport having a public-transport card is used.
- **Employer policy: Reimbursement per mode**
  Mileage reimbursement for car, bike and public transport (yes/no)
  Public transport subscription (yes/no)
  Purchase reimbursement for bicycle (yes/no)
- **Employer policy: Work from home support**
  Work from home reimbursement (yes/no)

It is important to note that the data contains information whether these different measures or incentives are used, not whether they are available to the participant. Additionally, although several other employer-related variables were available, only the above mentioned are included as this allows for an alignment with the interview part of the study. A full list of the available options and the reasoning behind the selection is provided in Appendix A.

3.2.4 Data Analysis

Separate LCA models were estimated for each of the three commuter groups (car-only, PT-only, bike-only). For each group, a series of models, typically ranging from three to seven clusters, were tested to find the best fit. The selection of the optimal model was guided by a combination of statistical fit criteria. As an example, the results for public transport are presented in Table 3.2.4.1, for the other commute groups these can be found in Appendix B. The selection criteria included the Bayesian Information Criterion (BIC) to assess overall model fit, and Bivariate Residuals (BVRs) to check for local fit. However, as can be seen in Table 3.2.4.1, these information criteria seem to favor models with a larger number of clusters, which often lose interpretability. Therefore, the final selection for the optimal model for each group was primarily based on two factors: a high Entropy R^2 statistic, showing a clear distinction between the classes, and the practical interpretability of the final cluster profiles. As a final rule, any solution that resulted in a cluster containing less than 5% of the sample for that group was also excluded to ensure the segments were substantial. The data preparation and exploratory data analysis were performed using SPSS, while the Latent Class Analysis was conducted using LatentGold.

Table 3.2.4.1: Overview of Cluster Selection Criteria for Public Transport

Number of Clusters	Total BVR	BIC	Entropy R^2	Smallest cluster
1	1289.345	10222.092	1	100.00%
2	475.788	15177.337	0.782	42.17%
3	320.909	15101.119	0.787	24.77%
4	243.643	15051.984	0.809	6.24%
5	149.634	15033.923	0.837	2.19%
6	128.469	15059.351	0.836	2.17%
7	89.067	9737.788	0.81	2.20%

3.2.5 Developments of Strategic Frameworks

To support more effective policies, two frameworks are introduced that visually display the commuter segments identified in the Latent Class Analysis. Chapter four will first describe each cluster in detail, and then look at the frameworks, where the goal is to evaluate which segments offer the most strategic value for intervention.

The first framework focuses on each cluster's policy sensitivity, based on how influential the attitudinal indicators included in the LCA are perceived to be for that cluster. The second framework uses the average age per cluster to reflect its potential for long-term behavioral change. In both cases, cluster size is included to indicate the potential impact of targeted interventions. The next subsections will present the frameworks in more detail.

Framework 1: Policy Sensitivity vs. Cluster Size

For the first framework, a Policy Sensitivity Index (PSI) is calculated for each cluster. This is done by first calculating the average influence score for each of the three categories of attitudinal indicators (enablers current mode, barriers first alternative, barriers second alternative) and then summing these three average scores. The resulting PSI is an indicator of how strongly a cluster perceives these categories of enablers and barriers as influential to their commute choice. Clusters with higher PSI scores will likely react more to policy changes affecting these specific enablers and barriers because they value these aspects as more influential to using or not using this mode.

The PSI formulas use nine specific attitudinal survey variables for each cluster. The influence scores for each of these variables, ranging from 1 ('not influential at all') to 7 ('very influential') are derived from the LCA. An important note is that the actual survey items making up these nine variables differ for each commuter group. For instance, the enablers rated by car-only commuters (e.g., 'free parking') differ from enablers rated by PT-only commuters (e.g., 'PT stop near work'). Similarly, the enablers for a mode differ from the barriers to that mode (e.g., 'shower facilities' as an enabler to cycling vs 'weather conditions' as a barrier). This use of different variables, while ensuring relevance for each group, presents a challenge for creating a direct, meaningful comparison of policy sensitivity across the different commute groups. However, the PSI calculation does take this into account. Although the specific variables used differ, the structure of the assessment is the same: every commute group is evaluated based on scores resulting from the LCA. Three enablers for their current mode, three barriers for each of the two relevant alternative modes. By first averaging the influence scores within these enablers/barriers (e.g., 'average current mode enabler', 'average alternative 1 barrier') and then summing these three averages, the PSI provides a standardized index. This approach still allows for a meaningful comparison of overall policy sensitivity across the different commute groups because it focuses on the combined sum of influence for choosing a commute mode.

To further explain the variables within the consistent structure, the car-only commute group is used as an example. The 'average current mode enablers' is calculated using three specific car enabler variables: MB2_B ('Free parking'), MB2_D ('Combining trips'), and MB2_G ('Reimbursement of costs'). Similarly, the 'average PT barriers' score comes from averaging scores for: MB6_B ('No stop close to work'), MB6_D ('Transfer and wait times') and MB6_G ('No cost reimbursement for PT'). Finally, their 'average bike barriers' score is calculated from items like MB7_A ('Weather conditions'), MB7_B ('No bike storage at work'), and MB7_E ('No reimbursement cost for bike'). For each car-only cluster, the PSI is the sum of these three specific average scores. Equations *3.2.1* to *3.2.3* show the specific PSI calculations for each commute group.

$$PSI = \bar{E} + \overline{B_1} + \overline{B_2}$$

$$PSI_{Car-Only} = \frac{MB2_B + MB2_D + MB2_G}{3} + \frac{MB6_B + MB6_D + MB6_G}{3} + \frac{MB7_A + MB7_B + MB7_E}{3} \quad (3.2.1)$$

$$PSI_{PT-Only} = \frac{MB3_B + MB3_D + MB3_G}{3} + \frac{MB5_C + MB5_D + MB5_E}{3} + \frac{MB7_A + MB7_B + MB7_E}{3} \quad (3.2.2)$$

$$PSI_{Bike-Only} = \frac{MB4_A + MB4_C + MB4_D}{3} + \frac{MB5_C + MB5_D + MB5_E}{3} + \frac{MB6_B + MB6_D + MB6_G}{3} \quad (3.2.3)$$

Other benefits of this PSI calculation method relate to its interpretability and construction. The sum of the three average scores creates a PSI score with values ranging between 3 and 21, closely relating to the original 1-7 scale items. The method still shows that the PSI is built from three distinct areas of influence, with each area contributing one equal part to the final score, making it a common way to construct an index.

To make the interpretation of the clusters easier, the PSI scores are categorized in three groups: 'Low', 'Average' and 'High', based on the tertile divisions of the 11 cluster PSI scores. This leads to the 'Low' category covering values from 3.00 up to and including 6.50, 'Average' ranges from 6.50 up to and including 12.09, and 'High' including all scores greater than 12.09 up to the maximum of 21.

Framework 2: Age vs. Cluster Size

The second framework was developed to offer strategic insights based on the age profile of each cluster, which serves as an indication for the potential for long-term behavioral change. The age profile for each identified cluster is presented by a weighted average score derived from the four age categories in the survey data (1: 18-34 years, 2: 35-49 years, 3: 40-64 years, 4: 65+ years).

To facilitate a clear comparison, these scores were categorized into two groups: 'Young' and 'Old'. The threshold for this categorization was determined by calculating the weighted average age of the entire sample, which resulted in a value of 2.09. This threshold was chosen because it takes the age profile of the entire analyzed population into account, offering a straightforward and data-driven method to create two separate groups for comparison. This framework is therefore designed to help identify younger segments where interventions might lead to more sustainable, long-term changes in commuting habits.

3.3 Qualitative Method

3.3.1 Qualitative Research Strategy

To answer sub question 3, which is about understanding the context and daily experiences behind the quantitative segments, a qualitative approach was needed. A single case study method was chosen as it allows for a closer look at a complex topic like corporate commuting in a real-life setting. It makes it possible to understand the specific reasons behind commuters' choices and what their daily journey actually involves, providing the detailed information needed to understand the story behind the numbers from the quantitative part of the research. This makes the case study method effective for examining the complex relationship between individual commuters and their organizational context, a level of detail that was missing from the quantitative part of the research.

3.3.2 Sample and Recruitment

The selection of participants for the interviews followed a purposive sampling method. The initial pool of participants was drawn from a contact list generated during a recent internal ASML study about the 'future workplace'. At the conclusion of that study, employees who had provided input on mobility-related topics were asked if they would be willing to participate in future research on mobility related topics. This resulted in a pre-existing list of 19 employees who had already agreed to be contacted for future research in the field of mobility at ASML. These individuals were then invited via an email to participate in this research, from which eight employees voluntarily took part. To expand the sample, snowball sampling was used, where participants were asked to refer colleagues which resulted in an additional 2 interviews. This led to a total final sample of 10 participants.

There were no specific inclusion or exclusion criteria for this study, beyond being an employee of the company and commuting to the office on a weekly basis. Prior to the start of each interview, all participants were informed about the research goals and provided their informed consent by signing an informed consent form, which can be found Appendix C.

The final sample of ten participants represented a mix of characteristics in terms of gender, age, and primary commute mode. This diversity was important to capture the wide range of experiences. An anonymized overview of the sample, including department, distance range, years at ASML and their main commute mode is provided in Table 3.3.2.1.

Table 3.3.2.1: Interview Sample

Department	One – way distance to work	Years at ASML	Main Commute Mode
Corporate Real Estate	30 – 50 km	< 2 years	Car
Finance	> 100 km	2 – 5 years	Car (Carpool)
Design and Engineering	< 10 km	2 – 5 years	Bike (/ Car)
Supply Chain	30 – 50 km	2 – 5 years	Car
Design and Engineering	10 – 30 km	2 – 5 years	Bike (/ Car)
Applications	30 – 50 km	>15 years	Car
Manufacturing	30 – 50 km	2 -5 years	Car (/ Public Transport)
Applications	> 100 km	10 – 15 years	Public Transport
Finance	> 100 km	10 – 15 years	Public Transport (/ Car)
Finance	50 – 100 km	10 – 15 years	Car

3.3.3 Data Collection Procedure

The data for the qualitative part of this study was collected through semi-structured interviews. This method was specifically chosen over an alternative like a focus group due to the personal nature of the research questions. Individual interviews provide a more confidential setting where participants can speak freely about their routines, frustrations and motivations, which is important for gathering honest data for the research. The semi-structured approach was then used as it balances consistency by covering the same core topics with each participant, while also providing the flexibility to explore individual experiences.

The ten interviews were conducted in-person between June 3rd and June 18th in private meeting rooms at various ASML locations to ensure confidentiality. The duration of the interviews ranged from 28 to 54 minutes. With consent from each participant, the interviews were recorded using Microsoft Teams whereafter the transcriptions were corrected and approved. In addition to the audio recordings, field notes were taken to capture non-verbal aspects such as the tone of voice.

Each interview followed a script, which can be found in Appendix D. The design of the interview was based on a combination of three inputs: the main themes from the academic literature, they key factors from the quantitative LCA results, and the specific issues identified in collaboration with the case study company.

A chronological, timeline-based approach was chosen as this helps the participants to better recall and reflect on specific factors that influence their decisions at different stages of their commute (Hope et al., 2013). To validate that different actions, feelings, and thoughts occurred during various stages of the commute, this approach was validated in the first two interviews. As it proved effective in acquiring a more detailed context, it was maintained for the following interviews. The interview began with questions about the participant's background, after which the timeline was explored across seven stages: before commuting to work, during the commute, arrival at work, during the day, before commuting home, during the commute home and after returning home. The interview then addressed the company's existing policies and services. Finally, a series of hypothetical scenarios was presented, where factors like parking policy, travel time and financial rewards were altered. The scenarios were made relevant to each mode choice, for example, a participant that is a car-user would get a scenario made relevant to car users. Note that these were used not as a fixed choice model, but to spark the conversation about what employees truly value and how they weigh different trade-offs. Prior to the main data collection, a test interview was conducted to test the script which led to a small adjustment in one of the hypothetical scenarios.

3.3.4 Data Analysis

The data analysis process began with the transcription of all ten interview recordings. The automated transcripts made by Microsoft Teams were manually reviewed and corrected against the audio recordings to ensure accuracy. A thematic analysis was performed using Microsoft Word and Microsoft Excel to organize the data.

The process started in Microsoft Word. For each relevant part in a transcript, a structured comment was placed using five pieces of information separated by a semicolon:

1. The main interview topic
2. The specific sub question
3. An initial descriptive code or aspect
4. A more detailed explanation
5. The direct quote itself

This led to comments such as: *"Timeline Based Commuting; Q3; Barrier PT; longer travel time; my travel significantly increases if I take the train [compared to the car]"*

Once the coding was completed for a transcript, all the comments were copied and pasted into Microsoft Excel. Using the Text to Columns feature with the semicolon as a delimiter, a separate sheet was created for each participant. These were in turn combined into one large datasheet. This allowed for the systematic sorting, filtering and comparing of codes across all ten interviews. Through an iterative process of reviewing this structured data, initial codes were merged, grouped and refined to form the final overarching themes that are presented in the results chapter.

4
Quantitative Results: National Commuter Segments

This chapter covers the results from the quantitative analysis. As described earlier, first an exploratory data analysis is performed, whereafter an overview of the different models is given with visualizations. Continuing on this, section 4.3 gives a comparison of the various models. Lastly, all segments are synthesized into two frameworks that visually present how the segments relate to each other and where opportunities lie for decisionmakers.

4.1 Exploratory Data Analysis

4.1.1 Indicators: Enablers and Barriers to Commute Modes

This section presents the descriptive analysis of the perceived enablers and barriers to commuting by car, public transport and bicycle. Respondents of the LRO-survey were asked to rate the importance of various factors on their decision to use or not use a certain commute mode. This was done on a 7-point Likert scale, ranging from “plays no role at all (1)” to “plays a decisive role (7)”. For each enabler and barrier, the mean scores and the standard deviations were computed to get insights into the broad context of the different factors in the commute mode decision process. The results are shown in Table 4.1.1.1.

It is important to note that the number of valid responses varies across the different aspects because of the conditional structure of the survey. Respondents were only asked attitudinal questions relevant to their commuting behavior. For example, a participant who responded to use the car at least once per week was asked to evaluate reasons for using the car (MB2), but did not receive the questions about reasons for not using the car (MB5). Similarly, participants who never used a particular mode were asked about barriers to that mode but not about enablers. As a result, the observed missing values are an outcome of this structure.

Table 4.1.1.1: Mean and Standard Deviations for Indicators

		N			
		Valid	Missing	Mean	Std. Deviation
Car Enablers	MB2_B: Free parking at work	3759	3326	4.74	1.99
	MB2_D: Combining activities	4034	3051	3.97	1.97
	MB2_G: Mileage reimbursement	4034	3051	3.80	2.03
Car Barriers	MB5_C: Paid parking at work	1755	5330	3.23	2.43
	MB5_D: Unreliable travel time due to congestion	1755	5330	3.25	2.21
	MB5_E: No mileage reimbursement	1755	5330	2.94	2.17
PT Enablers	MB3_B: Stop/station near work	1094	5991	5.52	1.45
	MB3_D: Direct connection	1094	5991	4.94	1.77
	MB3_G: Mileage reimbursement	1094	5991	5.18	1.88
PT Barriers	MB6_B: No stop/station near work	5645	1440	3.48	2.28
	MB6_D: Transfers and wait times	5645	1440	4.24	2.37
	MB6_G: No mileage reimbursement	5645	1440	2.80	1.99
Bike Enablers	MB4_A: Secure bike storage	1917	5168	3.61	2.10
	MB4_C: Mileage reimbursement	1917	5168	2.80	1.99
	MB4_D: Possibility to freshen up / shower	1917	5168	2.30	1.76
Bike Barriers	MB7_A: Weather conditions	4822	2263	4.05	2.20
	MB7_B: No (good) bike storage	4822	2263	2.37	1.84
	MB7_E: No mileage reimbursement	4822	2263	2.45	1.92

Among the enablers for car commuting, free parking at the workplace emerged as the most influential factor. As shown in Figure 4.1.1.1, responses for free parking at the workplace scored towards the higher side, suggesting that in general for the car-drivers the costs associated with parking play a role. The second most important factor was the ability to combine commuting with other activities. Figure 4.1.1.1 shows that responses to this question were a bit more spread out across the lower values as well. Notably, the peak at score 1 became larger, indicating that a substantial group (21% of the car drivers) saw no relevance in this factor. A similar pattern is observed for travel cost reimbursement. The distribution is quite dispersed, but an even larger peak of 24.7% can be seen at the lowest possible score, indicating that for some financial incentives play no role at all, but for the remaining part it does.

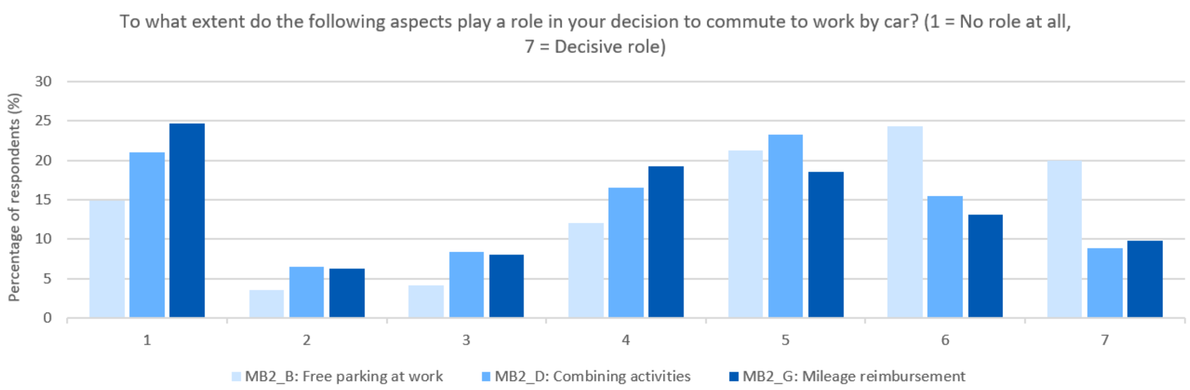

Figure 4.1.1.1: Bar Charts Enablers of Car Commuting

Although the mean scores for the three barriers are close to the middle score of 3.5, the distribution shown in Figure 4.1.1.2 shows how these values are distributed. For all three aspects, paid parking, unreliable travel times due to congestion and no compensation for travel cost by car, the most frequent response was actually the lowest possible score. This concentration was the highest for paid parking, where “no role at all” covered 47.9%. Despite the moderate means, the peaks suggest that for many commuters who don’t commute by car at least once a week, such factors played no role in that decision. The standard deviations show notable variation in perception, reflecting the diversity of personal and contextual circumstances influencing the respondents’ mode choice.

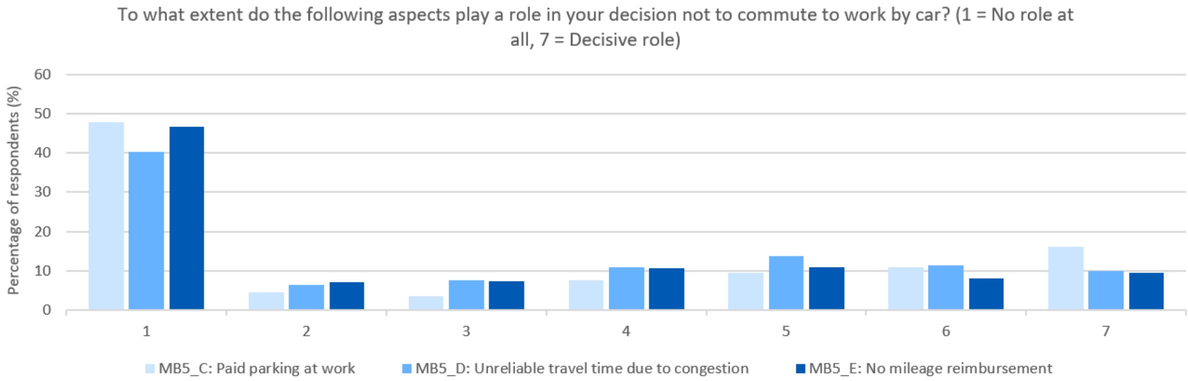

Figure 4.1.1.2: Bar Charts Barriers of Car Commuting

For the PT-enablers, having a station close to the workplace clearly scores higher, also shown by a mean of 5.53 and the skewness towards the upper-end of the scale. As shown in Figure 4.1.1.3 a large majority rated this factor as highly important. In contrast, the other aspects are also rated highly on average but are less skewed and more evenly distributed, resulting in higher standard deviations. Although the factors matter, they might not be equally important for all PT-users.

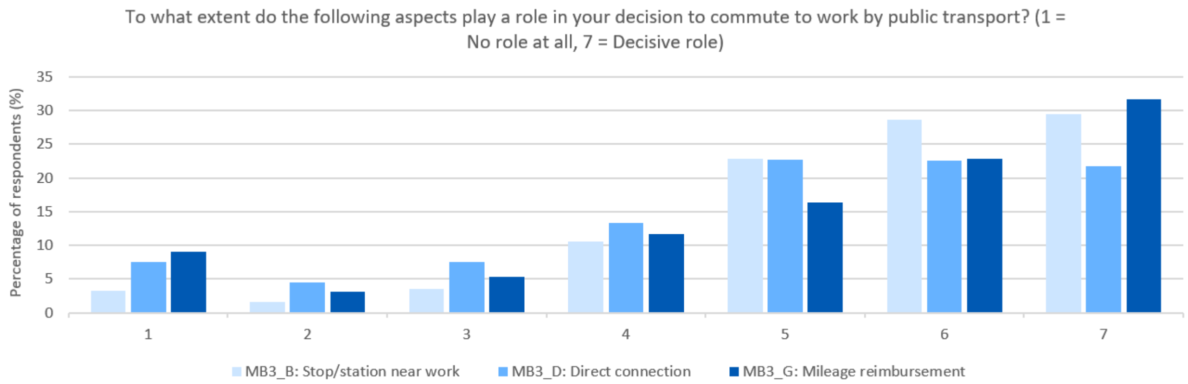

Figure 4.1.1.3: Bar Charts Enablers of Public Transport Commuting

Regarding the barriers to commuting by public transport, transfer and waiting times received the highest average rating, with also a fair share rating it not important at all. Not having a stop near work and no reimbursement for commuting costs were rated lower on average, with strong peaks at the lowest scores, suggesting these factors are not relevant for a large portion of the respondents.

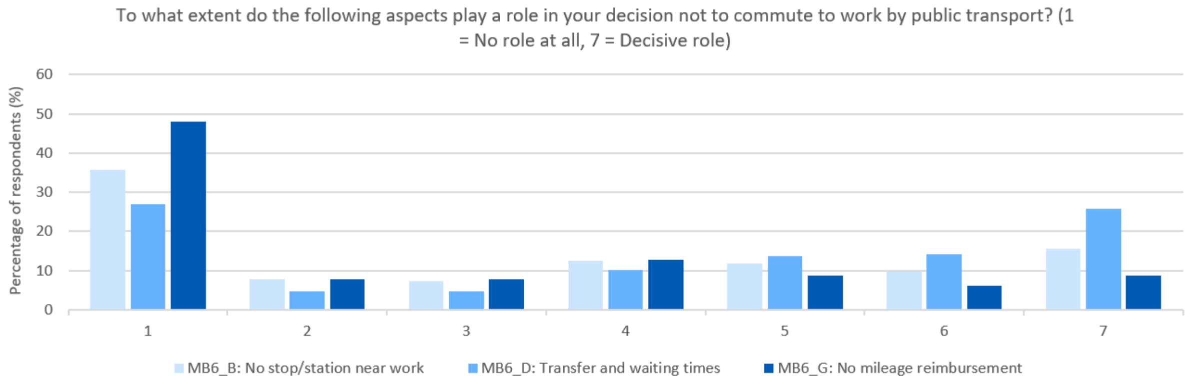

Figure 4.1.1.4: Bar Charts Barriers of Public Transport Commuting

For those commuting by bike, the presence of a secure bike storage facility was rated as the most important enabler although the response were quite distributed. Reimbursement of travel costs and the ability to freshen up or shower received lower average scores. All items show a concentration towards the lowest score, suggesting that these factors may not be that influential.

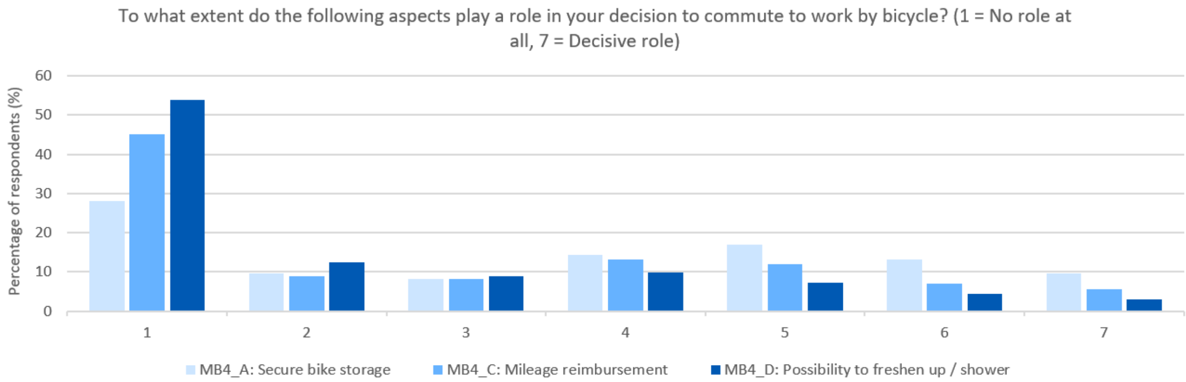

Figure 4.1.1.5: Bar Charts Enablers of Bike Commuting

Regarding the barriers for cycling, Figure 4.1.1.6 shows a clear difference in how these are viewed. For a lack of good bike storage and no mileage reimbursement, there is a strong peak for respondents indicating these factors play no role in their decision. In contrast, the response for weather conditions are much more varied. While a large portion indicates that weather plays no role, the remaining answers are more spread out across the scale, with a slightly higher concentration towards the 'decisive' end.

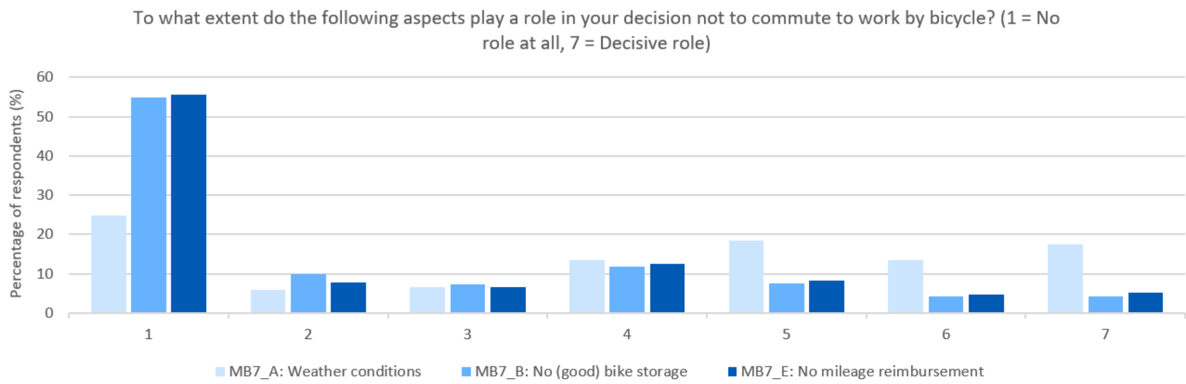

Figure 4.1.1.6: Bar Charts Barriers of Bike Commuting

4.1.2 Active Covariates: Distance and Socio Demographic Variables

The dataset includes several socio-demographic variables and travel distance as active covariates. Most respondents live within 30 kilometers from their workplace (72.5%), with a mean distance category of 2.21 indicating that longer commuters are less common. The age distribution is relatively even, although the 65+ category is less represented. Educational levels are more skewed towards higher levels, which is also shown in the mean. Gender is close to balanced.

Regarding the representativeness of this sample, the dataset has been statistically weighted by Ipsos I&O to be representative of the Dutch adult population in terms of gender, age and education level. This weighting was done prior to receiving the dataset and did not cover commuting distance. A comparison with national data suggests that this sample may include more long-distance commuters than the average. To be precise, in 2023 the average one-way commute in the Netherlands was 19.9 km, while the mean distance category of 2.21 in this sample indicates a longer average distance (CBS, 2025). Although the categorized data prevents the calculation of an exact mean, it does suggest a possible overrepresentation of longer distance commuters.

Table 4.1.2.1: Active Covariates Statistics

Variable	Category	Label	Percentage	Cumulative Percentage	Mean	Std. Deviation
Distance (meters)	< 5000.00	1	29.2	29.2		
	5000.00 – 29999.99	2	43.3	72.5		
	30000.00 – 54999.99	3	14.2	86.7		
	55000.00 – 79999.99	4	7.1	93.8		
	80000.00 – 104999.99	5	3.2	96.9		
	> 105000.00	6	3.1	100.0		
	Total				2.21	1.20
Age	18 – 34	1	34.1	34.1		
	35 – 49	2	31.7	65.8		
	50 – 64	3	29.8	95.6		
	65+	4	4.4	100.0		
	Total				2.05	0.90
Education	Low	1	22.4	22.4		
	Middle	2	28.0	50.4		
	High	3	49.6	100.0		
	Total				2.27	0.80
Gender	Male	1	47.8	47.8		
	Female	2	52.2	100.0		
	Total				1.52	0.50

4.1.3 Inactive Covariates: Mode Availability and Employer Policy

Mode availability was measured through three binary indicators: car ownership, the possession of a public transport card and bicycle ownership. 87.8% reported having access to a car in their household, PT card ownership was substantially lower at 61.2% and lastly bike ownership was reported at 87.2%. Cycling and car driving are widely accessible, whereas a more limited (but still substantial) group possesses a public transport card.

Usage of employer provided commuting incentives were included as inactive covariates and show relatively limited usage across the dataset. The most commonly used policy was kilometer-based reimbursement for car use, followed by reimbursement for working from home. Other policies, such as km-based reimbursement for cycling, having a public transport-subscription or km-based reimbursement for public transport were less used. The standard deviations reflect the binary nature of the variables. Since the question asked which arrangements respondents actually make use of, these figures reflect how commonly each incentive is used, not how widely they are offered to them.

Table 4.1.3.1: Mean and Standard Deviations for Inactive Covariates

		N			
		Valid	Missing	Mean	Std. Deviation
Employer Policy	B1_1: Mileage reimbursement Car	7085	0	0.39	0.49
	B1_2: Mileage reimbursement (e-) bike	7085	0	0.11	0.31
	B1_3: Mileage reimbursement PT	7085	0	0.07	0.26
	B1_8: Purchase reimbursement bike	7085	0	0.06	0.24
	B1_10: PT subscription	7085	0	0.09	0.29
	B1_11: Work from home reimbursement	7085	0	0.15	0.36
Mode Availability	Car ownership	7085	0	0.88	0.33
	PT card ownership	7085	0	0.61	0.49
	Bike ownership	7085	0	0.87	0.34

4.2 Overview of Latent Class Models

To account for the different sets of commuting enablers and barriers relevant to each transport mode, separate latent class analyses (LCA) were done for car-only, public transport (PT)-only and bike-only commuters. The goal was to identify distinct commuter segments within each commute group based on how individuals perceive various factors influencing their mode choice.

For each of the three groups, the final, optimal model was selected based on two key criteria. The first was a high Entropy R^2 value as a measure how well the classes are classified, and the second was a minimum cluster size of 5% of the group sample to ensure generalizability and statistical robustness. The final chosen models, which are summarized in Table 4.1.3.1, are those that met these criteria the best.

Table 4.1.3.1: Comparison of the Models

Commute Group	Sample Size (n)	Optimal number of Clusters	Entropy R^2	Smallest Cluster
Car-Only	3186	3	0.8439	10.37%
PT-Only	513	4	0.8088	6.24%
Bike-Only	935	4	0.8100	18.61%

4.2.1 General patterns between the different paths

To explore general attitudinal patterns towards commutes modes, a latent class model with only one class was estimated for each commute group. This provides the average response probabilities within a group, which can be used for a brief assessment of how overall attitudinal profiles differ between commuting modes, prior to identifying latent subgroups. Note that these comparisons describe the probability of a characteristic occurring within each commuting group, based on a one-class latent class model. They do not imply that these characteristics determine the commute mode choice or apply to the general population. They do reflect how each group is internally composed and offer insights into differences in group profiles, not causal effects. The findings are presented in Table 4.2.1.1. Regarding the indicators, higher values indicate a greater likelihood that the group considers an enabler/barrier to be important. Note that some covariate values are merged in the output, the corresponding cells are marked slightly grey. LatentGold automatically groups categories when a variable includes more than five, which is the default setting. This was not adjusted to maintain simplicity and readability of the results. The table below provides a baseline profile of the groups before identifying the subgroups.

Table 4.2.1.1: General Patterns for the Different Commute Groups

		Car – Only	PT – Only	Bike – Only
	Size	*N = 3186*	*N = 513*	*N = 935*
Indicators (7 point Likert scale)				
Car Enablers	MB2_B: Free parking at work	4.7291		
	MB2_D: Combining activities	3.9234		
	MB2_G: Mileage reimbursement	3.8770		
Car Barriers	MB5_C: Paid parking at work		3.8440	2.8962
	MB5_D: Unreliable travel time due to congestion		4.3002	2.6984
	MB5_E: No mileage reimbursement		3.8265	2.4599
PT Enablers	MB3_B: Stop/station near work		5.6589	
	MB3_D: Direct connection		5.0215	
	MB3_G: Mileage reimbursement		5.4035	
PT Barriers	MB6_B: No stop/station near work	3.9363		2.4941
	MB6_D: Transfers and wait times	4.8296		2.9273
	MB6_G: No mileage reimbursement	2.9228		2.3016
Bike Enablers	MB4_A: Secure bike storage			3.5454
	MB4_C: Mileage reimbursement			2.6481
	MB4_D: Possibility to freshen up / shower			2.1326
Bike Barriers	MB7_A: Weather conditions	4.1868	3.4074	
	MB7_B: No (good) bike storage	2.3487	2.1540	
	MB7_E: No mileage reimbursement	2.4328	2.1890	
Covariates (%)				
Distance	< 5000.00	18.86%	9.36%	53.58%
	5000.00 – 29999.99	46.83%	32.94%	43.74%
	30000.00 – 54999.99	19.68%	22.42%	2.67%
	55000.00 – 79999.99	14.63%	19.49%	
	80000.00 – 104999.99		15.79%	
	> 105000.00			
Age	18 – 34	33.21%	36.45%	23.74%
	35 – 49	33.15%	28.46%	31.87%
	50 – 64	29.97%	30.21%	37.54%
	65+	3.67%	4.87%	6.84%
Education	Low	21.91%	15.79%	2.57%
	Middle	32.58%	13.26%	28.45%
	High	45.51%	70.96%	45.88%
Gender	Male	51.98%	48.15%	42.99%
	Female	48.02%	51.85%	57.01%
B1_1	Uses mileage reimbursement for car	59.45%	19.49%	15.40%
	Does not use mileage reimbursement for car	40.55%	80.51%	84.60%
B1_2	Uses mileage reimbursement for bike	4.43%	8.38%	25.88%
	Does not use mileage reimbursement for bike	95.57%	91.62%	74.12%
B1_3	Uses mileage reimbursement for PT	3.74%	21.05%	3.74%

	Does not use mileage reimbursement for PT	96.26%	78.95%	96.26%
B1_8	Uses purchase reimbursement for bike	2.79%	5.85%	13.58%
	Does not use purchase reimbursement for bike	97.21%	94.15%	86.42%
B1_10	Uses a PT subscription	3.20%	38.40%	4.60%
	Does not use a PT subscription	96.80%	61.60%	95.40%
B1_11	Uses a work from home reimbursement	12.37%	30.41%	16.15%
	Does not use a work from home reimbursement	87.63%	69.59%	83.85%
Car Ownership	Owns a car	99.18%	100.00%	100.00%
	Does not own a car	0.82%	0.00%	0.00%
PT-card Ownership	Has a PT Card	47.77%	95.52%	58.72%
	Does not have a PT Card	52.23%	4.48%	41.28%
Bike Ownership	Owns a bike	84.59%	93.18%	97.33%
	Does not own a bike	15.41%	6.82%	2.67%

The commuting groups overlap on certain attitudinal questions, allowing for some comparisons. Car- and bike-only commuters both rated reasons for not using public transport, car- and PT-only rated reasons for not cycling, and bike- and PT-only rated reasons for not using the car. PT-only commuters consider weather conditions less important for not-cycling compared to car-only commuters. Storage and financial incentives are less influential to this group. In terms of not using PT, car-only users rate all the barriers as more important than bike-only commuters. Within both groups, the relative ranking is similar, with no direct connections and transfer times rated highest, followed by having a stop near the office and lastly financial reimbursement. For not using the car, PT-only commuters rate all barriers higher than bike-only commuters, with unreliable travel times due to congestion ranked the highest.

Starting with the socio-demographic and contextual characteristics, the three groups show some notable differences. Bike-only commuters have the highest probability of living within 30 kilometers of their workplace compared to car-only and PT-only commuters. This shows the physical and practical limitations of cycling as a mode of choice. PT-only commuters are most likely to live further away, showing the role that PT serves in longer distance travel. Looking at age, bike-only commuters show the highest probability of being over 34 years old, slightly more than car-only and PT-only commuters. PT-only commuters also stand out because of their higher probability of being highly educated, compared to both car-only and bike-only groups. There are smaller differences in gender, bike-only commuters have a slightly higher probability of being female than car-only or PT-only.

The employer policy measures used differ per mode as well. Car-only users are most likely to use car-reimbursement compared to PT-only and bike-only users. Bike reimbursement follows the same pattern, being the highest in bike-only commuters versus rarely used in other groups. The same goes for PT-only commuters, these have the highest likelihood of receiving public transport reimbursement and also the highest use of a PT subscription. This pattern between the mode specific policy and the commute group is also visible for bike purchase subsidies, having the highest usage in the bike-only group. Lastly, the vehicle ownership is oriented towards each specific commute group. In other words, the PT-only group has the highest percentage of public transport cards and the bike-only group has the highest percentage of bikes. The car ownership however is high for all three commute groups, which can be explained by the conditional structure of the survey as some of the variables taken into the model require a prior answer that leads to higher car ownership.

In summary, the three commuter groups differ most clearly in the distance to work, level of education and the use of employer provided benefits, the latter aligning with the mode they use. Bike-only commuters are typically close to work and PT-only commuters are more highly educated. Although the attitudinal patterns differ between the groups, the relative order in which barriers are rated often follow a similar pattern, as was seen with the lack of a direct connection and waiting times, not having a stop near work and financial incentives for PT.

4.2.2 Car-only users

Among the car-only commuters, a three-cluster solution was selected as the optimal model because of the highest Entropy R^2 value (0.8439). The resulting clusters were separated into Cluster 1 representing 44.82% of the total car-only users, Cluster 2 44.81% and Cluster 3 10.37%. Figure 4.2.2.1 visually displays the response pattern of the clusters. The figure shows how the three clusters differ from another. The horizontal axis includes both attitudinal indicators as well as covariates, while the vertical axis shows the normalized mean values for the indicators and active covariates and the probabilities for the inactive covariates.

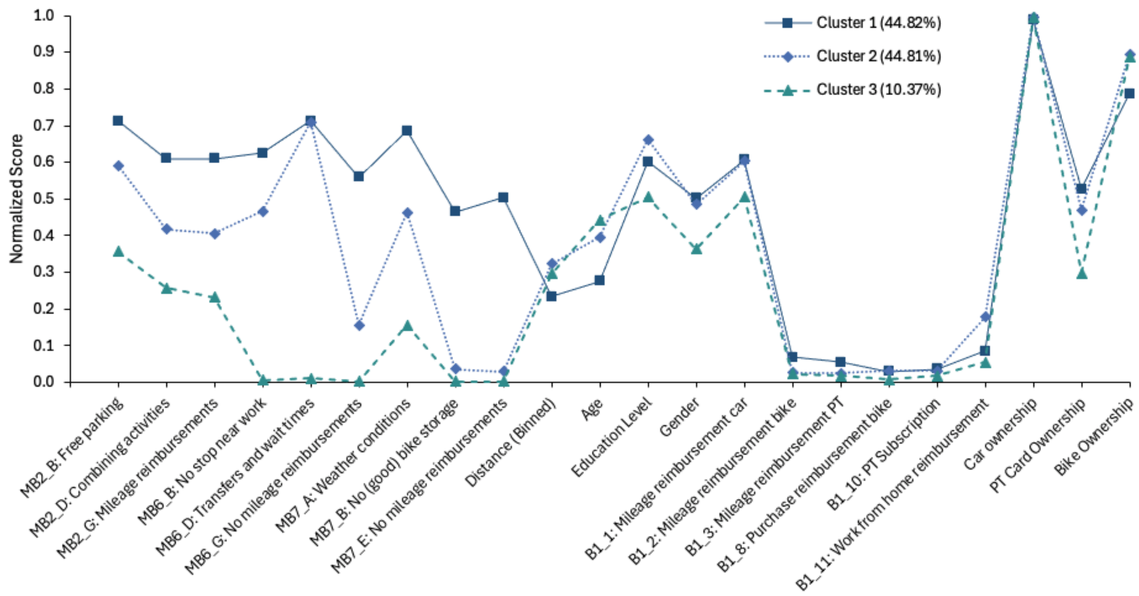

Figure 4.2.2.1: Pattern for Car-Only Commuters including clusters

Cluster 1 represents car commuters who are both positively motivated by car-related enablers and demotivated by perceived barriers to the other modes. The cluster values free parking and reimbursement for car use highly and above the car-only average. At the same time, they consider the absence of a public transport stop near work and long transfer times to be major disadvantages. Cost related issues for public transport are seen as a disadvantage as well, but slightly less the importance of reimbursements for car usage. They are also more likely to view cycling as unattractive, with weather having the largest influence. Their relatively high score for cycling reimbursement shows that financial incentives play a role in their commuting decisions. This may indicate that the availability of financial incentives for cycling is a way to encourage a mode shift within this group.

Cluster 2, while similar to Cluster 1 with the positive view on car-related enablers, is more neutral towards the barriers of other modes. Free parking and combining trips are still relatively important, but lower than in Cluster 1. When it comes to public transport and cycling, the barriers are valued as less important. Especially financial aspects score lower compared to Cluster 1. A possible reason is that people in this cluster are less likely to live close to work. The currently free parking and long wait or transfer times on public transport are important factors in their commute decisions, suggesting that addressing these barriers could be effective ways to influence this group's behavior.

Cluster 3 stands out as the group with the weakest attachment to all enablers and barriers addressed. The cluster consistently rates all items lower in importance. This suggests that they may use the car more out of routine than out of preference and with that, changing their behavior is difficult. In terms of demographics, this group is different from others: they are more likely to be male and in the age group 50-64 years old. They also have less access to other travel options, such as owning a PT-card and they are less likely to make use of car reimbursement. It should be noted that these values represent the use of employer provided benefits, not whether such benefits were actually offered. As a result, the number of people using most incentives is low across all clusters. For example, only 4.4% of car-only commuters say they use a cycling reimbursement. The differences for these variables are often only two to three percents. This makes it difficult to draw conclusions on how these policies influence commuting behavior as it is unclear whether low use reflects lack of interest or lack of access.

Taken together, the clusters reflect differences in how car-only commuter perceive commuting related factors. Cluster 1 places high importance on financial aspects, rating cost reimbursements as important across the board. Compared to the other clusters, they assign the highest scores to free parking and trip reimbursement as enablers to car usage, and a lack of financial support for public transport and cycling as a barrier. This may suggest that monetary incentives play a role in how this group makes commuting decisions. Cluster 2 assigns lower importance to cost reimbursement for PT and cares even less about financial compensation for the bicycle. However, they do rate long transfer and waiting times as relevant, showing that time and convenience may be more influential than cost in shaping their attitudes. Cluster 3 consistently ranked all factors as unimportant. This lack of engagement shows that influencing this group may be difficult.

4.2.3 Public Transport-only users

Among the public transport-only commuters, a four-cluster solution was found as the optimal model based on the highest entropy R^2 value (0.8088). The resulting cluster sizes were 37.94% for Cluster 1, 33.34% for Cluster 2, 22.47% for Cluster 3 and 6.24% for Cluster 4. Figure 4.2.3.1 visually displays the response patterns of the clusters.

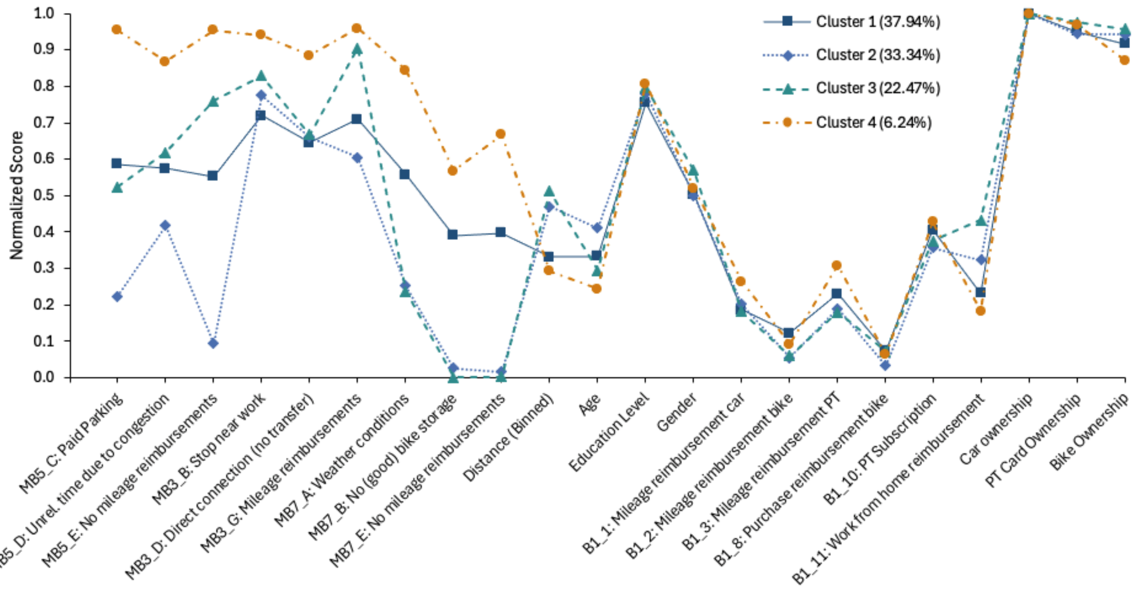

Figure 4.2.3.1: Pattern for Public Transport-Only Commuters including clusters

The largest subgroup, Cluster 1, shows relatively high scores on all PT enablers but slightly lower than compared to other clusters. A stop near work is rated as important, but less than for other clusters as shown by the lowest normalized score. A direct connection is also valued, and the overall pattern suggests that time and convenience matter. Car related barriers are scored close to the average scores, showing a more neutral stance on that mode. Among the cycling related barriers, weather is rated most influential, while parking facilities and financial incentives are less decisive but still relevant. This cluster contains the highest probability of commuters living between 5 and 30 kilometers from their workplace. This might explain their reliance on public transport and lower enthusiasm for cycling.

Cluster 2 stands out for their relatively lowest importance on car-related barriers. Unreliability due to congestion are rated as the most important, but still moderately important. Cycling related barriers are generally rated as unimportant. This group also has the highest probability of older commuters, specifically in 50 – 64 category and 65+ category. They also show the lowest usage of bike purchase reimbursements.

The third Cluster places a strong emphasis on financial incentives when it comes to both car and PT usage. The lack of reimbursement for car travel is rated as the most important factor for not using the car. The presence of PT reimbursement is a key reason for choosing public transport. Barriers to cycling, including weather, storage and reimbursement are all rated low. This group has a higher probability of living more than 30 kilometers from work and tends to be slightly younger, more highly educated and more often female. They also appear to have a higher chance of receiving work-from-home reimbursement compared to the average. Their higher likelihood of living further away may explain why they rate the lack of car reimbursement as a key barrier, while cycling plays little role. This suggests that if offered car reimbursement, this group might be more likely to switch.

Cluster 4 consistently gives the highest scores across all items. For car barriers, these all score well above the group average and the same for PT enablers. Cycling barriers, especially weather, and financial incentives are perceived as playing a big role in not choosing the bike. The group has the highest probability of having commuters that live within 5 kilometers of work. It also consists mostly out of younger commuters, between 18-34 years old. They are also more likely to be using car reimbursement and PT allowance, with lower work-from-home compensation. Additionally, they have the lowest rate of bike ownership among the PT-only group. They appear to be sensitive to both positive and negative influences, but potentially open to switching under the right financial conditions.

In summary, the four clusters among PT-only commuters show a variety of motivations and concerns. Cluster 1 is shaped by convenience and moderately sensitive to cycling initiatives. Cluster 2 shows little value on cost and bike-related factors, showing older loyal PT-commuters. Cluster 3 is driven by financial reasons and longer-distances, while Cluster 4 is engaged across all factors and may be the most responsive group to policy changes in any direction. These findings suggest that policy should focus on preserving PT use in Cluster 3 by maintaining or improving financial support, as these commute longer distances and thus are less likely to switch to bike-usage. Cluster 4 represents an opportunity to promote more active travel through cycling incentives. Enhancing the convenience and directness of PT may improve the commitment from Cluster 1, while for Cluster 2 maintaining service quality appears the most relevant approach.

4.2.4 Bicycle-only users

Among the bike-only commuter, a four-cluster solution was selected as the optimal model based on the highest Entropy R^2 value (0.8100). The resulting clusters were separated into Cluster 1 representing 32.44% of bike-only users, Cluster 2 26.67%, Cluster 3 22.67% and Cluster 4 18.61%. Figure 4.2.4.1 display the response patterns of the clusters.

Cluster 1 scores close to the group average across all indicators. The only notable exception is the relatively high importance on PT transfer and wait times. This cluster has the highest probability of respondents having a higher education level compared to the average for bicycle only users.

Cluster 2 consistently assigns low importance to all attitudinal indicators. Car barriers, such as paid parking, unreliable travel time due to congestion and lack of reimbursement are rated very low. The same goes for PT barriers like transfer and waiting times and missing PT reimbursement. The enablers for cycling also score low, with only the weather having a slightly larger influence. This suggests a group of habitual cyclists, whose mode of choice appears to happen out of habit. This is likely because they have a larger probability of living within 5km of work compared to the overall for the bicycle-only group. Additionally, they have the highest chance of being 50+ and lowest of being highly educated compared to the bicycle only group.

Cluster 3 scores the highest across nearly all indicators, suggesting a responsive group. For public transport, waiting times is again weighted the highest out of the barriers. For bicycle enablers, weather and storage are more important than reimbursement, which ranks the lowest within this cluster. The group is more likely to be under 50 years old. They also show higher use of car reimbursements and work-from-home allowances, overall suggesting a group of responsive cyclists.

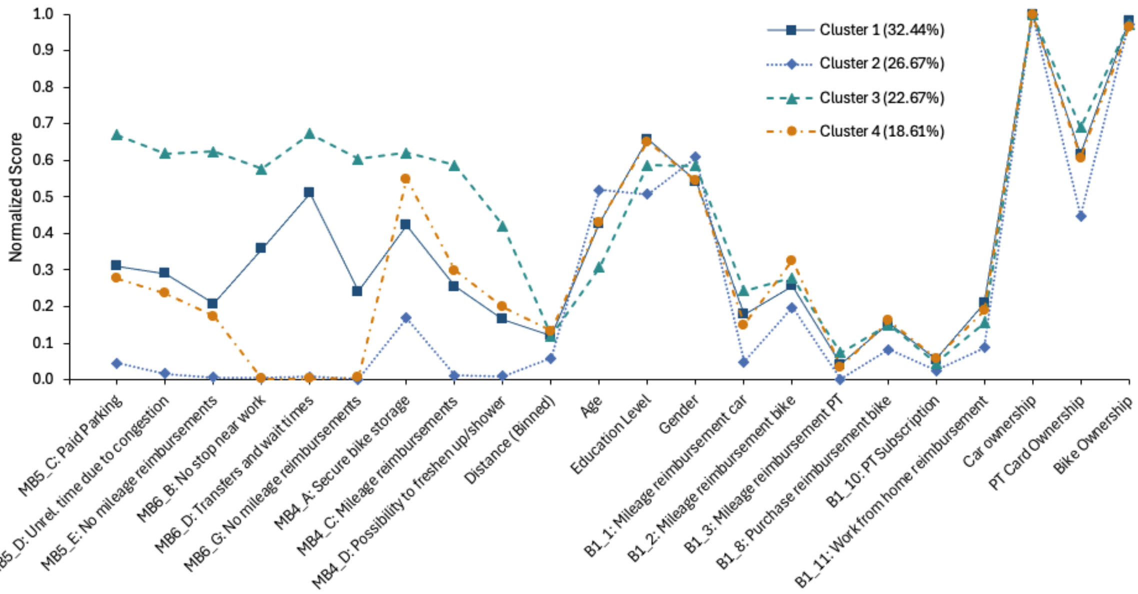

Figure 4.2.4.1: Pattern for Bike-Only Commuters including clusters

Cluster 4 shows a consistently low importance on public transport barriers. Bike related enablers are rated moderately, where car-related barriers are also rated low. As this group is less likely to own an PT-card, this may suggest that this group does not consider public transport as an alternative. Compared to other bicycle clusters, this cluster has the highest probability of mentioning the usage of bike reimbursements.

Concluding, the four clusters among bike-only commuters reflect a range of attitudes and motivations. Cluster 1 represents well educated cyclists with balanced views. Cluster 2 appears disengaged, commuting by bike out of routine rather than specific conditions. These are likely to continue cycling regardless of policy. Cluster 3 is broadly responsive and doesn't value cycling reimbursements as high as the other barriers. The responsiveness shows the importance of the barriers to other modes as a way to keep this cluster on the bike. A change in one of the competing modes could make this group switch mode, especially in free parking and PT transfer times. Cluster 4 does not appear to consider PT at all and may represent younger, short distance commuters. Although the barriers are rated relatively low compared to other clusters, free parking is seen as the most important factor, showing the importance of this barrier to minimizing car usage.

4.3 Comparison of the Models

Each of the selected models offered interpretable models and distinct clusters, allowing for insights into the various attitudes within each commute mode.

Although the specific segments differ per mode, some themes emerged across the segments. Across all groups, at least one cluster can be seen as relatively disengaged or habitual in their commuting behavior. This is visible in Cluster 3 for the car-only commuters, Cluster 2 for bike-only users and Cluster 2 for the PT-users. These groups generally assigned low values to enablers and barriers, suggesting that their mode choice may be influenced more by routines or a lack of alternatives, than from active decision making.

On the other hand, each model also included clusters that were highly responsive to practical and financial conditions. For example, Cluster 3 from the PT-only users showed sensitivity to reimbursement policies for both PT and car use, especially among longer-distance commuters. Bike-only Cluster 3 also had engagement with multiple variables, but with a focus more on practical barriers. Car-only Cluster 1 was most responsive to cost-related factors, placing high-value on free-parking and reimbursement policies.

Demographic patterns varied per segment as well. Habitual or less engaged clusters (e.g. PT-only Cluster 2 and Bike-only Cluster 2) tended to have a higher proportion of older commuters, whereas more responsive or incentive sensitive segments were often younger or better educated (e.g. PT-only Cluster 4 mostly consisting out of younger commuters, scoring highly on all factors).

While the three LCA models were chosen separately, their results reveal some consistent patterns across transport modes. These findings suggest that tailoring mobility policies to distinct commuter segments, instead of applying a one-size-fits-all solution, may improve the effectiveness of measures aimed at shifting commuting behavior.

4.4 Segment Frameworks

4.4.1 Framework 1: Policy Sensitivity vs. Cluster Size

The first framework, the Policy Sensitivity Index (PSI) framework, is visualized Figure 4.4.1.1. The vertical (Y) axis represents the PSI, with scores ranging from the theoretical minimum of 3 to a maximum of 21. On the horizontal (X) axis, the absolute cluster size can be seen. The exact results can also be found in Table 4.4.1.1.

Looking at Figure 4.4.1.1, Car Cluster 1 and Car Cluster 2 immediately catch the attention because of their significantly larger size compared to the others. Additionally, PT Cluster 4 is seen as the highest PSI scoring cluster despite its very small size.

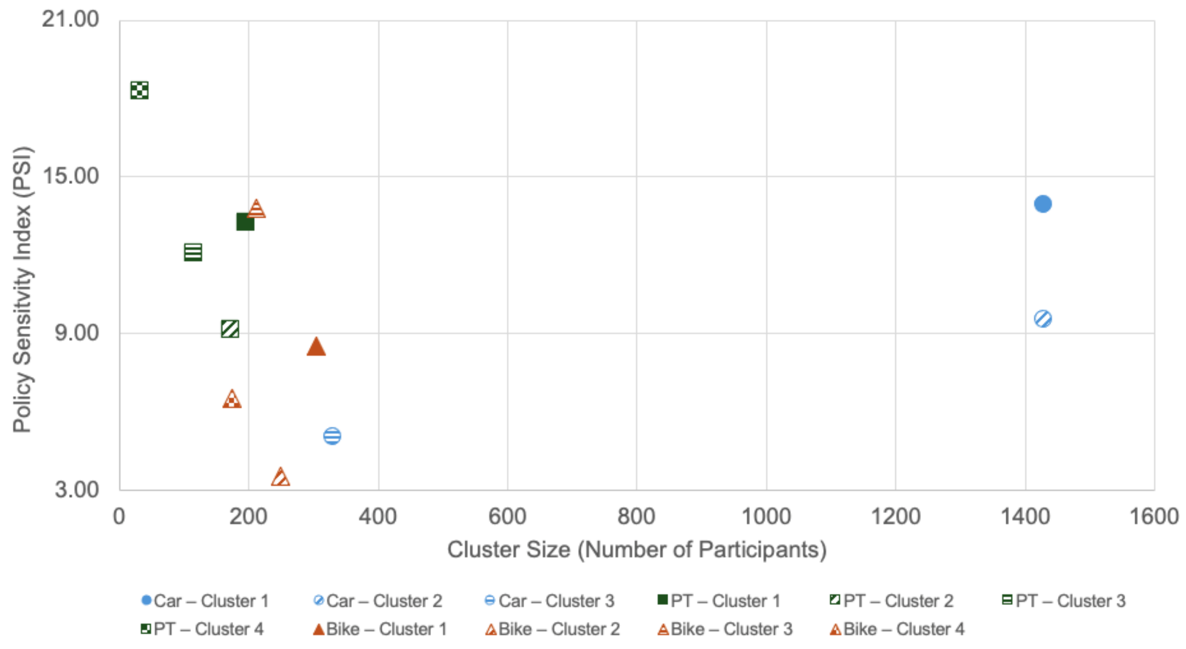

Figure 4.4.1.1: Framework 1: Policy Sensitivity Index vs Cluster Size

The categorization of the PSI scores into 3 distinct categories allows for a more nuanced understanding. Car Cluster 1 (PSI 13.97) falls into the 'High' category, where Car Cluster 2 (PSI 9.55) falls into the 'Average' category. Among the smaller clusters, Bike Cluster 3 (PSI 13.79) and PT Cluster 1 (13.27) also fall into the 'High' category. The remaining clusters fall into the 'Average' or 'Low' PSI categories, as shown in Table 4.4.1.1. This categorization will later on be used to develop targeted policy recommendations.

Table 4.4.1.1: PSI-Values and Age categories for the Framework

Cluster	Sample size group	Cluster size (%)	Cluster size (n)	PSI	PSI Category	Age	Age Category
Car – Cluster 1	3186	44.82%	1428	13.97	High	1.83	Young
Car – Cluster 2	3186	44.81%	1428	9.55	Average	2.19	Old
Car – Cluster 3	3186	10.37%	330	5.05	Low	2.33	Old
PT – Cluster 1	513	37.94%	195	13.27	High	2.00	Young
PT – Cluster 2	513	33.34%	171	9.13	Average	2.23	Old
PT – Cluster 3	513	22.47%	115	12.09	Average	1.88	Young
PT – Cluster 4	513	6.24%	32	18.27	High	1.73	Young
Bike – Cluster 1	935	32.44%	303	8.53	Average	2.28	Old
Bike – Cluster 2	935	26.67%	249	3.55	Low	2.56	Old
Bike – Cluster 3	935	22.67%	212	13.79	High	1.92	Young
Bike – Cluster 4	935	18.61%	174	6.50	Low	2.29	Old

4.4.2 Framework 2: Average Age vs. Cluster Size

The second framework, presented in Figure 4.4.2.1, shows each cluster's weighted average age profile against its absolute size. As mentioned before, a lower score indicates a younger profile for the cluster, a higher score refers to an older profile. Looking at the figure, Car Cluster 1 and 2 again catch the attention due to their significantly larger size compared to the rest. It is also notable that, once again, PT cluster 4 is one of the extreme values of the framework, this time being having the lowest average age. Many of the others appear relatively close to another, making a detailed interpretation difficult. Table 4.4.1.1 presents the specific weighted average age scores and the sizes for all clusters.

Applying the 'Young' and 'Old' categorization allows for a final evaluation by combining the insights from both frameworks. For example, Car Cluster 1 is now identified as belonging to the 'Young' group, and having a 'High' PSI score, which combined with its size make it a well-suited segment for targeting. In contrast, a segment like Bike Cluster 2, which falls into the 'Old' and 'Low' PSI categories, can be considered a lower priority for intervention.

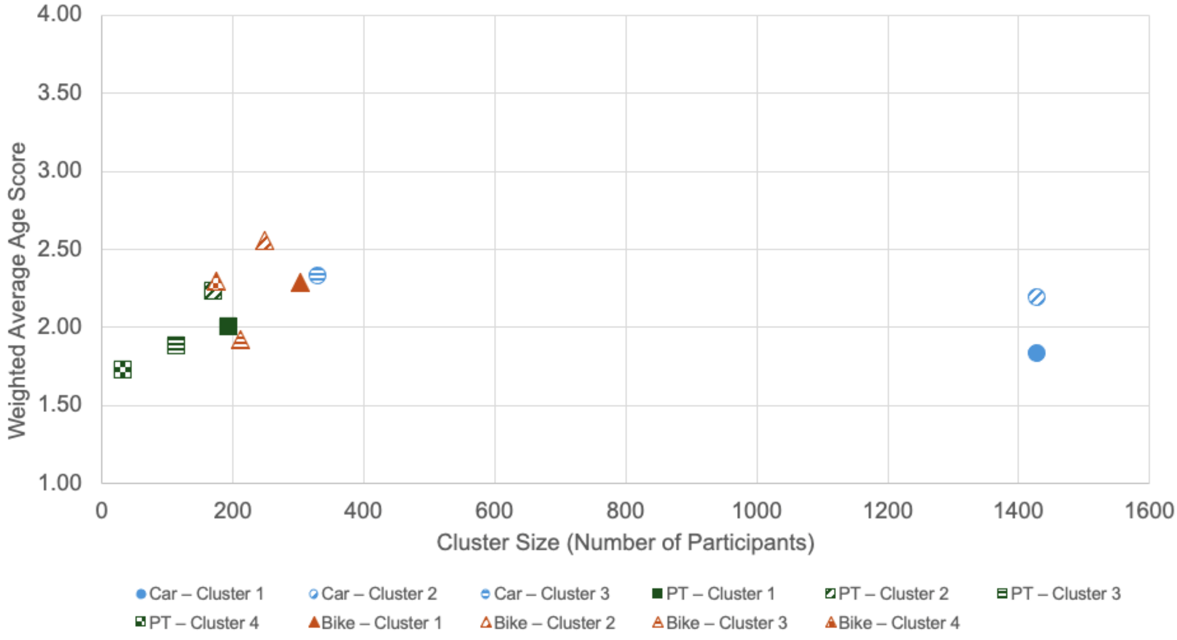

Figure 4.4.2.1: Framework 2: Weighted Average Age Score vs Cluster Size

In summary, the chapter identified several commuter segments within the Dutch context using Latent Class Analysis. Following this, two frameworks were used to evaluate these segments based on their size, policy sensitivity and age profile. This final analysis showed that certain clusters, especially the young and policy-sensitive car user segment, represent high-priority groups for policy intervention. These quantitative findings provide a structured, national-level foundation for the in-depth qualitative exploration of commuter experiences that will be presented in the next chapter.

5 Qualitative Results: Interviews at ASML

To further understand the context behind commuting behavior, this chapter explores the experiences of ASML employees. The findings presented are based on 10 semi-structured interviews conducted with a diverse group of employees. The participants represented the main commute modes, with five being primarily car users. This focus on car commuters is proportional to the findings of the quantitative analysis, which identified the car-only segment as the largest commuter group in the national dataset. The sample also provided a good spread across various departments, commute distances, and years of working experience at ASML. A detailed, anonymized overview of the respondent characteristics can be found in Table 3.3.2.1.

This chapter present the findings from these interviews in several parts. The first section outlines the perceived commute options, after which their daily commute is mapped chronologically. The findings are then synthesized per mode after which the employees' perspectives on existing and potential company policies and services are presented. The chapter finalizes by presenting the results from the hypothetical scenarios and some additional insights.

5.1 Perceived Commuting Options

Before starting with the daily timeline of the commute and those insights, it is interesting to first understand the potential ways in which participants could travel to ASML. The first eye-catcher when looking at the potential options, revealed that an employee's perception of what is a "realistic" option is influenced by distance to work and how easily accessible or close public transport infrastructure is. A clear pattern emerged when participants are grouped by their one-way commuting distance.

Employees living over 30 kilometers from the campus only mentioned public transport and car as viable options. However, those with poor public transport connections (more than 3 transfers) do not view it as a viable option at all. Leaving only the car as a realistic option.

Participants that are living closer, generally within a 50-kilometer range, did see public transport as a theoretical possibility, but one that was not attractive enough to choose. The recurring barrier by this group was a fast last-mile solution, where the final part of the journey (from Eindhoven Centraal to the office) could take roughly as long as the initial train ride from their hometown to Eindhoven.

Those living closest to the office also did not consider public transport as a viable option to get to the office but with different reasons. The issue did not lie with poor connections but rather capacity issues during peak hours. One participant who lived near the center described this frustration:

> *"The buses fill up in the mornings. They fill up at Eindhoven Central and even if you are at directly, the next bus stop, all the buses will have a sign to say 'Sorry, bus full'. So if you don't live in the center of Eindhoven, commuting by bus to work is not feasible, even if you live at the next bus stop… I've experienced this multiple times… It's just not possible in the mornings."* (Bicycle commuter, one-way distance to work of under 10 km)

This capacity issue makes public transport, or in this case the bus, not a reliable option for this group, leaving the car and the bicycle as their only modes for commuting to the campus.

To visually summarize the perceived options that ASML employees experience, the decision tree in the figure below shows how key factors influence the viable options for participants. This figure applies to all the participants of the interviews.

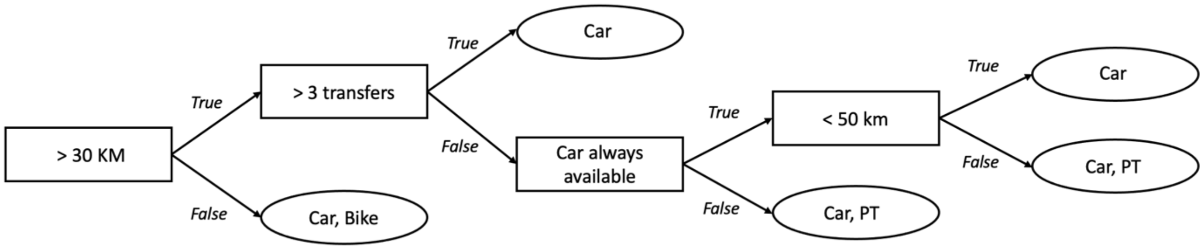

Figure 4.4.2.1: Decision Tree for Perceived Commuting Options

5.2 Timeline Based Commuting

The following sections map the daily commute using a chronological timeline-based approach. The value of this method is that it provides specific insights into at what stage of the commute certain actions are taken, and decisions are made. It focuses on how these moments are actually experienced by employees, including their feelings and frustrations. Gaining this detailed, stage-by-stage understanding therefore provides decision-makers with more concrete points for intervention, allowing for a better alignment between company policies and the actual needs of commuters.

5.2.1 Morning | Before Commuting to Work

In the preparation of commuting to work, differences were seen between participants that followed a fixed routine and those whose travel choice depends on daily factors. The primary mode of transport also influences whether a routine was followed or not.

Car users all indicated that their commute is driven by routine. Participants who use roads known for predictable congestion avoid these congestions by commuting at earlier hours. This means departing at a fixed early hour to ensure a smooth commute to work, as explained by one participant:

> *"The road that I use is the A58, which is always very busy, so I have to leave early to keep travel time as short as possible"* (Car Commuter, one-way distance to work between 30 and 50 km)

On the other hand, public transport users demonstrated a need to stay informed about their trajectory, noting that they actively monitor updates regarding track maintenance to avoid sudden disruptions in their commute.

Similarly, those that cycle reported a more flexible decision making with their choice being sensitive to weather conditions. It remained unclear what precisely entailed "bad weather", but this would lead them to switching from the bicycle to the car, which was demonstrated as follows:

> *"On the other hand, if the weather is very bad, for example it's raining, it's cold, it's miserable, then I'll take the car."* (Bicycle commuter, one-way distance to work of under 10 km)

Next to the specific modes of transport, personal circumstances, such as children, also shape morning preparations. Although the impact is dependent on the age of the children, participants mentioned it required extra flexibility. This was clearly mentioned by a participant:

> *"What I've learned when you have a small child is that you have to accept things can always go differently than you planned, especially with time. So if I plan to leave the house with my kid at 8:00, I also have to accept that it could easily become 8:15. It's a matter of expectation management that you have to teach yourself"* (Public transport commuter, one-way distance to work of over 100 km)

Some aspects can make the phase prior to the commute feel challenging or easy. The most frequent recurring challenge is uncertainty in having a possibly longer travel time due to the weather or traffic. This gets worse with unexpected problems like a flat tire. Another challenge is the time dependent availability of last-mile options. For example, participants who leave later in the morning know that the faster bus services are no longer running and that the shared e-bikes (ASML's campus e-bikes to be specific) are likely all gone, making them more prone to use the car. A different kind of challenge comes from events that require a change to the normal route, like an extra early meeting. One participant explained that this makes them consider car usage (instead of the train) as it saves them time in the early morning:

> *"Sometimes, let's say I really must be here at 7:30, it's also possible that I consider taking the car. The reason is that those extra 15 minutes [that the participant normally takes for granted by commuting by train instead of car] in the morning are worth more."* (Public transport commuter, one-way distance to work of over 100 km)

On the other hand, some aspects make the morning easier. These are mostly about having more control or knowing what to expect. Flexible working hours lets people avoid rush hour and better manage their family schedules. It also helps when things are predictable, like knowing you can easily find a parking spot on a Friday. A different kind was mentioned by a carpooler, who explained the social pressure of knowing others are waiting as a motivator to get out of bed immediately and start the day:

> *"Carpooling means I will never say, 'Oh, I'll turn over one more time', because I know I am going [to the office] with other people."* (Car (carpooling) commuter, one-way distance to work of over 100 km)

5.2.2 Morning | During the Commute to Work

For car users, the journey to work is often filled with listening to the radio or music for entertainment. The primary feeling associated with the commute is stress related to traffic congestion. This was cited as the main drawback of their journey, with frustration especially being high when participants are under time pressure due to an early meeting. Therefore, the topic of avoiding traffic was reoccurring in a large portion of the interviews.

Regarding public transport users, the commute is characterized by both positive and negative experiences. The train ride is considered comfortable and relaxing, that helps them to prepare for the workday. It also provides them with a period of productive personal time where they can read books or catch up on the news, which they otherwise would have to do at home.

However, this positive experience is often countered by challenges at the end of the journey and uncertainty in the event of a delay. Starting with the end of the journey or the 'last-mile', the shared e-bikes are very popular but are known for their limited availability, causing a switch to the generally disliked bus service. One participant even stated this as a barrier to coming to the office more:

> *"I just find the bus terrible… that really holds me back from coming to the office often."* (Car commuter, one-way distance to work between 30 and 50 km)

Furthermore, the uncertainty in the event of a delay is a source of stress. Several contrasted this with driving, where car traffic can be predictable and frustrating, the unknown length of a potential train delay was perceived as more stressful. This was experienced most mid-journey, leaving the commuter stranded:

> *"It is mainly annoying when you're already on your way… if I'm in Eindhoven and suddenly nothing is departing, or you get stranded somewhere, that can be very frustrating"* (Public transport commuter, one-way commute distance to work of over 100 km)

This feeling is worsened during construction times, with a reported lack of communication regarding adjusted bus schedules and departure locations.

The experience from cyclists appeared to be influenced by the quality of the route itself. A high-quality route was defined as being safe, scenic (or 'green') and having minimal traffic interruptions. The scenic aspect was a significant positive factor, with one cyclist even taking a longer journey because it was more enjoyable. Additionally, the cycling also helped them to feel more awake and energized compared to driving.

> *"I have now chosen a route that I enjoy more with less traffic lights and more green. It's a bit longer… but it's just more comfortable than having to go over the Eindhoven ring road."* (Bicycle commuter, one-way commute distance to work between 10 and 30 km)

Lastly, the aspect of safety was a major concern. A participant mentioned worries regarding a recent accident, and another stressed their worries regarding unsafe situations created by poor communication and temporary signage during construction:

> *"I think the biggest issue is communication during construction… the detour routes that happened during construction are not well planned or basically that whoever plans it clearly has never used the bike in their life… I get the feeling that they just get some contractor and that puts up a sign and calls it a day without actually testing whether the path is viable or not"* (Bicycle commuter, one-way distance to work of under 10 km)

5.2.3 Morning | Arrival at Work

Despite frustrations that can occurring during the morning commute, participants reported that these did not have a long-lasting impact on the start of the workday. All but one indicated being able to quickly let go of any stress or annoyance from the commute to work.

Satisfaction with campus facilities differed per mode. Cyclists mentioned some criticism in the facilities provided. A shortage in the number of parking spots available was mentioned, as well as missing good changing rooms or shower facilities at some locations, leading to the employees feeling cold for the rest of the day after cycling to the office. Carpoolers on the other hand appreciated the priority parking spaces but showed the desire for electric vehicle (EV) charging facilities. This currently forces them to occupy parking spaces at a nearby hospital. The parking situation for individual car drives was a point of dissatisfaction. Long distances of available spots, the overall struggle to find a spot and the small sizes of the parking sports were mentioned as frustrations. This leads to many arriving early to minimize the struggle of finding a spot, where others intentionally arrive later to take advantage of spots that open up later in the morning. This shows that the guarantee of a parking spot can be a deciding factor in choosing to drive, as noted by a participant:

> *"Something I would also do is if I need to come to the office, but I only need to come in later, then I'll come after 11:00 and the reason for that is they open more parking at 11. So then I'll probably drive [by car]."* (Bicycle commuter, one-way distance to work of under 10 km)

5.2.4 Afternoon | Before Commuting Home

The decision of when to commute home is mainly determined by the participant's work agenda. For many the end of their last meeting means the start of their commute. However, for those with flexibility in their schedule, avoiding the afternoon rush hour becomes the second factor. This was noted by both public transport as well as car users. Some participants reported checking online traffic information during the day to help plan their commute home as efficient as possible. Lastly, children were also mentioned as a factor determining the departure time.

For the return of the journey, nearly all participants used the same mode(s) of transport they used to get to work. This was only broken under the exceptional case of a complete traffic gridlock, where a participant would consider leaving the car behind to travel home by train. However, daily factors can still influence certain parts of the trip, for instance the decision between taking a shared e-bike or the bus to/from the train station due to weather conditions.

5.2.1 Afternoon | During the Commute Home

The commute home is experienced differently and more relaxed than the morning commute. The primary reason is the absence of work-related time pressure to arrive at a specific moment. This allows for a focus on unwinding and transitioning to their personal lives. For example, a car user calls friends or family, carpoolers debrief the day with each other, or as explained by a cyclist:

> *"I'm also in the afternoon not in a rush to get from point A to point B, so I can spend a bit more time looking at the surroundings… there is a nice lake that you cycle past normally, some wildlife there, people fishing... So that's a nice way to unwind."* (Bicycle commuter, one-way distance to work of under 10 km)

Participants were found to actively manage their journey. One car user reported using navigation on the way home to avoid getting stuck in a traffic jam, something they didn't do on the way to the office. Similarly, a public transport user reported keeping an eye out for shorter, more crowded trains. The success of the journey home was defined by its predictability. A "good" trip was described as seamless, where all different parts of the commute worked as expected. A "bad" trip was defined by unforeseen disruptions, such as getting stuck in traffic or facing sudden delays, as one participant mentioned:

> *"An announcement is made right when the train was supposed to depart: 'Yes, sorry but the conductor has not reported for his shift yet, so we don't know when we can leave.' Yes, then I get really very frustrated… If you want to get people on that train… you have to ensure the service is on par. And it really very often is not."* (Public transport commuter, one-way distance to work of over 100 km)

5.2.2 Afternoon | After Returning Home

Regarding the commute home, benefits were again dependent on the commute mode. Those who selected the car as it is the most time-efficient option for them considered the time saved as a gain for their private life. Train users used the journey for activities they otherwise would have to do in their private time, such as reading books or the news. Furthermore, all cyclists including those who only bike for their last mile, highlighted the health benefits of their commute, not necessarily viewing it as daily exercise but as an overall healthy choice.

However, some other less direct benefits were mentioned as well. The commute in general was seen as a mental separation between work and home. This process was described as important for being more present in their private lives. One car user clearly illustrated this by contrasting it with their work-from-home experience, where they had trouble switching off from work:

> *"I notice now that with that half-hour ride home, I can really let go of my work… Whereas on the days that I work from home… I'm often unconsciously still doing some things for my work while cooking dinner or doing other things. When I commute, I notice that I can really switch off and feel that I'm away from ASML."* (Car commuter, one-way distance to work between 30 and 50 km)

Despite the benefits, the main drawback mentioned was the significant amount of personal time a long commute can consume. This problem is strengthened by employees wanting to make the commute "worth it". One participant explained only coming to the office for intentionally long workdays. This combination, while efficient, was described as unsustainable if it were required daily with a strong statement:

> *"I used to do this every day, right? From Monday to Friday. Well, if ASML decides you have to come to the office every day, then I will find another job. I really can't, I wouldn't be able to keep that up."* (Public transport commuter, one-way distance to work of over 100 km)

However, similar to the arrival at work, participants generally noted that once home, frustrations from the commute itself were quickly forgotten.

5.3 Perceived Enablers and Barriers per Commute Mode

The timeline-based approach in the previous section showed insights into the day-to-day commuting experiences of the participants. While this chronological approach shows actions and events, it is useful to synthesize these findings to understand the overarching enablers and barriers associated with each primary commute mode.

For many participants, the private car remains a primary commuting option due to its time efficiency and the perceived control it offers over the journey. Beyond these functional benefits, the interviews also revealed a more personal enabler for car usage. For some participants, the commute is not simply a way to get to the office, but also an enjoyment itself. This experience from the act of driving can be a factor in their modal choice, making the car their preferred option, as mentioned by a participant:

> *"I also just enjoy driving, I find that important, so I don't mind being in the car."* (Car commuter, one-way distance to work of over 100 km)

However, the availability of parking spaces was mentioned as a significant enabler as well, aligning with research from van Wezel et al. (2025). Several participants mentioned that the guarantee of a parking spot (on a specific location or less busy days like Friday) directly influenced their decision to drive to the office:

> *"I find it very nice to come to the office on Friday. Because this means even if I arrive at 8:30 or 8:45, I can still just park at P4 and be within walking distance. It's just easier finding a parking spot then."* (Car commuter, one-way distance to work between 30 and 50 km)

On the other hand, the primary barriers for using the car are also the aspect of parking, along with traffic. The general lack of available parking spaces and the inconveniently long distance of parking lots were noted as frustrations. This leads to a feeling of wasted time and stress after the drive is complete, as described by one participant:

> *"Yes, I feel like a real loser if I can't find a parking spot here. I find it really pathetic… That you sit in the car for an hour to get to work and then you basically can't even begin… That even over there [parking garage further away from office location] on the roof every single spot is taken."* (Public transport commuter, one-way distance to work of over 100 km)

The stress of getting stuck in traffic, especially on known congested roads was another drawback. Additionally, some mentioned that the financial reimbursement does not cover the full cost of driving and that the commute itself can be tiring.

The primary enablers for choosing public transport focus on three key factors: public transport is free, the commute is comfortable and easy access to a station near home. The commute being free is a significant financial motivator. In addition, participants described the train ride as comfortable and relaxing that is less tiring than driving. Finally, the participants mentioned living close to a train station, making this a viable option in the first place. In the words of a participant:

> *"I live right next to [LOCATION] station, so I'm on the platform faster than I'm at the car parking… When I'm on the train, I read my books. It's paid for by ASML… With the train, it's just free."* (Public transport commuter, one-way distance to work of over 100 km)

Despite the enablers, participants mentioned multiple barriers to using public transport, with the last-mile problem being the most critical. This was often framed as an issue of time inefficiency, where for some the final part of the commute takes nearly as long as the main train ride itself, making this entire option unattractive. One participant explained this further:

> *"The problem for me is not getting from [LOCATION] to Eindhoven Central, that's a good connection… The problem is mainly getting from Eindhoven Central to Veldhoven, which just takes a lot of time… the intercity train is about 20 minutes… but the travel time now [in total]*

is about 45 minutes… a 50% increase in travel time. I find that relatively a lot, and that's the reason why I don't do it." (Car commuter, one-way distance to work between 30 and 50 km)

Although the campus e-bikes are considered as a good alternative solution for the last mile, the availability is not guaranteed, and they are less popular in bad weather. This forces public transport users onto the bus, which was described as slow and crowded due to its many stops. Beyond the last mile other drawbacks include the need for multiple transfers and a lack of flexibility compared to the car.

Beyond the issues of the last mile and crowdedness, the low frequency was also mentioned as a barrier, limiting the flexibility that is appreciated highly. The problem becomes especially visible to those who reported not working the strict nine to five schedule, as frequencies declined outside peak hours. This was put in perspective with what makes public transport a viable alternative:

> *"I studied in [LOCATION] and have experienced the metro there. It runs every few minutes, and it's the only public transport I've ever enjoyed. With the train and bus, it's different… and by the time I leave, usually after 5, the frequency has already decreased."* (Car commuter, one-way distance to work of over 100 km)

For participants living closer to the campus, the bicycle is often considered as the most time-efficient commuting option. Several noted that the time required to drive, find a parking spot and then walk to their desk can make the commute longer than simply cycling to their building. Next to this practical advantage, the quality of the route is also an enabler. Participants mentioned the importance of a "nice cycle to work", which was defined as a scenic route that passes by parks and nature with very little car traffic. This experience is shown in particular by one participant who cycles despite sufficient parking spots being available:

> *"HTC has abundant parking, so even with abundant parking, I choose not to [drive] because it's close and it's a nice cycle to work."* (Bicycle commuter, one-way distance to work of under 10 km)

This positive travel experience contributes to a sense of well-being, helping the cyclists feel more awake and provide a general health benefit from the commute.

Despite these enablers, the viability for cycling is limited by two clear and practical barriers. The most significant is distance, as with longer distances cycling becomes more impractical. The second barrier is weather. Although it remains unclear what exactly is considered as bad weather, rain was perceived as more influential than (cold) temperature. This would cause them to abandon the bicycle in favor of the car, as one participant stated:

> *"Except if it's raining really hard… then I might come by car."* (Bicycle commuter, one-way commute distance to work between 10 and 30 km)

In short, there is a clear trade-off across the different modes. The car offers control and speed but comes with the stress of traffic and parking. Public transport offers cost-savings and a relaxing journey but is hindered by significant last-mile problems and unreliability. Lastly, the bicycle offers health benefits and a pleasant commute but is limited by distance and weather.

5.4 Feedback on Existing Policies and Services

Regarding public transport support, the free NS Business Card was seen as a major benefit. However, participants suggested it could be improved by allowing private travel (for example on the condition of commuting by train twice a week). Another suggestion was to include NS-cycling subscription to provide a backup for the last mile when the campus e-bikes are unavailable. A free train ticket is thus a great advantage, but it loses its attractiveness if the last part of the commute is a struggle.

Regarding financial incentives for cycling, the reimbursement was seen as having little impact on the behavior of those already cycling. One (cycling) participant noted that the extra amount received was so minimal, that it was not a significant financial motivator. Additionally, another cyclist was confused why the reimbursement is capped at a certain distance. The logic of not fully encouraging those that make the bigger effort was unclear.

In general, the participants involved were all well aware of the commuting services offered by ASML. The shuttle service for inter-campus travel received the most positive comments, with the only suggestion of having it available for longer hours. The campus e-bikes were also seen as a good solution, but with a lack in availability at peak times, as well as some safety and comfort concerns.

Like mentioned earlier, the general parking situation remains a concern for individual drivers. Priority parking for carpoolers however was positively received, but a lack in missing facilities like EV charging stations was mentioned. Lastly, the introduction of Hub locations to work from was positively received, with the sidenote that not all teams consider working at this location as an official office day yet.

5.5 Findings from the Hypothetical Scenarios

To explore employee preferences and trade-offs, a series of hypothetical scenarios were discussed during the interviews. The findings from these discussions are outlined below.

When presented with a Park and Ride (P+R) scenario, the discussion revealed a certain order of importance regarding some values. Participants showed little interest in a purely financial reward for using the system, but instead the decisive factor was a guarantee of saving time. This especially held true in the topic of avoiding the worst traffic congestion that the participants experienced near the ASML campus. This perspective was further supported by a participant who already uses a similar system:

> *"If I can park my car at a location like that, and I'm saying not more than 2km away… and I can take either a shuttle or a bike, yes, that would be ideal for me."* (Car commuter, one-way distance to work between 30 and 50 km)

The concept of a "Mobility Guarantee" was explored as a way to reduce the perceived constraint on flexibility for not using the private car. It was positively received by participants, who saw it as a valuable safety net, especially for potential carpoolers. While it was acknowledged that such a service would be used very rarely, some remained hesitant to switching to carpooling if this service were offered. In addition, some practical concerns were raised about what would justify its use.

The introduction of a guaranteed reserved parking spot at the campus was generally seen as a fair potential solution to the current parking issue, but one cyclist noted the risk that guaranteeing a spot might encourage them to drive more often. In contrast, public transport users appeared to be less tempted. They indicated a strong preference for their current mode and were generally not interested in switching back to the car, as a guaranteed parking did not guarantee no traffic issues. For this group, carpooling was also seen as a less attractive alternative due to concerns about privacy and social pressure.

5.6 Additional Insights on other topics

When asked about potential ways in which ASML could encourage employees to travel more sustainably, the idea of paid parking was a common suggestion. This was however with a strong condition that any system must be implemented fairly, for example by reflecting a person's travel distance and/or salary. One participant noted that this is already happening in practice with a colleague who is willing to pay for the convenience:

> *"The funny thing is, I know a colleague of my manager… he just parks there at the hospital. He just pays. Yes, he just wants a parking spot, and he just pays, so I think it can really work."* (Public transport commuter, one-way distance to work of over 100 km)

The feedback on both existing policies and potential policies indicates that participants value a balanced employer "philosophy" on mobility. Instead of a restrictive approach that removes choice, they appreciate the possibility of making the decision themselves. This was clearly mentioned by one employee who put this in perspective with his former workplace:

> *"Previously, I worked at [COMPANY]'s headquarters, and I remember the sentiment there was: 'There is only parking for guests and for Executive Management, everyone else figure it out and take the train'… I believe you should enable people to choose a mode that they find attractive. However, I don't think you have to solve all the associated problems."* (Car commuter, one-way distance to work of over 100 km)

The interviews also revealed several general issues and opportunities related to carpooling. An important practical barrier is the lack of a single, effective phone application to facilitate all necessary functions. Socially, a network effect was seen, with a car user explaining that a colleague was actively trying to convince them to start carpooling. Lastly, a lack of recognition for carpoolers their "good" behavior was stressed:

> *"I think the recognition can be improved. But recognition comes in many forms, recognition is also that you do have a charging station at a carpool spot. Not that you think 'oh, you carpoolers don't have an electric car?' Yes, that makes no sense."* (Car (carpooling) commuter, one-way distance to work of over 100 km)

Participants also commented on the company's culture regarding employee housing. The "old culture" which expected employees to live near Eindhoven or Veldhoven was described as unsustainable and not possible for the company's future. This perspective implies that a significant portion of the workforce will always have a substantial commute.

Finally, a critical theme that emerged in the interviews is the challenge of the last mile. This issue was repeatedly mentioned as a barrier that limits the effectiveness of positively received policies like the free public transport card. One participant formulated the problem in a very direct way:

> *"The fact that there is no train station here is the biggest flaw of Veldhoven."* (Public transport commuter, one-way distance to work of over 100 km)

6
Discussion

6.1 Integrating National and Case Study Insights

This section will synthesize the findings from the quantitative and the qualitative parts of the research by looking for similarities and differences between them. This helps to create a more complete picture of commute behavior, moving beyond what either the quantitative or qualitative data could show on their own. The combined analysis explores the real reason behind the statistics, helping to explain how and why certain decisions are made. This will later on be used to compare the findings from this research with the existing literature.

6.1.1 Mileage Reimbursements

The Latent Class Analysis (LCA) shows that the importance of mileage reimbursement for the car differed both when comparing commute groups (car-only, public transport-only, bike-only) as well as looking deeper into the car-only clusters. Although the average score for car users suggests that reimbursement has some influence, the clusters show more subtle results. Cluster 1 valued it the most and the importance decreased for cluster 2 and was lowest for cluster 3. The qualitative interviews support the idea that this reimbursement is often not a decisive factor because the mileage reimbursement does not fully cover the actual cost of driving. This helps to explain why it may not be a powerful enabler for all clusters. This suggests that for many commuters, the car mileage reimbursement is not a strong incentive that encourages them to drive, but more a partial subsidy on a choice they would have likely made anyway.

In contrast, the quantitative data shows that for public transport, the importance of mileage reimbursement is the highest. This also holds for all the separate public transport only clusters, there are no significantly low scoring groups. The qualitative interviews directly supported this. At ASML, the free NS Business Card (a complete reimbursement of the travel costs) was repeatedly mentioned as a major benefit and a reason to choose the train over other modes.

The findings for bicycle reimbursement showed another pattern. The LCA showed that the majority of the cyclists valued it as having low importance, with only one of four clusters scoring somewhat high. The interviews again aligned well with this, where it was mentioned that for an incentive to be really appreciated, the net difference must be significant. A participant explained that the shorter distances typical for cycling (which can also be capped by policy) only lead to small net financial gains. This suggests that for this commuter group, the small financial reward from a mileage reimbursement is unlikely to be a primary driver of their decision-making. However, the potential for these incentives to trigger a change in commute mode remains unknown by this research.

6.1.2 Time and Convenience

Public transport (PT) is valued differently by users of public transport and non-users of public transport. For those that commute by public transport, the LCA showed that having a PT stop near work was the most important enabler, followed closely by financial reimbursements and having a direct connection. Those who do not commute by public transport, mention transfers and wait times as the main barrier preventing them from choosing it. Interestingly, the qualitative interviews did not directly mention these specific terms. Instead, the participants focused on the poor quality of the last mile solution itself. The bus stops are present, but the bus service is considered unpopular because it stops too often, is too full and too slow. This allows a more subtle interpretation of the quantitative findings. A possible explanation to these differences could be that the perspectives on the bus connection leads commuters to perceive Eindhoven Centraal as the effective end point of their public transport journey, from which they find their own solution, like the shared e-bikes. From this perspective, the idea of “no stop nearby” is not about a lack of physical bus stops, but also about the stop being convenient and viable.

The interviews also showed how commuters perceive delays, suggesting that not all delays are experienced equally. Car users reported frustration with traffic congestion, which they could manage to some extent by managing departure times. Public transport users however described the unpredictable aspect of public transport delays as significantly more stressful. The feeling of being stranded for an unknown time was highlighted as worse than being stuck in a traffic jam. This suggests that the unreliability of a commute is not just about the frequency of delays, but also about the level of uncertainty and the lack of control. This distinction between a delay as a time metric versus the stress of uncertainty is an important insight that was not visible from the quantitative data.

In contrast to the financial motivations discussed earlier, the interviews revealed that for cyclists, time efficiency can be a significant enabler. The total door-to-door time by bicycle is often quicker than by car, as it avoids the time spent searching for a parking space and then walking to their desk. The timeline-based approach was essential in uncovering a deeper layer to this, revealing a difference between the morning and evening commute. It showed that participants are often less in a rush on the way back home and explicitly experience the return journey as a way to unwind from the workday. This practical time saving, along with health benefits, infrastructure and the influence of the weather appear to be more influential for cyclists than monetary rewards.

6.1.3 Parking Scarcity and Cost

The national survey data showed free parking as the highest rated enabler for all three car-only clusters. However, a direct link confirming this as the main motivator was not found in the interviews with ASML employees. A potential explanation is that the benefit of free parking is currently outweighed by the problem of parking scarcity. Instead, participants frequently mentioned paid parking (the exact opposite of free parking) as one of the most effective ways ASML could encourage employees to travel more sustainably. This shows an interesting point, the biggest encouragement for car driving on a national level is the same one that employees believe is the most promising for promoting sustainable modes of transport if it were implemented. This shows a powerful, but at the moment unused, possible implementation for ASML.

The interviews did show how employees currently deal with parking scarcity. The main strategy is avoiding peak hours. Participants explained they adjusted their schedules to arrive either before or after the peak hours to save time both by avoiding road congestion as well as the search for a parking spot. Continuing on the will to skip this struggle, a participant explained that some are already willing to pay for their guaranteed parking spots. This was shown with the story of a colleague who chooses to pay at a nearby hospital for a guaranteed parking spot, removing the stress of uncertainty over a financial cost. Both these strategies (avoiding peak hours and paying) show that employees try to minimize the downsides of the car commute. The fact that employees are willing to trade their personal time or their money to in return get a smoother commute, reinforces the idea that a paid parking system could be a potential direction, especially if this system guarantees a space and with that reduces the daily stress and struggle of the search.

6.1.4 Infrastructure and Facilities

The final part of integration is about infrastructure and facilities provided to employees, especially cyclists. The LCA highlighted the importance of a secure bicycle storage. Although not specifically pointing at ‘secure’, the interviews did confirm this but also pointed at shortcomings in other aspects such as sufficient parking and a lack of shower rooms. The latter was directly involved in the LCA as well and was, even though the values differed per cycling cluster, rated low.

Beyond the campus itself, the interviews showed the importance of the infrastructure for cyclists. Especially the quality of the route (scenic and safe) was valued highly. This was not measured in the LCA and helps to further understand the cyclists' perspective.

6.2 Practical Implications for Corporate Mobility Policy

The first implication from the findings is that in order to have sustainable commuting options adopted by a large portion, they must be perceived as both visibly superior and reliable. For an employee driving around a full car park, seeing plenty of free bike racks or seeing carpoolers easily park their cars acts as real-life promotion for a better way to commute. In contrast, the reported shortage on shared e-bikes during peak hours functions as a strong discouragement. It shows that a good facility, if unreliable, increases frustration and pushes employees back towards the certainty of their own car. The implication here is to ensure alternatives are of good quality, as the perception of whether the grass is greener on the sustainable side depends on the reliability, visibility and the convenience of the provided options.

Secondly, the findings imply that companies should recognize and leverage the power of 'network effects' to promote sustainable travel. The interview finding where an employee was actively being encouraged by a colleague to start carpooling is a clear example of this. The focus should not just be on converting car users, but also on keeping the current sustainable commuters satisfied. A happy cyclist, train or bus user or carpooler is arguably the most trustworthy promotor for that mode. Additionally, they can also share practical tips and encouragement in a way that cannot be completely influenced by policy or decision makers. So, investing in the experience of sustainable commuters is not just about retention, it's also about the marketing that can grow the adoption of these modes.

The quantitative segmentation shows that a single one-size-fits-all policy is inefficient. However, targeting hidden clusters directly is impractical. Therefore, it is important that companies use the knowledge of these different sensitivities to design policies with built in differences based on fair and objective criteria. This approach is directly supported by the qualitative findings, where the participants suggested that paid parking should reflect an employee's salary and travel distance. This still allows a company to influence a target profile in a way that is both practical and more likely to be accepted by the entire workforce.

The findings consistently showed parking policy as a powerful way to influence commuting patterns, but its implementation also carries risks. The fact that 'free parking' is the highest rated national enabler for car use, and that employees themselves suggest paid parking as a key tool for sustainability shows this high impact potential. However, in a competitive 'War for Talent' (a term invented by McKinsey in 1998 to show that companies are fighting to attract the best talent), introducing a push measure like paid parking can be perceived as reducing the attractiveness of the company, potentially harming recruiting and retention rates. This suggests that the decision to use parking as a disincentive should be handled with care. It shows the balance companies must find between achieving spatial and sustainability goals and remaining an attractive employer.

The last mile problem identified in the case study shows that although subsidized transport, like the free train pass (NS business card) are well appreciated, its value greatly reduces if the final connection to the office is slow and unreliable. Even with a good main commute, the entire option can fail if the last mile presents a barrier. This means that if a company wants to promote train usage, practical and efficient ways to complete the last mile are just as important as providing the subsidized train pass in the first place.

Finally, the recurring issues of the last mile problem and traffic congestion show that the extent to which a company can improve its employees' commutes is also connected to the infrastructure in the area. Solutions by companies themselves, such as providing shared e-bikes or flexible working hours, are helpful, but they do not solve the underlying issue. To make sustainable commuting a more practical and attractive option for employees, close collaboration with governmental bodies is needed. This is because problems like an inefficient local bus service or recurring road congestion cannot be solved by the company alone.

6.3 Contributions to the Literature

6.3.1 Commuter Segmentation

The findings from this research support the idea in the literature that segmenting commuters is important for creating more effective mobility policies (Diana & Pronello, 2010; Santos et al., 2013). By not treating them as one large group, decisionmakers can better match policies to the specific needs and motivations of different segments. The LCA used in this research was a useful method as it successfully identified different commuter profiles within the car, public transport and bicycle user groups. This confirms the value of using such a method to find these groups, as has been done in other studies (Ardeshiri & Vij, 2019; Chatziathanasiou et al., 2024; Vallée et al., 2024).

The segmentation found the consistent appearance of two main types of commuters across all transport modes, the habitual commuter and the responsive commuter. The idea of this habitual commuter aligns with the ideas of Lo et al. (2016), who pointed out how attitudes and norms can form habits that are hard to change. The research also provides a more nuanced perspective on the potential for mode-switching within specific commuter groups. Although in a multimodal context, Molin et al. (2016) suggested that public transport users often hold positive attitudes towards car-usage, making them more susceptible to switching. Our research offers a more nuanced view. By segmenting the public transport group further, we found that only the smallest cluster showed a significantly higher susceptibility to changing to car use. This suggests that the broader group of public transport commuters may be more stable than previously assumed.

Furthermore, although some demographic patterns were found in these clusters (e.g. habitual segments tended to be older) the overall influence of socio-demographics was less important than suggested by the literature. Dai et al. (2016) for example identified factors like age and gender as influential on commuting choice. Instead, our results align more with the specific Dutch context such as by Ton et al. (2019), which also found gender to be of less significance. This strengthens that the main differences were based on their attitudes, not just their demographic profiles. This supports the work of Haustein and Hunecke (2013), who argue that psychological factors can be better at predicting travel mode choice than socio-demographics alone.

Finally, this research contributes to the debate on the importance of attitudes versus traditional factors like time and cost. Our findings partially support the work of Paulssen et al. (2014), who argued that attitudes toward comfort and flexibility are more influential than time and cost. Our quantitative results similarly suggest that financial costs are not as decisive. However, our qualitative findings show that travel time, particularly predictability, remain highly relevant in commuting decisions. This underscores how a mixed-methods approach can reveal aspects that may be understated in purely attitudinal (quantitative) models.

6.3.2 The Role of Infrastructure

The findings confirm the importance of the built environment in shaping commute choices, a theme established in the literature. The qualitative results from ASML directly support the conclusions of L. Yang et al. (2015) and Naess (2012) who found that factors like urban density and the proximity of public transport stops are critical factors in travel behavior.

However, this research adds another layer to these findings by highlighting the last mile problem. Although a strong ‘pull’ measure such as ASML’s free public transport card is aligned with recommendations to incentivize public transport usage, its effectiveness was found to be limited by the poor connection from the final station to the campus. Interview participants repeatedly described how the last part of the commute by train was inefficient and thus making the entire option unattractive.

This provides an example for the argument made by Lin (2018) who mentioned that simply investing in pull measures like free bus services may not be enough to change behavior if they fail to align with commuters' practical needs. The contribution is to see the travel infrastructure as a complete chain, showing that a single poor connection can undermine a sustainable travel option.

6.3.3 Push and Pull Measures

The quantitative analysis supports the value of pull measures, showing that especially for public transport users, reimbursement for their travel cost was an important factor in their choice of mode. This is consistent with the literature showing that employer provided incentives, such as these discounted or free public transport passes, are effective tools for encouraging public transport use (Dong et al., 2015; L. Yang et al., 2015). However, the qualitative findings introduce an important condition: for an incentive to be effective it must be seen as significant. For example, cycling ASML employees described the financial reimbursement as too small to be a real motivator. This suggests that while pull measures like financial rewards can work, the real-world impact is dependent on the perceived value.

Furthermore, the research provided insights into the acceptance of push measures. The openness of employees to paid parking is consistent with the principles found in the literature. Keizer et al. (2019) and Wicki et al. (2019) for example noted that the acceptance of these restrictive measures depends on the perceived personal costs and the availability of alternatives. This was reflected by the ASML employees who suggested that such a policy would have to be fair and if good alternatives to driving were in place.

6.3.4 Psychological factors

A key contribution of this research stems from the qualitative findings, which provided deep insights into the psychological and emotional dimensions of the commute, aspects that the quantitative data did not give.

The interviews held revealed that the commute can serve as a positive psychological function. The description of the commute home as a "mental buffer" that helps to separate work life from one's private life is a clear example of this concept discussed by Friman et al. (2013) and Novaco & Gonzalez (2009). Similarly, the findings that cycling helped one to feel more awake once arriving at the office supports research of Walsh et al. (2024) on mental well-being as a motivator for active travel. It also aligns with the argument from Paulssen et al. (2014) that comfort and enjoyment can be more influential than traditional aspects like time.

In contrast, negative experiences were also a topic. The stress related to congestion, particularly the frustration of searching for a parking space, were cited as drawbacks of driving. This experience of stress among car users aligns directly with the findings of Wener and Evans (2011), who found that drivers reported higher levels of stress and more negative moods compared to train users. For these commuters, the perceived problems with the alternatives are so significant that they use the car, knowing the consequences.

Finally, the study offers a nuanced perspective on the "spillover" effect of the commute, a concept discussed by Chatterjee et al. (2020), where the emotional experience of the journey affects the period immediately following it. While the literature suggests a strong carry-over effect, our qualitative results indicated that participants were often able to let go of their commute related stress relatively quickly upon arrival.

6.4 Reflections on Methodology

I chose a mixed-methods approach, which I ended up finding very valuable. I realized that the numbers from the Latent Class Analysis (LCA) are only useful to explain the story to a certain extent. The qualitative interviews came in very handy here to provide the 'story' behind the numbers. What was also helpful was to have the knowledge from the LCA results during the interpretation and analysis of the interviews. The LCA provided some first insights into what could be overarching themes that emerged from the qualitative data. This combination was very useful to really understand the story behind commutes' choices.

Although I was very familiar with Python and other clustering methods, the research introduced me to a new method, the Latent Class Analysis and a new program, LatentGold. This took some time, but I found the video clips from my supervisor very helpful, and the program works quite intuitively. Choosing the right number of clusters was another part of the analysis. The more traditional criteria like BIC and BVR consistently favored models with more clusters, which weren't always useful. Therefore, I selected the final models based on a high Entropy R^2 statistic, a minimal cluster size and interpretability. This allowed for a consistent method for making the decision, making the clusters distinct but also practical and interpretable. Presenting the final cluster results in the frameworks was challenging, but I decided to focus on it being actionable and easy to understand by decision makers, not scientifically groundbreaking.

The variables chosen for the LCA was based on correlation coefficients and what I initially expected to be relevant. Looking back with the knowledge from the interviews, other variables seem interesting as well. For example, the interviews showed the importance of factors such as 'sufficient parking availability' (MB2_A), 'having a stop/station near home' (MB3_A), and the 'perceived safety of the cycling route' (MB7_I). This also shows a limitation of the study, I was limited in some way to the existing variables in the survey data, rather than having the choice to define my own.

Choosing ASML as a case study, while also an opportunity, was a great choice because of the urgency of the mobility issue there. During the interviews, I consistently started with a brief 'get to know' conversation, to help build a bond and create a safe and honest environment. The timeline-based structure worked well, which was confirmed by a participant in their feedback. I did also face some challenges myself, such as deciding what information was truly important during the analysis, trying to stay neutral in the conversation and picking the most important questions to ask when time was short. To prepare for this, my supervisor offered me to attend her lectures on interview techniques, which helped me a lot. For example, I taught me some practical techniques to politely get more context, as well as that some of the most interesting topics get discussed right after the recording is turned off.

6.5 Strengths and Limitations

6.5.1 Strengths

The main strength of the research lies in its mixed-methods design. The integration of quantitative national level insights with a qualitative case study provides a more comprehensive understanding of commute behavior than a single method. Additionally, insights like the stress experienced by participants of the qualitative part of the research would otherwise not have been included in this research.

Specifically for the quantitative part, the choice of Latent Class Analysis was a strength. Unlike other, simpler, methods that's just group respondents based on how close their scores are, LCA identifies groups based on consistent patterns in their answers. Another big advantage is that it can handle categorical data from the survey, like the 1-7 Likert scale items. This results in more realistic and interpretable segments, making it a good fit for this study. This statistical approach, along with the criteria to select the best model led to a segmentation that is supported by the data but also interpretable.

Another strength of the quantitative analysis was the use of the national Landelijk Reizigersonderzoek (LRO) dataset. The large scale of this survey provides considerable advantages. It enhanced the external validity of the findings, meaning that the segments are not just specific to one context, but these reflect a broader pattern across the Netherlands. Secondly, a large and diverse sample is important for the stability of a method like LCA. It ensures the model has sufficient data to identify the segments, adding more confidence to the robustness of the segmentation.

Regarding the qualitative part, semi-structured interviews were chosen over other methods like focus groups. This was done in order to explore the day-to-day context of commuting decisions in depth. It allowed for confidential conversation where employees could speak freely about their frustrations and motivations, without the influence of group dynamics. The effectiveness of this approach became clear in the quality of their responses. Participants often spoke with emotion, clearly expressing their enthusiasm as well as their frustrations with barriers they faced.

While it is impossible to determine if a different interview script would have produced the same insights, the chosen timeline-based approach with hypothetical scenarios proved to be effective. The timeline-based approach was valuable as it helped to uncover specific emotions experienced at different points of the commute. It also helped participants to think of topics they otherwise would have forgotten. For instance, it revealed the difference between a morning journey which was experienced more rushed and a return trip which was experienced as a way to unwind. Furthermore, the use of scenarios sparked the conversation, allowing the participants to move beyond the simple preferences and think about at which point an alternative does become attractive. The effectiveness of this structure was supported by the participants, who responded positively to the format in the feedback part of the end of the interviews.

6.5.2 Limitations

Despite the strengths, the research also has several limitations. Starting with the overall research design, there is a mismatch between the two datasets, as they do not cover the same time period or geographical scope. This means that certain circumstances specific to one of the two periods could influence the findings. For example, a public transport strike during the interview period could place extra importance on the reliability of public transport whereas poor weather during the LRO survey could make weather conditions appear more important. Additionally, the quantitative data reflects national patterns, while the qualitative data is rooted in the specific context of the Eindhoven region. While the two sources of information are used together, direct comparisons must be made with care.

Regarding the quantitative analysis some limitations come from using an existing national dataset. The dataset being an existing one, means that the research was limited to the available variables. This prevented the design of new questions. Because of this, some ideas that came from the interviews, like the last mile problem, could not be measured as a single factor in the survey. Furthermore, the data on employer policies shows only the incentives that participants reported using, not the full range they had access to. This is a limitation because it is difficult to know if a policy is not used because the participant is not interested, or because it is not offered to them. Another limitation relates to the Policy Sensitivity Index used for the framework in Chapter 4. As the survey asked different questions to each commute mode group (Car-only, PT-only, Bike-only), the index was built using different variables for each group, which means that the resulting scores should be interpreted with caution. Finally, although any self-reported data contains the risk of a strategic response bias (try to influence policy with their decisions), this is likely small for this dataset as the incentive for one individual the influence the outcome is minimal.

The qualitative findings also have some limitations, the fist being the generalizability. The case study focuses on one high-tech company and so some mobility context related factors may not apply to other companies or regions. A broader limitation of the interview method is that it is time intensive, which limits the number of participants that can be included. Next to the size of the sample, the characteristics also pose some limitations as the sample consists of a relatively larger portion living further away from the office. The short distance perspective might be underrepresented. Additionally for privacy reasons the commute distances were provided in categories, reducing the precision of the analysis based on the factor distance. The recruitment process introduces the risk of selection bias as participants were drawn from a list of volunteers who were already more engaged in mobility issues. Although this was partially mitigated by snowball sampling (asking participants to refer colleagues), this led to a higher number of participants from the same department. Finally, the interview data is sensitive to participant biases. These include the social desirability bias, participants may have positioned themselves to be more environmentally conscious, or strategic answering where they might have over emphasized certain problems in the hope of influencing the company policy in their favor.

6.6 Future Research

First, future quantitative modelling could build upon the LCA performed. It would be valuable to conduct an LCA using a different set of variables, especially those identified as important in the qualitative phase like the safety of a cycling route. Another option could be to compare commuters' actual travel distance with their perception of distance as a barrier to reveal psychological insights. Both could reveal new commuter profiles based on practical and psychological factors.

Additionally, the group of commuters living within a 30-kilometer range was underrepresented in this research compared to those commuting longer distances. To create a more balanced and complete understanding of commuting behavior, future studies could focus specifically on the challenges and motivations of this range group. This would ensure that the specific barriers they face are given the same attention.

To address the generalizability of the case study further, a cross-sector comparison could be a valuable next step. Future research could compare the commute segments, mobility problems and implications to those at different types of organizations, to see which aspects apply more broadly and which don't.

Continuing on the qualitative finding that employees might accept paid parking if it's perceived as 'fair', future research could look at what makes a parking policy fair and acceptable. This could look at how pricing should be differentiated based on factors like salary, distance to the office or access to sustainable alternatives to determine the most effective pricing design.

In addition, this research identified the last mile as a critical barrier. A potential next step would be quantitative research to identify the specific 'tipping point' at which the time and inconvenience of the last mile outweigh the benefits of the main commute by public transport. To conduct such a research, new quantitative data from a stated preference survey could be a usable data source. The goal of such a study would be to quantify this 'tipping point' by determining the acceptable ratio of last mile travel time to main journey travel time, before commuters find the option unattractive.

The qualitative findings showed that commuter stress is a critical but complex psychological factor. While this research identified its existence, future studies could look deeper at the specific causes of this mobility related stress. For example, research could try to understand the relative importance of different stress causing factors like unpredictability, additional time due to congestion or a lack of personal space. By quantitatively measuring and comparing the impact of these components, decision makers can better understand which interventions would be most effective at creating a less stressful commute.

Lastly, the interviews showed that the commute serves as a mental buffer between work and home. Future research could explore this aspect more deeply by looking at how different job roles and the extent of teamwork influence the ability to switch off from work after returning home. Understanding this connection could enable employers to design more targeted mobility or work policies that better support the work-life balance of employees in specific roles.

7
Conclusions

7.1 Answers to Research Questions

Sub Question 1: What insights does the existing literature reveal about employee segmentation based on commuting behavior, perceived enablers and barriers, and responsiveness to employer mobility policies?

To start with the employee segmentation, there is a shift from relying on socio demographics towards more attitude-based methods. This allows for the development of policies that avoid the 'one-size-fits-all' approach by grouping commuters based on shared values and psychological drivers.

Secondly, the literature identifies distinct perceived enablers and barriers for each transport mode. Car commuting is driven by convenience and comfort, while costs and travel related stress demotivate it. The viability of public transport depends on network accessibility and service reliability. For cycling, safe infrastructure and end of trip facilities are enablers, whereas distance remains a key barrier. Another insight across the different modes is that practical barriers often outweigh an employee's environmental intentions.

Lastly, regarding responsiveness to employer mobility policies, the literature states that a combined "push and pull" approach is more effective than a single one. "Pull" measures are generally popular but only effective if they are truly practical and convenient. "Push" measures that disincentivize car use can be effective but often face resistance. The acceptance depends on the perceived fairness of the policy and the availability of viable alternatives for commuters. The literature concludes that to be effective, mobility policies must be targeted to specific commuter segments, using a balanced mix of measures that address their unique motivations and practical barriers.

Sub Question 2: Which distinct commuter segments can be identified in the Netherlands based on perceived commuting mode enablers and barriers, socio-demographic factors, commuting distance and mode availability?

The Latent Class Analysis successfully identified several distinct commuter segments within each of the three primary transport modes, showing differences beyond the mode choice. For car-only users, the segments included a policy sensitive cluster motivated by financial incentives, a more convenience-oriented cluster with a focus on practical factors and a smaller cluster of habitual drivers, characterized by their low importance on all factors. The public transport only clusters were more diverse, ranging from a loyal (older) habitual cluster to a smaller (younger) sensitive cluster. There were two segments in between, one focused on convenience and another (more long distance) on financial aspects. Among the bicycle only users we also found four distinct clusters. The largest was a balanced cluster, with average scores on most of the indicators. In contrast, there was a highly responsive cluster sensitive to the barriers of other modes as well as a habitual cluster with shorter commute distances and an older average age. A fourth cluster showed relatively low importance on car or public transport barriers but valued having secure bicycle storage highly.

The segmentation showed that even within a commute mode, the population consists of different profiles with different needs and sensitivities.

Sub Question 3: What contextual factors and daily experiences help to explain the commuting decisions of the identified segments?

The qualitative case study was very helpful for understanding the story behind the quantitative data by looking at the contextual factors and daily experiences that explain commute decisions.

First, the interviews showed two big practical challenges that shape daily commutes. The most critical was the last mile problem for public transport users, where the benefit of a free public transport pass was reduced by a slow and unreliable final bus connection. Similarly, for car users, the daily challenge of finding a parking spot emerged as a big source of stress and wasted time, a problem that directly influenced their schedules.

Second, the research provided insights into what motivates commuters. It showed that the effectiveness of financial incentives depends on how they are valued by an employee. A large benefit like a free train pass was a strong motivator, where a small reimbursement for cycling was seen as not having much effect for those already cycling. In contrast, the interviews also found strong non-financial enablers, particularly the importance of a safe and scenic cycling route.

Finally, the study showed important psychological and social factors. An important finding was the role of the commute as a 'mental buffer', providing a transition that helps employees to mentally separate their work and home lives. Furthermore, the influence of network effects through encouragement from colleagues and personal circumstances such as children, were shown to be important contextual factors. These findings show that commuting choices are not just a simple money and time equation, but a deep part of the personal and social aspect of a person's life.

Main Research Question: To what extent do different employee segments in the Netherlands vary in the enablers and barriers they perceive when making commuting decisions?

This research showed that different employee segments in the Netherlands vary a great deal in the enablers they perceive when making commuting decisions. The quantitative analysis first identified these different employee segments. The profiles varied from deeply habitual to high policy responsive. The qualitative case study then provided the deep context for this variation. It showed that the influence of any given factor is not the same for everyone but is instead shaped by a combination of practical issues (like the last mile problem and parking difficulties), how employees value financial incentives and personal (psychological) factors.

7.2 Recommendations

Based on the conclusions drawn from the research, this section presents a series of recommendations for corporate mobility policy. The recommendations are structured in a two-step approach to provide clear and actionable insights. The first subsection identifies which segments should be prioritized for policy intervention based on the strategic framework analysis. Continuing on this, the second subsection outlines several actions that can be taken to influence commuting behavior and address the key issues uncovered in this research.

7.2.1 Prioritizing Key Commuter Segments

To provide a strategic focus for the recommendations, the commuter segments are first prioritized based on three criteria derived from the framework analysis: the cluster's size (representing potential impact), the Policy Sensitivity Index, and its average age profile (representing potential for long-term change).

The primary priority should be on addressing the large car-user segments, as this offers the most significant potential impact. Within this group, Car Cluster 1 is the top priority. Its large size, combined with its high policy sensitivity and younger age profile, make it the ideal target for interventions aiming to achieve a lasting modal shift. Car Cluster 2 is the second priority due to its equally large size. Its average PSI score shows it is open to tailored policies, although its older age profile suggests a more limited long-term impact compared to Cluster 1.

The next priority should be on reinforcing the behavior of younger, policy sensitive sustainable commuter to build a long-term base of sustainable behavior. This includes Bike Cluster 3 and PT Cluster 1, which are both young and have a high PSI, making them good candidates for supportive measures. PT Cluster 3 is also a priority due to its younger age profile, suggesting that interventions could have a lasting impact.

Finally, several clusters are considered a lower priority. Car Cluster 3, Bike Cluster 2 and Bike Cluster 4 are all categorized as lower priority due to a combination of low policy sensitivity and an older average age. While PT Cluster 4 has a very young and high PSI profile, its very small size make it a lower priority in terms of overall impact.

7.2.2 Recommended Actions

Based on the findings of this research the following recommendations are proposed for the case company and other large parties who are facing similar mobility challenges.

First, to deal with the last mile problem, which was identified as a critical barrier to public transport usage, a two-sided approach is recommended. To start, the company should actively collaborate with governmental bodies and municipalities to encourage and support projects aimed at improving public transport services to the campus. On the other hand, it should explore the further development of a hub network. These hubs are smaller, remote offices located in key cities closer to where employees live. By officially recognizing work performed at a hub as an office day, the overall impact of travel can be reduced. This does not need to eliminate travel to the main office entirely. For example, an employee required in the office three days a week might commute to the main campus twice a day and use the local hub once. The first part deals with the last mile problem by improving the connection for the days the employee does come to the main office, the second part reduces the number of times they make the commute in the first place. This two-sided approach addresses a key barrier addresses a key barrier identified in the qualitative research and serves as a powerful ‘pull’ measure, making public transport a more viable and attractive alternative for all commuter segments, especially the large car-user groups.

The research showed that the impact of financial incentives is not uniform. Therefore, it is recommended that the focus should be on optimizing rather than expanding financial incentives. It is advised that effective subsidies like the free public transport pass, which are proven to be powerful motivators are maintained. On the other hand, further investments or changes in small nominal reimbursements should be carefully considered, as from this research it did not become clear whether these small amounts are a decisive factor in an employee’s choice to change their commute mode.

Given the challenges with parking scarcity and the risks coming with the ‘War for Talent’, a new approach for parking is suggested. This involves implementing a more managed parking system, which acts as a ‘push’ measure to regulate demand. This type of ‘push’ measure is a key strategy for influencing the two largest, top priority segments identified earlier. This could take several forms. One option is a traditional pro-rata paid parking system, where the fee or price is linked to criteria like an employee’s salary and/or commute distance. A more flexible alternative could be a credit or token-based model, where employees receive a set number of free parking days per month and then pay for additional use. While introducing such a measure during a competitive ‘War for Talent’ requires care and attention, it can still succeed if the solution is designed to be fair and is communicated clearly as a step towards a more sustainable future for everyone.

To effectively encourage a shift in behavior, the facilities for sustainable alternatives must be visibly superior to the car commute. It is recommended that the company provides convenient facilities of high quality for all sustainable modes, including premium carpool spots with guaranteed EV charging and good bicycle facilities. This should be prioritized over building more general car parking spaces as the research suggests that an increased amount of parking spaces will likely increase the amount of car users. Creating this visibly superior alternative is a foundational ‘pull’ strategy, essential for retaining sustainable commuters and for attracting car users by showing a more appealing alternative.

Carpooling was identified as one of the most viable and attractive alternatives, but its potential is held back by several issues. To address the main barrier of flexibility, it is recommended to further explore the concept of the ‘Mobility Guarantee’. This service, which would provide a ride home in an emergency, was seen as an attractive safety net, and a pilot could test its viability and potential on carpool adoption. Secondly, the current facilities enabling carpooling do not meet user needs. As a result, employees are using three different applications to enable this commute mode. It is recommended to combine this into a single user-friendly platform. Finally, the participants expressed the need for recognition for their choice. Given that this group acts as a promoter for sustainable commuting, addressing their issues with care is important for maintaining their satisfaction and using their positive influence. These measures are designed to strengthen carpooling as a more sustainable alternative for current solo drivers, and as a more attractive option than driving alone for any public transport user who may need to switch to a car.

7.3 Final Remark

It’s easy to view the daily commute as just a numbers problem that can be solved by minimizing time and cost. However, as this research has shown, the reality is far more complex. The commute to and from work is a human experience, not only influenced by practical challenges like the last mile problem or parking difficulties, but also by social influences from colleagues and the hidden role as a mental buffer between work and home. Therefore, the key lesson from this research is that to truly succeed, corporate mobility policy must become more human-centric. The most effective and sustainable approaches will be those that place the daily routines, frustrations and personal needs of their employees at the heart of their design.

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Appendices

Appendix A Overview Selected LRO Variables and Explanations

The three different paths or commute groups all have a different set of questions that they answer. This makes it troublesome to create one large correlation table, as these might have empty values for certain combinations. For example, questions from MB2, regarding why participants do use the car, and MB5, regarding why participants do not use the car, will be 0. This is because a participant either uses the car at least once a week, and gets asked question MB2, or they don't use the car at least once a week and get asked the question MB5.

Given that the research includes car-only commuters, PT-only commuters and bike-only commuters, all different questions are included. We therefore look for correlations within the questions to determine which ones to include.

As can be seen in the correlation table for MB2 for example, MB2_A and MB2_B have a Pearson Correlation coefficient of 0.751, indicating that these are correlated. It is therefore not useful to include both and therefore one of the two will be dropped. Table X gives an overview of all the coded variables, whereafter the other tables cover the reasons why they are dropped or included. Note that all variables are in the format: *"To what extent is [full variable name] of influence on your decision to commute/not commute by car/public transport/bike to work?"*

Table 7.2.2.1: Overview of all the possible attitudinal aspects

Code	Full variable name
MB2_A	Sufficient parking space
MB2_B	Free parking at work location
MB2_C	Picking up/dropping off others
MB2_D	Combining activities
MB2_E	Transport of luggage
MB2_F	Being able to call during the commute
MB2_G	Mileage reimbursement car
MB2_H	Usage of lease car / company car
MB2_I	Car necessary for business meetings
MB2_J	Charging facilities at work
MB2_K	No viable alternative
MB3_A	Stop near home
MB3_B	Stop near work
MB3_C	Good connection
MB3_D	Direct connection
MB3_E	Being able to work during the commute
MB3_F	Travelling together
MB3_G	Mileage reimbursement public transport
MB3_H	Stimulated by employer
MB4_A	Secure bike storage
MB4_B	Charging facilities e-bike at work
MB4_C	Mileage reimbursement bike
MB4_D	Being able to shower or freshen up
MB4_E	Stimulated by employer
MB5_A	No car available
MB5_B	No parking facility at work
MB5_C	Paid parking at work
MB5_D	Unreliable travel times due to congestion

MB5_E	No mileage reimbursement car
MB5_F	No charging facilities for electric cars at work
MB6_A	No stop near home
MB6_B	No stop near work
MB6_C	No good connection
MB6_D	Transfers and waiting times
MB6_E	Unreliability due to delays
MB6_F	Transport of luggage
MB6_G	No mileage reimbursements train
MB7_A	Weather conditions
MB7_B	No (good) bike storage at work
MB7_C	No secure bike storage at work
MB7_D	No charging facilities for e-bikes at work
MB7_E	No mileage reimbursements for cycling
MB7_F	Not possible to freshen up at work
MB7_G	Too large distance to cycle
MB7_H	Not having a (good) bike
MB7_I	Unsafe routes

Table 7.2.2.2: Overview of the reasoning for the inclusion of the Car Enablers

Variable Name	Included (I) / Dropped (D)	Reason
MB2_A	D	Correlation of 0.751 with MB2_B. Using both is unnecessary, MB2_B aligns better with the case study as this is something that still can be implemented.
MB2_B	I	-
MB2_C	D	Although the variable seemed interesting, it covered the concept of chaining trips, like in MB2_D. Looking at the descriptive statistics, MB2_D had a larger standard deviation, raising more interest into how this would influence the research
MB2_D	I	-
MB2_E	D	The latent class model only works with a limited set of variables, this variable was dropped as others seemed more relevant.
MB2_F	D	The latent class model only works with a limited set of variables, this variable was dropped as others seemed more relevant.
MB2_G	I	Relevant regarding the case study
MB2_H	D	This is a conditional question, not everyone who answered MB2 was asked this question. Therefore it was dropped.
MB2_I	D	The latent class model only works with a limited set of variables, this variable was dropped as it aligned less with the case study.
MB2_J	D	This is a conditional question, not everyone who answered MB2 was asked this question. Therefore it was dropped.
MB2_K	D	Not included as this variable made it difficult to form recommendations.

Table 7.2.2.3: Overview of the reasoning for the inclusion of the PT Enablers

Variable Name	Included (I) / Dropped (D)	Reason
MB3_A	D	Correlation of 0.743 with MB3_B. Correlation of 0.634 with MB3_C. MB3_B has a correlation of 0.704 with MB3_C. It has a higher correlation with both MB3_A and MB3_C, and is therefore included.
MB3_B	I	-
MB3_C	D	Both MB3_C and MB3_D cover the quality of the connection. MB3_C correlates higher with the already included MB3_B and is therefore dropped.
MB3_D	I	-
MB3_E	D	The latent class model only works with a limited set of variables, this variable was dropped as others seemed more relevant.
MB3_F	D	The latent class model only works with a limited set of variables, this variable was dropped as others seemed more relevant.
MB3_G	I	Relevant regarding the case study
MB3_H	D	The latent class model only works with a limited set of variables, this variable was dropped as others seemed more relevant.

Table 7.2.2.4: Overview of the reasoning for the inclusion of the Bike Enablers

Variable Name	Included (I) / Dropped (D)	Reason
MB4_A	I	Relevant as employers or organizations can facilitate this.
MB4_B	D	The question seems only relevant to users of e-bikes. As not the entire dataset has an e-bike, we drop this variable.
MB4_C	I	Relevant as employers can directly influence this, also making it interesting for the case study.
MB4_D	I	Relevant as employers can facilitate this to their employees.
MB4_E	D	It is not entirely clear what is meant by 'the employer stimulating this mode of transport'. As others seemed more relevant regarding the case study, this variable was dropped.

Table 7.2.2.5: Overview of the reasoning for the inclusion of the Car Barriers

Variable Name	Included (I) / Dropped (D)	Reason
MB5_A	D	Dropped as mode ownership is already included in the model.
MB5_B	D	Correlation of 0.730 with MB5_C. As MB5_C is something that can still be implemented in the organization of the case study, this variable is seen as more interesting.
MB5_C	I	-
MB5_D	I	Included as it covers a topic that is expected to be a big reason for commuters to not commute by car.
MB5_E	I	Included as this is in within the influence of an organization. Findings can help in adjusting policy.
MB5_F	D	Dropped as it focuses specifically on electric cars, where not all participants of the survey drive an electric car.

Table 7.2.2.6: Overview of the reasoning for the inclusion of the PT Barriers

Variable Name	Included (I) / Dropped (D)	Reason
MB6_A	D	Very similar to MB6_B but MB6_B aligns better with the case study as organizations may be in a better position to acquire a public transport stop close to their work location than an induvial in their home neighborhood.
MB6_B	I	-
MB6_C	D	MB6_C and MB6_D have a correlation coefficient of 0.759. MB6_D and MB6_E of 0.773. MB6_C and MB6_E of 0.669. MB6_D correlates with both MB6_C and MB6_E the highest and is thus included.
MB6_D	I	-
MB6_E	D	-
MB6_F	D	The latent class model only works with a limited set of variables, this variable was dropped as others seemed more relevant.
MB6_G	I	Included as it is under the direct influence of the employer.

Table 7.2.2.7: Overview of the reasoning for the inclusion of the Bike Barriers

Variable Name	Included (I) / Dropped (D)	Reason
MB7_A	I	Included as it is a factor out of the influence of organizations but still expected to influence one's choice to commute by bike. Prior research at the case study revealed this variable influences this mode of choice, therefore included again as a way to verify.
MB7_B	I	MB7_B and MB7_C both cover the topic of bike storage in a different way, MB7_B aligns slightly better with the case study as not all interviewees may have a secured bike storage.
MB7_C	D	-
MB7_D	D	The question focuses specifically on e-bikes. As not all participants have an e-bike, this variable is dropped.
MB7_E	I	Included as it is within the influence of an organization, findings can help adjust the policy. Compared to MB7_F no extra facilities are needed, all other enablers and barriers also cover monetary influences.
MB7_F	D	-
MB7_G	D	The distance a participant has to cover to get to work is included in a different way, although this question covers the perception towards distance, this seemed redundant.
MB7_H	D	Vehicle ownership is included in the model in a different way, hence this variable can be dropped.
MB7_I	D	Dropped as other variables seemed more interesting. Changes in this variable are often very cost expensive and thus not an initial choice for a solution.

Additionally, from the list of employer policies that were mentioned in the Landelijk Reizigersonderzoek, a selection of relevant variables was made as well. This was done purely based on which variables aligned well with the case study context. Below a list of all the variables mentioned is shown.

Table 7.2.2.8: Overview of the potential Covariates

Variable Name	Included (I) / Dropped (D)	Meaning of the variable
B1_1	I	Mileage reimbursement car
B1_2	I	Mileage reimbursement (e-)bike
B1_3	I	Mileage reimbursement public transport
B1_4	D	Mileage reimbursement in general -> Dropped as we are specifically interested in the policies regarding the specific modes.
B1_5	D	Lease car
B1_6	D	Mobility budget
B1_7	D	Personal mobility card
B1_8	I	Bike purchase reimbursement
B1_9	D	Lease policy bike
B1_10	I	Public transport subscription
B1_11	I	Work from Home reimbursement
B1_12	D	Others; open question
B1_13	D	None of the above

Correlations

		MB2_A	MB2_B	MB2_C	MB2_D	MB2_E	MB2_F	MB2_G	MB2_H	MB2_I	MB2_J	MB2_K
MB2_A	Pearson Correlation	1	,751**	,277**	,327**	,255**	,238**	,381**	,244**	,140**	,342**	,137**
	Sig. (2-tailed)		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	N	4034	3759	4034	4034	4034	4034	4034	451	4034	413	4034
MB2_B	Pearson Correlation	,751**	1	,247**	,342**	,228**	,178**	,403**	,243**	,097**	,357**	,107**
	Sig. (2-tailed)	0.000		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	N	3759	3759	3759	3759	3759	3759	3759	430	3759	383	3759
MB2_C	Pearson Correlation	,277**	,247**	1	,374**	,444**	,449**	,344**	-,111*	,338**	,266**	,141**
	Sig. (2-tailed)	0.000	0.000		0.000	0.000	0.000	0.000	0.018	0.000	0.000	0.000
	N	4034	3759	4034	4034	4034	4034	4034	451	4034	413	4034
MB2_D	Pearson Correlation	,327**	,342**	,374**	1	,526**	,313**	,271**	,159**	,190**	,275**	,074**
	Sig. (2-tailed)	0.000	0.000	0.000		0.000	0.000	0.000	0.001	0.000	0.000	0.000
	N	4034	3759	4034	4034	4034	4034	4034	451	4034	413	4034
MB2_E	Pearson Correlation	,255**	,228**	,444**	,526**	1	,445**	,274**	-0.016	,362**	,291**	,149**
	Sig. (2-tailed)	0.000	0.000	0.000	0.000		0.000	0.000	0.735	0.000	0.000	0.000
	N	4034	3759	4034	4034	4034	4034	4034	451	4034	413	4034
MB2_F	Pearson Correlation	,238**	,178**	,449**	,313**	,445**	1	,375**	,221**	,511**	,373**	,199**
	Sig. (2-tailed)	0.000	0.000	0.000	0.000	0.000		0.000	0.000	0.000	0.000	0.000
	N	4034	3759	4034	4034	4034	4034	4034	451	4034	413	4034
MB2_G	Pearson Correlation	,381**	,403**	,344**	,271**	,274**	,375**	1	,224**	,312**	,377**	,255**
	Sig. (2-tailed)	0.000	0.000	0.000	0.000	0.000	0.000		0.000	0.000	0.000	0.000
	N	4034	3759	4034	4034	4034	4034	4034	451	4034	413	4034
MB2_H	Pearson Correlation	,244**	,243**	-,111*	,159**	-0.016	,221**	,224**	1	,398**	,315**	,215**
	Sig. (2-tailed)	0.000	0.000	0.018	0.001	0.735	0.000	0.000		0.000	0.000	0.000
	N	451	430	451	451	451	451	451	451	451	177	451
MB2_I	Pearson Correlation	,140**	,097**	,338**	,190**	,362**	,511**	,312**	,398**	1	,441**	,254**
	Sig. (2-tailed)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000		0.000	0.000
	N	4034	3759	4034	4034	4034	4034	4034	451	4034	413	4034
MB2_J	Pearson Correlation	,342**	,357**	,266**	,275**	,291**	,373**	,377**	,315**	,441**	1	,188**
	Sig. (2-tailed)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000		0.000
	N	413	383	413	413	413	413	413	177	413	413	413
MB2_K	Pearson Correlation	,137**	,107**	,141**	,074**	,149**	,199**	,255**	,215**	,254**	,188**	1
	Sig. (2-tailed)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
	N	4034	3759	4034	4034	4034	4034	4034	451	4034	413	4034

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

*. Correlation is significant at the 0.05 level (2-tailed).

Correlations									
		MB3_A	MB3_B	MB3_C	MB3_D	MB3_E	MB3_F	MB3_G	MB3_H
MB3_A	Pearson Correlation	1	,743**	,634**	,401**	0.050	0.028	,279**	,142**
	Sig. (2-tailed)		0.000	0.000	0.000	0.097	0.360	0.000	0.000
	N	1094	1094	1094	1094	1094	1094	1094	1094
MB3_B	Pearson Correlation	,743**	1	,704**	,430**	0.031	-0.051	,308**	,160**
	Sig. (2-tailed)	0.000		0.000	0.000	0.302	0.092	0.000	0.000
	N	1094	1094	1094	1094	1094	1094	1094	1094
MB3_C	Pearson Correlation	,634**	,704**	1	,500**	,066*	-,068*	,355**	,168**
	Sig. (2-tailed)	0.000	0.000		0.000	0.029	0.024	0.000	0.000
	N	1094	1094	1094	1094	1094	1094	1094	1094
MB3_D	Pearson Correlation	,401**	,430**	,500**	1	,144**	,176**	,216**	,171**
	Sig. (2-tailed)	0.000	0.000	0.000		0.000	0.000	0.000	0.000
	N	1094	1094	1094	1094	1094	1094	1094	1094
MB3_E	Pearson Correlation	0.050	0.031	,066*	,144**	1	,421**	,084**	,214**
	Sig. (2-tailed)	0.097	0.302	0.029	0.000		0.000	0.005	0.000
	N	1094	1094	1094	1094	1094	1094	1094	1094
MB3_F	Pearson Correlation	0.028	-0.051	-,068*	,176**	,421**	1	0.040	,258**
	Sig. (2-tailed)	0.360	0.092	0.024	0.000	0.000		0.182	0.000
	N	1094	1094	1094	1094	1094	1094	1094	1094
MB3_G	Pearson Correlation	,279**	,308**	,355**	,216**	,084**	0.040	1	,532**
	Sig. (2-tailed)	0.000	0.000	0.000	0.000	0.005	0.182		0.000
	N	1094	1094	1094	1094	1094	1094	1094	1094
MB3_H	Pearson Correlation	,142**	,160**	,168**	,171**	,214**	,258**	,532**	1
	Sig. (2-tailed)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
	N	1094	1094	1094	1094	1094	1094	1094	1094

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

*. Correlation is significant at the 0.05 level (2-tailed).

Correlations

		MB4_A	MB4_B	MB4_C	MB4_D	MB4_E
MB4_A	Pearson Correlation	1	,476**	,405**	,398**	,402**
	Sig. (2-tailed)		0.000	0.000	0.000	0.000
	N	1917	1917	1917	1917	1917
MB4_B	Pearson Correlation	,476**	1	,464**	,439**	,446**
	Sig. (2-tailed)	0.000		0.000	0.000	0.000
	N	1917	1917	1917	1917	1917
MB4_C	Pearson Correlation	,405**	,464**	1	,503**	,546**
	Sig. (2-tailed)	0.000	0.000		0.000	0.000
	N	1917	1917	1917	1917	1917
MB4_D	Pearson Correlation	,398**	,439**	,503**	1	,577**
	Sig. (2-tailed)	0.000	0.000	0.000		0.000
	N	1917	1917	1917	1917	1917
MB4_E	Pearson Correlation	,402**	,446**	,546**	,577**	1
	Sig. (2-tailed)	0.000	0.000	0.000	0.000	
	N	1917	1917	1917	1917	1917

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

Correlations

		MB5_A	MB5_B	MB5_C	MB5_D	MB5_E	MB5_F
MB5_A	Pearson Correlation	1	,326**	,304**	,297**	,314**	,422**
	Sig. (2-tailed)		0.000	0.000	0.000	0.000	0.000
	N	1755	1755	1755	1755	1755	1755
MB5_B	Pearson Correlation	,326**	1	,730**	,476**	,473**	,301**
	Sig. (2-tailed)	0.000		0.000	0.000	0.000	0.000
	N	1755	1755	1755	1755	1755	1755
MB5_C	Pearson Correlation	,304**	,730**	1	,502**	,517**	,338**
	Sig. (2-tailed)	0.000	0.000		0.000	0.000	0.000
	N	1755	1755	1755	1755	1755	1755
MB5_D	Pearson Correlation	,297**	,476**	,502**	1	,476**	,360**
	Sig. (2-tailed)	0.000	0.000	0.000		0.000	0.000
	N	1755	1755	1755	1755	1755	1755
MB5_E	Pearson Correlation	,314**	,473**	,517**	,476**	1	,424**
	Sig. (2-tailed)	0.000	0.000	0.000	0.000		0.000
	N	1755	1755	1755	1755	1755	1755
MB5_F	Pearson Correlation	,422**	,301**	,338**	,360**	,424**	1
	Sig. (2-tailed)	0.000	0.000	0.000	0.000	0.000	
	N	1755	1755	1755	1755	1755	1755

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

Correlations

		MB6_A	MB6_B	MB6_C	MB6_D	MB6_E	MB6_F	MB6_G
MB6_A	Pearson Correlation	1	,671**	,610**	,506**	,478**	,388**	,387**
	Sig. (2-tailed)		0.000	0.000	0.000	0.000	0.000	0.000
	N	5645	5645	5645	5645	5645	5645	5645
MB6_B	Pearson Correlation	,671**	1	,662**	,546**	,507**	,405**	,404**
	Sig. (2-tailed)	0.000		0.000	0.000	0.000	0.000	0.000
	N	5645	5645	5645	5645	5645	5645	5645
MB6_C	Pearson Correlation	,610**	,662**	1	,759**	,669**	,351**	,337**
	Sig. (2-tailed)	0.000	0.000		0.000	0.000	0.000	0.000
	N	5645	5645	5645	5645	5645	5645	5645
MB6_D	Pearson Correlation	,506**	,546**	,759**	1	,773**	,418**	,365**
	Sig. (2-tailed)	0.000	0.000	0.000		0.000	0.000	0.000
	N	5645	5645	5645	5645	5645	5645	5645
MB6_E	Pearson Correlation	,478**	,507**	,669**	,773**	1	,446**	,404**
	Sig. (2-tailed)	0.000	0.000	0.000	0.000		0.000	0.000
	N	5645	5645	5645	5645	5645	5645	5645
MB6_F	Pearson Correlation	,388**	,405**	,351**	,418**	,446**	1	,469**
	Sig. (2-tailed)	0.000	0.000	0.000	0.000	0.000		0.000
	N	5645	5645	5645	5645	5645	5645	5645
MB6_G	Pearson Correlation	,387**	,404**	,337**	,365**	,404**	,469**	1
	Sig. (2-tailed)	0.000	0.000	0.000	0.000	0.000	0.000	
	N	5645	5645	5645	5645	5645	5645	5645

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

Correlations

		MB7_A	MB7_B	MB7_C	MB7_D	MB7_E	MB7_F	MB7_G	MB7_H	MB7_I
[MB7_A	Pearson Correlation	1	,360**	,354**	,320**	,356**	,366**	,091**	,339**	,380**
	Sig. (2-tailed)		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	N	4822	4822	4822	4822	4822	4822	4822	4822	4822
MB7_B	Pearson Correlation	,360**	1	,865**	,748**	,673**	,651**	,091**	,443**	,504**
	Sig. (2-tailed)	0.000		0.000	0.000	0.000	0.000	0.000	0.000	0.000
	N	4822	4822	4822	4822	4822	4822	4822	4822	4822
MB7_C	Pearson Correlation	,354**	,865**	1	,779**	,693**	,656**	,092**	,460**	,518**
	Sig. (2-tailed)	0.000	0.000		0.000	0.000	0.000	0.000	0.000	0.000
	N	4822	4822	4822	4822	4822	4822	4822	4822	4822
MB7_D	Pearson Correlation	,320**	,748**	,779**	1	,718**	,670**	,085**	,470**	,520**
	Sig. (2-tailed)	0.000	0.000	0.000		0.000	0.000	0.000	0.000	0.000
	N	4822	4822	4822	4822	4822	4822	4822	4822	4822
MB7_E	Pearson Correlation	,356**	,673**	,693**	,718**	1	,678**	,114**	,470**	,522**
	Sig. (2-tailed)	0.000	0.000	0.000	0.000		0.000	0.000	0.000	0.000
	N	4822	4822	4822	4822	4822	4822	4822	4822	4822
MB7_F	Pearson Correlation	,366**	,651**	,656**	,670**	,678**	1	,152**	,453**	,529**
	Sig. (2-tailed)	0.000	0.000	0.000	0.000	0.000		0.000	0.000	0.000
	N	4822	4822	4822	4822	4822	4822	4822	4822	4822
MB7_G	Pearson Correlation	,091**	,091**	,092**	,085**	,114**	,152**	1	,185**	,256**
	Sig. (2-tailed)	0.000	0.000	0.000	0.000	0.000	0.000		0.000	0.000
	N	4822	4822	4822	4822	4822	4822	4822	4822	4822
MB7_H	Pearson Correlation	,339**	,443**	,460**	,470**	,470**	,453**	,185**	1	,573**
	Sig. (2-tailed)	0.000	0.000	0.000	0.000	0.000	0.000	0.000		0.000
	N	4822	4822	4822	4822	4822	4822	4822	4822	4822
MB7_I	Pearson Correlation	,380**	,504**	,518**	,520**	,522**	,529**	,256**	,573**	1
	Sig. (2-tailed)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
	N	4822	4822	4822	4822	4822	4822	4822	4822	4822

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

Appendix B LCA Model Fit Criteria

Table 7.2.2.1: Latent Class Analysis Model Fit Criteria: Car – only group

Number of Clusters	Total BVR	BIC	Entropy R^2	Smallest cluster
1	12775.272	99457.022	1	100.00%
2	2473.487	45207.046	0.829	47.52%
3	1609.450	44144.822	0.844	10.37%
4	1257.710	43375.623	0.841	9.71%
5	672.908	42973.273	0.812	9.13%
6	479.720	92255.519	0.815	5.67%
7	392.802	42527.614	0.803	5.81%

Table 7.2.2.2: Latent Class Analysis Model Fit Criteria: Public Transport – only group

Number of Clusters	Total BVR	BIC	Entropy R^2	Smallest cluster
1	1289.345	10222.092	1	100.00%
2	475.788	15177.337	0.782	42.17%
3	320.909	15101.119	0.787	24.77%
4	243.643	15051.984	0.809	6.24%
5	149.634	15033.923	0.8366	2.19%
6	128.469	15059.351	0.8357	2.17%
7	89.067	9737.788	0.81	2.20%

Table 7.2.2.3: Latent Class Analysis Model Fit Criteria: Bicycle – only group

Number of Clusters	Total BVR	BIC	Entropy R^2	Smallest cluster
1	6026.806	25812.754	1	100.00%
2	757.481	23825.9576	0.8762	48.02%
3	416.843	23491.8306	0.8068	29.30%
4	304.848	23371.384	0.81	18.61%
5	219.0344	23305.915	0.8014	6.46%
6	230.0278	23254.69	0.8199	3.72%
7	221.7108	23238.1775	0.8262	3.73%

Appendix C Informed Consent Form

Informed Consent Form – Master Thesis Interviews

Research Title:
To what extent do different employee segments in the Netherlands vary in the enablers and barriers they experience when making commuting decisions?

Researcher:
Tijs Braaksma, MSc Student, Management of Technology, TU Delft

Supervisors:
Maarten Kroesen (TU Delft) – m.kroesen@tudelft.nl
Pim de Weerd (ASML) – pim.de.weerd@asml.com

Purpose of the Research

This research aims to explore to what extent different employee segments in the Netherlands vary in the enablers and barriers they experience when making commuting decisions. The study focuses on identifying different employee segments, and then gain a deeper understanding of each of those segments. The interviews support a qualitative analysis to gain a deeper understanding of each of the segments.

What Participation Involves

- You will be asked to participate in a semi-structured interview lasting approximately **50-60 minutes**.
- With your permission, the interview will be audio-recorded and transcribed to support accurate analysis.
- You may decline to answer any question or withdraw from the interview at any time without providing a reason.
- After the interview, you will have two weeks to review the transcript to correct factual inaccuracies or request removal of specific parts. If you do not request the transcript, or do not respond within this two-week timeframe, the transcript will be used as-is for analysis.

Confidentiality and Data Management

- Your name and identifiable information will not be included in the thesis or any publications.
- A unique participant code will be used to pseudonymize your responses.
- Audio recordings and transcripts will be securely stored in encrypted TU Delft storage.
- Only the researcher and supervisors will have access to the raw data.
- Data will be stored for a maximum of two years after project completion, after which all personal data will be deleted.
- While risks are minimal, any potential risks related to privacy will be mitigated through secure storage and strict anonymization protocols.

Use of Data

- The anonymized results may be used in the MSc thesis, academic publications, or presentations.
- No individual participant will be identifiable in any output.

Voluntary Participation and Rights

- Your participation is voluntary.
- You may withdraw at any point, and any data collected until that moment will be excluded from the study if requested.
- You have the right to access or request deletion of your personal data at any time during the project.

Consent Checklist (Please check each box and sign below):

[ ] I have read and understood the information provided above.
[ ] I agree to participate in this study.
[ ] I consent to the interview being audio-recorded.
[ ] I understand how my data will be used, stored, and protected.

Participant Name: ______________________________
Signature: ______________________________
Date: ______________________________

Researcher Name: Tijs Braaksma
Signature: ______________________________
Date: ______________________________

For questions about the research, you may contact:
Tijs Braaksma – T.H.Braaksma@student.tudelft.nl, tijs.braaksma@asml.com
Maarten Kroesen – M.Kroesen@tudelft.nl

Appendix D Interview Script

Intro & IC- 5 min

Hi, thanks for participating today. My name is Tijs, and I'm a Master's student at TU Delft. As I'm finalizing my Master's, I'm now writing my thesis here at ASML. I'm part of the Access & Mobility team, which works on various project related to the accessibility of our company sites, such as ensuring that parking facilities and buildings are easy for everyone to access, and on mobility topics, such as offering plenty of options for all employees to get to the office.

My thesis focuses on understanding the different factors that motivate or demotivate the use of certain commute modes. I'm interested in learning about how you get to the campus and why you choose that particular way of travelling over others.

To understand this, we'll have this interview today that will take roughly 50 minutes. To make sure I cover all your insights accurately, I'd like to record our discussion. This recording will only be used by me, to help create a written version of our conversation. No one else will listen to or access the recording, and it will be deleted once I have that written version. Is that okay with you?

[Yes/No]

Then before we get started, just a reminder that everything you say remains confidential. There are no right or wrong answers, and you have the option to stop the interview at any point. Lastly, if there is anything unclear, feel free to say so and I will try to make the question more clear.

Participant info – 2 min

Okay to begin, I'd like to gather a little bit of background information. This will help me better understand your commuting experiences.

1. Could you tell me your current position and the department you work in?
   […]
2. And for how long have you been working at ASML?
   […]
3. What is your one-way distance from your home to your main location at ASML?
   […]
4. Now, if you think about your working days last week, could you briefly describe how you commuted?
   […]

Timeline based Commuting – 20 min

Alright so now we're going to be going through your typical commuting day. As we move through each stage, I'd specifically like to explore any factors that motivate or demotivate using certain commute options.

Before we dive into a specific day, it would be helpful to understand the different ways you <u>potentially could</u> commute to ASML.

1. Considering your location, and personal circumstances (car ownership, public transport stop near home, having a good bike, etc.), what do you consider to be realistic options for you to get to ASML?
   […] *(if needed: e.g. driving, carpooling, public transport, cycling, walking, combinations?)*
2. From these options, which ones do you currently use?
   […] *And what are the main reasons for choosing that option?*

3. Are there any ways of travelling to ASML, that you have considered, but have decided not to use, or to stop using?
   […] *If yes: What were the main reasons for not choosing or to stop using that option?*
   […]

Now, let's move to the timeline stages and let's think about a typical morning when you're preparing to travel to ASML.

Morning | Before commuting to work

1. To begin, when it comes to your morning commute to ASML, do you generally follow a fixed routine, using the same mode of transport, or does your choice of travel vary, depending on the day or other circumstances?
   a. [depends/routine]

   Depends:

      i. What are the key factors that typically influence your commuting choice for getting to ASML? *Could you give a specific example?*

   Routine:

      ii. Could you tell me what are the main reasons that maintain this particular routine for you? What makes this way your preferred option over an alternative? C*ould you give a specific example?*
2. Thinking about the period before you leave your home. Are there aspects that can make the preparation for your commute feel frustrating, or challenging? *E.g. public transport suddenly shows delays, or uncertainty about the weather*
3. Are there any aspects that make preparing for your commute easier? *E.g. getting out of bed and seeing it's a sunny morning, or if you're driving, knowing there's no traffic when you leave, or having a flexible start time to work so there's less pressure*.

Morning | During the commute to work

1. Okay so this was all before your commute, now let's look at the period during your commute. Could you walk me through your typical morning journey to ASML? As you do so, could you share any experiences, thoughts or feelings that stand out during this trip. *For instance, stress from traffic congestion if you commute by car, or anxiety about missing a transfer if you use PT.*
2. Thinking about that trip, what specific aspects of the commute most significantly influence how you experience that trip (positive or negative)? *E.g. the reliability of your modes, the comfort*.

Morning | Arrival at work

1. In what ways would you say your morning commute influences the start of your workday?
2. When looking at the facilities at ASML that relate to your commute, such as parking, bike storage, changing rooms or even the location of the building, how do these influence your overall commuting satisfaction?

During the day

1. In what ways, if at all, does your morning commute experience affect your activities, energy levels or mood during the day?

Afternoon | Before commuting home

1. What are the factors generally determining when you decide to go home and the way you choose to travel?
    a. Follow up question: Does this vary depending on the day of the week?

Afternoon | During commuting home

1. So now you're on your way home. Could you walk me through your typical journey home, from the moment you leave your workspace until you arrive at your front door? For each part, what are you doing, seeing or thinking about?
2. How would you say this related to your commute to work in the morning? Are there any differences or similarities?
3. Thinking about this commute home, what specific aspects of this trip most significantly influence whether it feels like a 'good' commute home, or a 'bad' or 'draining' one?

Afternoon | After returning home

1. How does the commute home influence your mood or activities in the evening?
2. Overall, what would you say are the main benefits or drawbacks you experience in your personal time because of your commute home? *E.g. Cycling to work already counts as daily exercise for me, so I don't have to work-out anymore* OR *The train ride home allows me to switch off, so when I'm home I can be present with my family.*

Company Policy – 10 min

1. To start, what commuting related policies, services or facilities from ASML are you familiar with?
    a. Mileage reimbursement car, bike, work-from-home reimbursement
    b. Free PT
    c. Carpooling
    d. Vanpooling pilot
    e. Shuttle services
    f. E-bikes
    g. Bike purchase reimbursement
2. Which ones do you actively use and why?
3. Which ones do you not use and why?
4. What suggestions, if any, do you have for ASML to better support your existing travel needs or to make your commute easier?
5. Looking more broadly: if ASML wanted to encourage employees, including yourself, to use more sustainable forms of transport, what kinds of new initiatives or changes to existing policies or services do you think would be most effective in doing so?

Hypothetical Scenario Exploration – 10 min

Car users Scenario 1:

Let's look at three options for you as a current car user. Option A, as shown here, is your current situation. Option B introduces a P+R system, with a slightly longer total time due to the shuttle taking you from the P+R to the campus, but with an extra monetary reward. Just to be clear, this means that it will take you 5 minutes more compared to your current situation. Option C introduces an improved PT connection, leading to a reduction of 5 minutes in your overall travel time. Additionally, you get access to a Mobility Guarantee. This means that if you are at work and suddenly have to go home due to, for example, a child that is ill, you can book a taxi to bring you home completely free of charge.

Considering these options, which one would you chose and why?

	Option A – As is scenario	Option B – P+R proposition	Option C – Improved Public Transport (PT)
One-way travel time	Current time	Current + 5 min	Current -5 min
Parking policy	Free, but peak congestion of ca. 15min	Free, no peak congestion at P+R, free shuttle to campus	Current
Company support & reimbursement	Current: free PT, €0.23/km car, €0.35/km bike, bike purchase reimbursement	Current + receive €2/day for using P+R	Current
Mobility Guarantee (MG)	No	No	Yes

Car users Scenario 2:

Now similarly with a new scenario where we're looking at carpooling. Option A remains the same, but in option B you spent 10 minutes less commuting, the driver gets a higher mileage reimbursement and so does the carpooling passenger. In option C you still have the benefit of a reduced travel time, but a slightly lower financial reimbursement. In return, you get the Mobility Guarantee.

Considering these options, which one would you chose and why?

	Option A – As is scenario	Option B – Financially boosted carpooling	Option C – Carpooling with security
One-way travel time	Current time	Current -10 min due to having prime parking spots	Current -10 min due to having prime parking spots
Parking policy	Free, but peak congestion of ca. 15min	Carpoolers have prime spots, non-carpoolers have the as-is scenario	Carpoolers have prime spots, non-carpoolers have the as-is scenario
Company support & reimbursement	Current: free PT, €0.23/km car, €0.35/km bike, bike purchase reimbursement	Driver gets €0.35/km, passenger gets €0.08/km.	Driver gets €0.28/km, passenger gets €0.06/km.
Mobility Guarantee (MG)	No	No	Yes

PT/Shuttle users Scenario:

Let's look at three options for you as a current public transport/shuttle user. Option A, as shown here, is your current situation. Option B introduces a reserved car parking system. Option C introduces financial rewards for carpooling, and you get access to a Mobility Guarantee. This means that if you are at work and suddenly have to go home due to, for example, a child that is ill, you can book a taxi to bring you home completely free of charge.

Considering these options, which one would you chose and why?

	Option A – As is scenario	**Option B – Seamless car commute**	**Option C – Financially rewarding carpooling**
One-way travel time	Current time	Current time	Comparable to current
Parking policy	Not applicable	Guaranteed free **reserved** parking on site	Carpoolers have free prime spots
Company support & reimbursement	Current: free PT, €0.23/km car, €0.35/km bike, bike purchase reimbursement	Current	Driver gets €0.28/km, passenger gets €0.06/km.
Mobility Guarantee (MG)	No	No	Yes

Bicycle users Scenario:

Let's look at three options for you as a current bicycle user. Option A, as shown here, is your current situation. Option B introduces a reserved car parking system. Option C introduces a rebalanced bike reimbursement, but in return you get access to a Mobility Guarantee. This means that if you are at work and suddenly have to go home due to, for example, a child that is ill, you can book a taxi to bring you home completely free of charge.

Considering these options, which one would you chose and why?

	Option A – As is scenario	**Option B – Seamless car commute**	**Option C – Rebalanced biking package**
One-way travel time	Current time	Comparable to current	Current time
Parking policy	Not applicable	Guaranteed free **reserved** parking on site	Not applicable
Company support & reimbursement	Current: free PT, €0.23/km car, €0.35/km bike, bike purchase reimbursement	Current	Bike reimbursement adjusted from €0.35 to €0.25/km
Mobility Guarantee (MG)	No	No	Yes

Additional

We've talked about the idea of a 'Mobility Guarantee', where ASML would ensure an emergency ride home if you used a sustainable transport mode and have to leave work unexpectedly. Thinking about this idea, what are your general thoughts on it?

Open Discussion – 5 min

1. Is there anything else about your commuting experience that you think is valuable but hasn't been covered yet?
2. Do you have any further questions or comments about the interview or the research?
3. Do you have any recommendations or suggestions on how we can improve these interviews?
4. Do you know anyone else who might be interested in participating in these interviews?