The barriers and opportunities of car-sharing: An analysis of sustainability transitions in regimes and practices in the Dutch automobility system

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Abstract

This research applies and tests the conceptual framework by Hargreaves et al. (2013) to a new empirical context to enhance our understanding of the sustainability transition from car ownership to car-sharing in the Dutch automobility system. This system undergoes significant pressure due to its impact on congestion, environmental pollution, and climate change. Car-sharing can potentially create a more sustainable automobility system, but its diffusion into the established automobility regime is relatively low. This research aims to understand the barriers and challenges of a potential transition and to develop strategies to overcome them. Current literature predominantly used a vertical, hierarchical, and macro approach (using the multi-level perspective MLP) or a horizontal micro approach (using social practice theory SPT) to analyse this potential transition. These two theoretical perspectives are often seen as competing frameworks in the literature. This research aims to prove the added theoretical and practical value of combining these two theoretical lenses to gain a more comprehensive understanding of the transition towards car-sharing. Therefore, this study is guided by the research questions: What are the intersections between the transitions in the automobility regimes and practices from car ownership to car-sharing, and how can these intersections be transformed into points of opportunity to facilitate a more sustainable Dutch automobility system? This research presents new empirical findings from a qualitative case study of the Dutch automobility system and peer-to-peer and business-to-consumer car-sharing services. In-depth semi-structured interviews were conducted with various stakeholders, including car-sharing providers, provinces, municipalities, mobility consultants, car owners, and car-sharing users guided by the MLP and SPT frameworks. The twin analysis revealed six critical intersection points where regimes and practices constrain each other and inhibit the transition to a more sustainable automobility system. The SPT-based analysis added value to the regime transition by identifying constraints faced by the car-sharing niche due to embedded automobility practices, including ownership practices, stacking practices in time and space, and challenges in switching practices. The MLP-based analysis added value to the practice transition by emphasizing the role of wider regimes in disrupting embedded automobility practices, including urban planning, transport, and economic regimes. These intersection points demonstrated that only adopting one theoretical lens might overlook certain innovation dynamics. Moreover, this research provides intervention strategies that can help policymakers leverage the opportunities presented by these intersections to remove regulatory barriers, develop supportive measures, and implement incentives to facilitate car-sharing growth and foster a more sustainable Dutch automobility system.

Table of contents

1. Introduction

The automobility system has undergone significant transformation in recent years, driven by various environmental, social, and technological factors. The traditional car ownership model has faced growing criticism and pressure due to its negative impact on air pollution, urban congestion, and energy consumption. To illustrate this, transport alone accounts for one-quarter of the EU's total greenhouse gas emissions (European Environment Agency, 2022). Therefore, the EU has set a goal to reduce transport emissions by 90% by 2050 (European Environment Agency, 2022). Although the average CO_2 emissions of new passenger cars were slightly reduced by 12% in 2020 (European Environment Agency, 2022), the distance travelled by car has increased by 40% over the past 20 years, and the stock of cars has increased by 53% (European Environment Agency, 2015). This suggests that more than shifting to low-emissions vehicles is required. The stock of cars and the volume of trips need to be reduced to curb mobility-related greenhouse gas emissions (Julsrud & Farstad, 2020).

As a response, alternative mobility options have emerged, such as car-sharing, promoting a shift from car ownership to car use. Car-sharing is recognized as a promising alternative that can challenge the dominant automobility regime and promote environmentally sustainable mobility. According to several empirical studies, car-sharing can reduce car ownership rates, the frequency of car use, and the car kilometres travelled (Chen & Kockelman, 2016; Martin & Shaheen, 2011). Although car-sharing use has rapidly grown in recent years, the number of users is still low (Svennevik, 2019). Therefore, this research aims to understand how the car-sharing niche is constrained to become part of the automobility regime.

A transition towards car-sharing not only requires a shift in consumer behaviour, but is a complex process influenced by broader changes in the automobility system. Individual preferences, attitudes, and behaviours regarding car usage and broader social, cultural, and economic factors play a role. Studying these interplays requires a holistic approach to account for macro-level and micro-level factors. Therefore, this research has applied the Multi-level Perspective (MLP) and Social Practice Theory (SPT) to gain a deeper understanding of the transition from car ownership to car-sharing. MLP would understand the transition to car-sharing as a regime change where a novel innovation at the niche level aims to transform the current regime of private car ownership. On the other hand, SPT investigates how the new consumer practices can disrupt the existing user practices of private car owners by studying practice change. Although the two theoretical approaches have different ontologies, units of analysis, and scopes, they are not mutually exclusive and can complement each other in understanding socio-technical transitions. Each theory has already been applied to study the transition towards car-sharing. However, little attention is paid to the theoretical limitations of solely applying a multi-level or social practice approach and how they can be fruitfully combined to inform a socio-technical transition. Hargreaves et al. (2013) were the first to have developed a conceptual framework (originally from Shove (2003)) integrating the two theories. This framework identifies the intersection points of regimes and practices to gain new insights into the barriers and opportunities of sustainability transitions. The theoretical value of integrating MLP and SPT for empirical studies is affirmed by recent studies, which ask

future studies to gain a deeper understanding of practices in transition studies (Svennevik et al., 2020). Seyfang & Gilbert-Squires (2019) were the first to fill this gap by applying the framework by Hargreaves et al. (2013) to the UK retail banking sector. Contributing to this neglected empirical site of connecting the MLP with SPT, this research has applied and tested this framework to a new empirical context of the Dutch automobility system. The research aims to extend and improve on recent car-sharing studies by showing the importance of simultaneously investigating regimes and practices to inform the transition to a more sustainable automobility system. Combining the MLP and SPT approach is particularly useful for the case of car-sharing due to the complex interplay between individual behaviours and broader societal, economic, and cultural factors in this potential transition. It also allows for identifying intersections between regimes and practices, which can be translated into opportunities to facilitate the transition from car ownership to car-sharing. The research questions are thus:

1. What are the intersections between transitions in the automobility regime and automobility practices towards car-sharing in the Dutch automobility system?

2. How can these intersections between transitions in the automobility regime and automobility practices be transformed into points of opportunity to facilitate a more sustainable Dutch automobility system?

To answer these research questions, new empirical findings from the MLP-based and SPT-based analysis of the transition towards a sustainable automobility system are presented. This research has used a qualitative case study of the Dutch automobility system focused on the transition towards car-sharing. Semi-structured in-depth interviews are conducted with regime and niche actors from the Dutch automobility system to investigate the current automobility regime and how it needs to be transformed to adopt car-sharing. Additionally, households are interviewed to investigate the embedded automobility practices and how they need to be reconfigured to develop new proto-practices. Proto-practices represent an early form of practices that are in the process of development (Julsrud & Farstad, 2020). Subsequently, understanding the transition to car-sharing is advanced by identifying the connections between these two theoretical approaches by building on the conceptual framework by Hargreaves et al. (2013). This research results in a better understanding of the barriers and opportunities of the transition to car-sharing. These insights can provide actors and policymakers with new strategies to unlock the transformative potential of a more sustainable automobility system.

This thesis is structured as follows: *Section 2* explains and discusses the relevance of the theoretical contexts of MLP and SPT, shows how the conceptual framework by Hargreaves et al. (2013) integrates MLP and SPT and introduces the empirical context of car-sharing in The Netherlands. *Section 3* describes the methods employed to collect and analyse data, including the sampling and coding techniques. *Section 4* presents the findings derived from the in-depth interviews and various documents, rapports, and blogs. The multi-level perspective and social

practice approach serve as the frameworks to organize and analyse the significant themes obtained from the empirical data. Subsequently, the findings of the MLP-based and SPT-based analysis are combined to identify the intersections between the regimes and practices. Drawing upon these intersections, various strategies for intervention are proposed to leverage the opportunities to facilitate a more sustainable automobility system. *Section 5* discusses the theoretical and methodological implications of this research, the societal and practical implications, the limitations of this research, and avenues for future research. Finally, *Section 6* presents the conclusions of this research and provides suggestions for policy implications derived from the research's findings.

2. Theoretical contexts

Car-sharing represents a potentially radical change, consisting of a niche innovation and novel proto-practices, challenging the current automobility system. Understanding the underlying dynamics of a transition towards a more sustainable automobility system requires the application of theories focused on socio-technical systems and innovation. Therefore, this study draws on the Multi-Level Perspective (MLP) and Social Practice Theory (SPT). The MLP and SPT are theoretically valid as both approaches address the dynamics of innovation and social-technical change (Seyfang & Gilbert-Squires, 2019; Svennevik et al., 2020). MLP has been proven beneficial in understanding socio-technical transitions formed by interactions between the regime, landscape, and niche levels (Svennevik, 2021). SPT can help study changes in mobility systems concerning everyday life automobility practices (Svennevik, 2021).

In addition, MLP and SPT are empirically valid because various scholars have examined the transformative potential of the automobility system (e.g., Loose et al., 2006; Mounce & Nelson, 2019). Morton et al. (2017, p. 493) affirm that ''The coming decades have the potential to witness a shift away from incremental improvement towards substantial evolution of the automobility system, driven by technical innovations and alterations in the social practices around car use.''

Thus, MLP and SPT individually offer valuable insights into the barriers and opportunities to sustainability transitions. However, various scholars have suggested the potential of gaining new theoretical insights by combining these two theories (e.g., Geels, 2011; Hargreaves et al., 2013; Smith et al., 2010). However, other scholars have pointed out that friction can arise due to their epistemological differences (Shove & Walker, 2010; Svennevik et al., 2020). SPT analyses the horizontal circulation of practices accounting for the stability of innovation (Hargreaves et al., 2013). In contrast, MLP analyses transition through vertical relationships along three hierarchical levels to better understand changes in innovations (Hargreaves et al., 2013). Regardless, integrating MLP and SPT-based analyses helps understand how practices intersect with wider regimes, which is crucial for an innovation's success (Hargreaves et al., 2013). Therefore, this research investigates how the embedded automobility user practices relate to the novel proto-practices of car-sharing in the context of a potential regime transition to car-sharing.

The subsequent section is structured as follows. *Section 2.1.* explains the MLP perspective and discusses its relevance for the automobility system. *Section 2.2.* explains the SPT theory and how it helps to understand the current automobility practices and how these might change. *Section 2.3.* integrates the two theories using the conceptual framework of Hargreaves et al. (2013). Finally, *Section 2.4.* introduces the empirical case of car-sharing in The Netherlands.

2.1. Transitions in regimes and practices

2.1.1. The Multi-level perspective (MLP)

The MLP provides a heuristic and analytical framework to understand transitions in particular societal functions and systems by analysing the dynamic process of three interacting levels: the regime, landscape, and niche (Geels, 2011, 2012). The regime level comprises heterogeneous components, including users, industry, policy, technology, science, culture, and artefacts (Geels, 2002, 2004). The alignment between these components results from coordinating practices and rules pursued by diverse actors such as firms, policymakers, consumers, civil society, and engineers. In the case of the automobility system, the dominant socio-technical regime of privately owned cars involves actors such as car manufacturers, car dealers, and car owners (Meelen et al., 2019). These actors share specific rules that align multiple components of the existing socio-technical regime (Meelen et al., 2019). For instance, user practices emerge from its users' daily use of cars. The car-related infrastructure and regulations are built and maintained by transportation ministries. Moreover, the symbolic meaning of cars is produced by the media, civil society, and users. (Geels, 2002). These heterogeneous elements are aligned to provide stability for the existing innovation (McMeekin & Southerton, 2012). However, this stability does not imply inertia, as incremental innovation still takes place (Geels, 2005).

The landscape level forms the exogenous environment consisting of several heterogeneous factors related to deep structural trends, influencing niche and regime dynamics (Geels, 2011; Shove & Walker, 2010). These trends are characterized by their long-term effect, which occurs more slowly than changes at the regime level (Geels, 2002). Moreover, the landscape level is beyond the regime and niche actors' influence. However, the regime can adapt to landscape changes to maintain the system's stability (Geels, 2002).

Another way to destabilize the socio-technical regime is through developing novel innovations at the niche level (Geels, 2002). The niche level refers to a protected space where innovative activities take place (Geels, 2011). Various scholars have highlighted the importance of a ''niche'' as a protected space for the emergence of radical innovations (Geels, 2005). Because initially, radical innovations have lower performance and cannot compete with the existing socio-technical regime (Geels, 2005). Niches are crucial for transitions because they provide radical innovations with spaces for learning processes and building social networks (Geels, 2011; Geels, 2005).

The dynamic interaction of processes at the regime, landscape, and niche levels can result in a transition, replacing one regime with a new regime involving new rules and practices (Geels, 2012; Geels et al., 2015). This transition process takes multiple steps. First, radical innovations emerge in the niches and begin to stabilize and develop their own rules. Next, landscape pressure and regime weakness create a ''window of opportunity'' for niche innovations. Finally, niche innovations gradually replace the regime (Geels, 2005).

The MLP has been applied to studies examining the niche dynamics of car-sharing. For example, Ornetzeder & Rohracher (2013) examined how the niche of car-sharing grows through grassroots activities. Further, Meijer et al. (2019) found three types of niche upscaling strategies for car-sharing business models. These studies predominantly focus on the niche activities of car-sharing. This study extends current research by examining the difference between the current automobility regime and the car-sharing niche to offer useful insights for understanding the transition towards a more sustainable automobility system.

The MLP is useful for studying car-sharing because it has the potential to transform the automobility system into a more sustainable trajectory (Meelen et al., 2019). However, to disrupt the dominant existing regime of privately owned cars, not only is the development of a novel innovation crucial, but landscape trends exerting pressure on the dominant regime are also important. Therefore, the interaction of the three levels compromising the MLP facilitates studying such a socio-technical transition.

However, various scholars have criticized the MLP perspective for not considering some other crucial points of transitions. MLP studies analyse a specific regime, such as energy and food (Hargreaves et al., 2013). Transitions that cut across multiple regimes are thus only partially captured by an MLP perspective. Moreover, MLP is useful for understanding how novel innovations can break through the socio-technical regime, but the underlying mechanism that maintains the status quo is overlooked (Hargreaves et al., 2013). In other words, the MLP focuses too much on novelty while neglecting normality. The following section discusses how the Social Practice Theory can be useful in addressing these shortcomings.

2.1.2. Social practice theory (SPT)

Understanding and explaining the potential of car-sharing to disrupt the existing automobility regime requires looking beyond individuals and social structures (Kent & Dowling, 2013). SPT is a theoretical approach that is successfully developed to decentralize the individual, where practices are seen as the primary unit of analysis (Svennevik et al., 2021; Watson, 2012). In contrast to theories perceiving behavioural change as a result of individualized and linear decision-making processes, SPT perceives behavioural change as a result of the development of practices and how they are reproduced, maintained, and challenged (Hargreaves, 2011; Kent & Dowling, 2013). Practices are maintained and strengthened through the continued performance of practitioners within a society (Hargreaves, 2011; Julsrud & Farstad, 2020). The reproduction of practices accounts for the stability of practices and reveals the difficulties in attempting to change practices, but it is necessary for a transition towards more sustainable trajectories (Hargreaves et al., 2013).

The stability and change of practices can be described and analysed through a scheme proposed by Shove et al. (2012, p. 22), consisting of the configuration of the three elements constituting a practice: material, meaning, and competences (see *Figure 1*). Material includes things, technologies, and tangible physical entities. Meaning includes the symbolic meaning, ideas, and aspirations. Finally, competences include skills, know-how, and technique. (Svennevik et al., 2020).
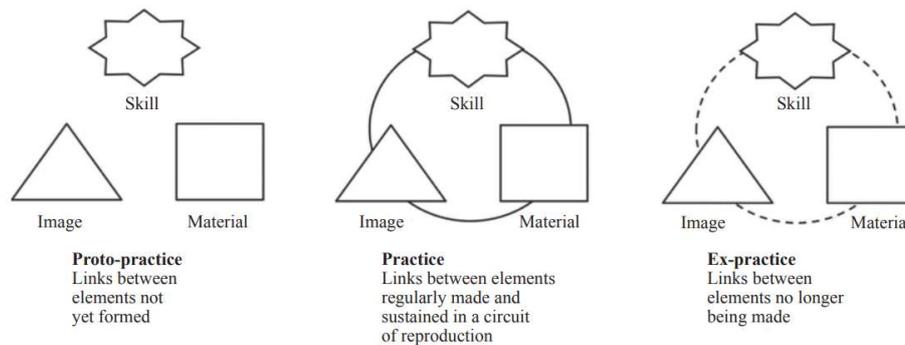
Figure 1.

Proto-practices, practices, and ex-practices (source: Pantzar & Shove, 2010, p. 450)

Although the elements exist separately as a ''proto-practice'', a change in one element can hardly cause a change in a practice (Watson, 2012). A practice can only be established if linkages are created between the elements. These linkages can also be disconnected at a later stage, turning practices into ex-practices where the practice no longer exists (Schatzki, 2011; Shove et al., 2012).

In addition, to understand the dynamics of practices and how practices can change, a practice cannot be analysed in isolation (Kent & Dowling, 2013). Instead, practices are connected with other daily life practices through practice bundles (Watson, 2012). Thus, to better understand the reproduction of practices and how practices can change, the interdependencies between different practices also need to be considered.

SPT has proven a useful theoretical approach to study how a (car-sharing) automobility system becomes embedded in people's everyday lives (Christensen et al., 2022; Svennevik, 2021). This has been researched in a diverse set of ways; Kent & Dowling (2013) have studied how car-sharing endures as a routinely performed social practice; Svennevik et al. (2020) have researched under which conditions car-sharing practices are reproduced; and Svennevik et al. (2021) have deconstructed practices to reveal how new mobility practices emerge. The current scientific work has focused mainly on the emergence and reproduction of car-sharing proto-practices rather than how car-sharing disrupts embedded automobility practices (Hargreaves et al., 2013). Therefore, this study explores the potential for novel car-sharing proto-practices to be developed by consumers and replace and disrupt the current unsustainable automobility practices.

SPT is relevant to study the sustainability transition towards car-sharing because the automobility system is a substantive part of people's everyday life, consisting of a clear set of elements (e.g., freedom and convenience) comprising the system of practices. Additionally, automobility practices are often intertwined with other practices (e.g., shopping, working, and traveling).

Furthermore, the SPT can extend the analyses of MLP by addressing the limitations of MLP. First, in contrast to the MLP, the SPT is equipped to analyse transitions that cut across multiple regimes because this theory perceives practices as interrelated systems of practices (Hargreaves et al., 2013). Furthermore, SPT complements the focus on novelty by MLP by addressing the normality of innovations (Hargreaves et al., 2013). This means that MLP can understand where radical change comes from, while SPT can understand how practices are maintained and reproduced. This study adds theoretical value to the existing literature by combining the MLP and SPT and testing and applying it to new real-world innovation.

2.2. Connecting the MLP and SPT

MLP and SPT are theoretical approaches that address socio-technical change but take a different approach regarding the underlying mechanism of achieving a system change or socio-technical transition (Hargreaves et al., 2013). From the MLP perspective, a regime transition occurs when the regime and landscape dynamics create a window of opportunity for novel innovation to break through and reconfigure the dominant regime (McMeekin & Southerton, 2012). Whereas, from the SPT perspective, a transition in practices occurs when a novel combination of proto-practices disrupts the established practices and, as a result, recruits practitioners (Kent & Dowling, 2013).

Although MLP and SPT have emerged as two competing approaches with fundamentally different ontologies, a link exists between the lock-in and stability of established regimes and practices and the disruptive potential of niches and proto-practices (Hargreaves et al., 2013; Svennevik et al., 2020). Watson (2012, p. 489) reaffirms the linkage between MLP and SPT: "Changes in socio-technical systems only happen if the practices which embed those systems in the routines and rhythms of life change." This quotation implies that an analysis of a systemic change through either regime or practice change might overlook the importance of other innovation dynamics (Hargreaves et al., 2013; Shove, 2003). MLP might overlook the importance of zooming in on people's daily lives, while SPT fails to consider the ''bigger picture'' (Hargreaves et al., 2011.; Svennevik et al., 2021). Identifying the potential connections between MLP and SPT might help understand the development of sustainable innovations better, particularly why sustainability transitions are prevented (Hargreaves et al., 2013).

Hargreaves et al. (2013) have recognized the potential complementary of MLP and SPT to better understand the complexity of socio-technical change. They were the first to apply the framework by Shove (2003) that seeks to connect these two distinct theories and explore their linkages without diminishing the theoretical value of both approaches. This is done through the subsequent three steps in constructing the framework (*Figure 2*); first, the

analysis of the vertical relationships between the three levels of the MLP; second, the analysis of the horizontal circulation of the elements of practices; and finally the identification of the intersection points between the regimes and practices (Hargreaves et al., 2013). According to Hargreaves et al. (2013), future research on sustainability transitions should focus on these intersection points as they help to understand why sustainable innovations are constrained, which subsequently helps to analyse how these barriers can be transformed into opportunities to facilitate a sustainability transition.
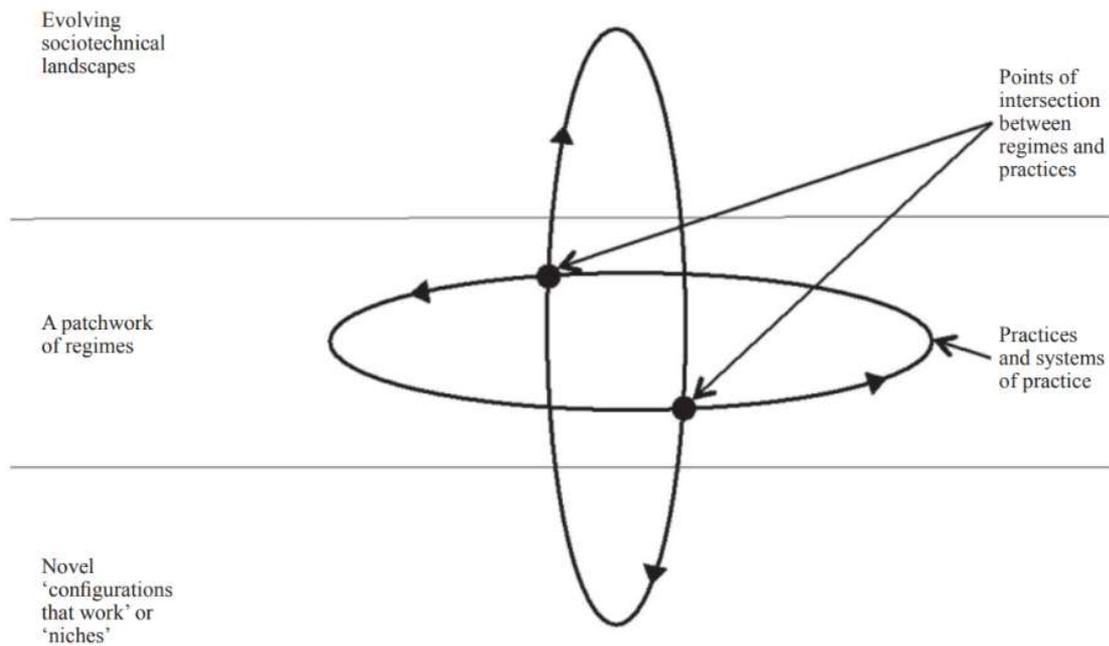
Figure 2.
Combining the MLP and SPT (source: Hargreaves et al., 2013, p. 409)

Moreover, Watson (2012) has also shown the added value of connecting MLP and SPT. He argues that the interlinkages of MLP and SPT might reveal how regime transitions can enable or constrain practice transitions and vice versa. The "regime" from the MLP could inform how established practices are locked in and maintain dominance. At the same time, the concept of "practice" from SPT could inform how the dominant regime is locked in to sustain an embedded practice. The intertwined character of regimes and practices thus reveals that a change in regimes can facilitate a change in practices (Hargreaves et al., 2013).

Most of the research on sustainability transitions has either applied the MLP or SPT perspective, while only a few studies have considered the intersection points between these two theoretical approaches (except for Hargreaves et al., 2013; Seyfang & Gilbert-Squires, 2019). However, none have empirically applied the framework to the transition to car-sharing. Therefore, this study aims to explore new empirical insights by identifying and analysing the intersection points between regimes and practices facilitate the transition towards a more sustainable automobility system. Moreover, the research offers additional

theoretical insights regarding the potential limitations of combining the hierarchical and flat ontologies of the MLP and SPT by applying the framework by Hargreaves et al. (2013) to a new empirical context.

2.3. Empirical context: Car-sharing in The Netherlands

Car-sharing has been active in The Netherlands since 1974 but remained a niche market despite governmental support of several car-sharing programs (Nijland & van Meerkerk, 2017). This is illustrated by the fact that the private car fleet is growing faster than the Dutch population (CBS, 2020). In January 2020, the Netherlands owned over 7.6 million privately owned passenger cars, equivalent to 543 cars per 1000 inhabitants (CBS, 2020). These numbers illustrate the challenge of disrupting the current automobility behaviour of owning a private car. Nonetheless, the Dutch Government is still optimistic about the future of car-sharing, setting up a Green Deal in 2015 where 54 different partners (governmental authorities, companies, and environmental organizations) have worked together to grow the car-sharing market (Green Deal, 2021). The Green Deal aimed to increase car-sharing to 100,000 cars and 700,000 users in 2021. In March 2021, there were 97,825 shared cars and 971,000 users (Green Deal, 2021). The growing number of privately owned cars in The Netherlands and the relatively moderate expansion of the car-sharing market represent The Netherlands as an interesting study area to examine the transition to car-sharing.

Car-sharing can be distinguished by different types of business models; business-to-consumer, peer-to-peer, and one-way. Business-to-consumers is seen as the ''classic car-sharing'' where a car-sharing organization rents out cars to users (Munzel, 2020). The shared cars are taken from specific parking spots and have to be returned to the same location (Munzel, 2020). Around 2011, the peer-to-peer car-sharing model emerged, where car owners can rent out their own cars to fellow consumers operated by a coordinating car-sharing organization (Munzel, 2020). In these traditional car-sharing systems, the car needs to be returned to the same place where the user picked it up. In a business model based on ''one-way'', the shared car can be left at defined places by the user (Burghard & Dütschke, 2019).

Car-sharing is a relevant and interesting empirical context for applying the conceptual framework by Hargreaves et al. (2013) because car-sharing can potentially transform the current automobility system of privately owned cars into a more sustainable one. This becomes evident from the research from Nijland & van Meerkerk (2017), who have shown that car sharers from The Netherlands drove 15% to 20% fewer car kilometres and owned 30% fewer cars compared to their previous situation. This resulted in a decrease in CO_2 emissions by 13-18% (Nijland & van Meerkerk, 2017).

The empirical context of the Dutch automobility system reveals the dominance of privately owned cars despite the efforts of the Dutch government to support the uptake of car-sharing. Therefore, this research investigates how the twin analysis of automobility regimes and practices and the intersection between these two can inform the transition to car-sharing.

3. Methodology

3.1. Research design

This study has used a qualitative approach to investigate the potential of car-sharing to achieve a sustainability transition in a case study of the Dutch automobility system. This transition is a relatively new and evolving phenomenon. Therefore, it requires a method to capture and analyse empirical data about current perceptions, behaviours, and emerging trends. These up-to-date insights might not be fully captured through quantitative research methods based on pre-existing data. Further, a qualitative research method prioritizes subjective experiences and allows respondents to share their perspectives and stories. Focusing on underlying motivations and emotions can provide a more nuanced understanding of this socio-technical transition. The following steps were taken during the research to help answer the research questions.

First, the MLP-based analysis has investigated the vertical relationships between the regime, landscape, and niche levels. A qualitative approach is well-suited to account for the complex and dynamic interrelation between these levels.

Next, the SPT-based analysis has investigated the horizontal circulation of the elements of automobility practices. A qualitative approach is well-suited to ask 'how' and 'why' questions to reveal the people's experience and meaning of certain processes and structures of their lives (Bryman, 2015; Miles & Huberman, 1994). This helps to understand the individual's everyday mobility behaviour and how it changes over time.

The final step combines the empirical findings of the MLP-based and SPT-based analysis by applying the framework by Hargreaves et al. (2013). The intersections between the automobility regimes and practices are identified in two distinct steps: a) how embedded automobility practices constrain transition in regimes and b) how dominant automobility regimes constrain transition in practices.

The following sections elaborate on the steps of the analytical framework (*Figure 3*). *Section 3.2.* explains how the empirical data is collected, and *Section 3.3.* describes the data analysis process and how the empirical findings of MLP and SPT are integrated. Finally, *Section 3.4.* addresses the research quality and research ethics.

MLP   SPT

Data collection

1. Semi-structured interviews | Reports & website information   1. Semi-structured interviews

Data analyis

2. Deductively coding by applying the MLP framework   2. Deductively coding by applying the SPT framework

Landscape level
Stabilizer and destabilizers
Private car ownership regime
Regime characteristics: Users/markets, industry, policy, technology, science/knowledge, culture and artefacts
Car-sharing niche
Niche characteristics: Users/markets, industry, policy, technology, science/knowledge, culture and artefacts
Niche development: Network formation, learning processes, expectations/visions

Car ownership practices	Car-sharing proto-practices
Element of practice	**Element of practice**
Material	Material
Meaning	Meaning
Competences	Competences
Practitioner	Practitioner
Related practices	Related practices

3. Creating new categories through inductive coding   3. Creating new categories through inductive coding

Iterative coding   *Iterative coding*

MLP + SPT

Twin analysis MLP + SPT

4a *How regime transitions are constrained by embedded automobility practices?*

Vertical hierachial levels: **Landscape Regime Niche** | Horizontal circular levels: **...practices ...practices ...practices**

4b *How practice transitions are constrained by dominant regimes of private car ownership?*

Horizontal circular levels: **Systems of practices Practices Elements of practice** | Vertical hierachial levels: **...regime ...regime ...regime**

Figure 3.
Analytical Framework

3.2. Data collection

Primary empirical data is collected for the MLP-based and SPT-based analysis by conducting in-depth semi-structured interviews with 21 respondents via MS Teams. For the MLP-based analysis, the sample consists of multiple actors and organisations to enhance the reliability and validity of this research (see *Table 1*). The respondents are purposefully sampled based on their relevance to this research. This type of sampling ensures that the respondents have first-hand expertise and specific knowledge in this research area. Furthermore, this sampling technique allow respondents to be selected from various viewpoints, which helps to capture the heterogeneity and complexity of the Dutch automobility system and the car-sharing niche. First, three car-sharing providers were interviewed to gain valuable insights into the dynamics of the car-sharing niche. These providers interact directly with users of the service, allowing them to give insights about user behaviours, motivations, and preferences. Moreover, the practical and operational challenges of car-sharing are highlighted by car-sharing providers, such as fleet management and customer support, which can inform recommendations for policymakers. Second, an incumbent automobile manufacturer is interviewed to tap into their expertise in the market dynamics and industry trends of the Dutch automobility system. Further, the incumbents can provide insights into their positioning and how they adapt their business model to new mobility trends. These insights have enriched the research findings. Third, policy advisors from the Province of Utrecht and the municipality of Utrecht are interviewed because of their knowledge of existing regulations, policies, and initiatives that affect the transition towards car-sharing. They are also responsible for engaging with various stakeholders, which can deepen the understanding of the broader ecosystem. Last, two mobility consultants are interviewed because of their unique viewpoints and specialized knowledge and experience on this research topic which can add a new perspective to this research.

Table 1.
Respondents of the MLP-based analysis

ID	Group	Organisation	Role
#1	p2p car-sharing provider; closed-community	Amigo Mobility / Louwman Group	Lead Venture / CTO
#2 & #3	b2c car-sharing provider	Century	Project manager Sustainability and Innovation & Sales manager / Manager car rental
#4	b2c car-sharing provider; closed-community	OnzeAuto	Online Marketeer
#5	Incumbent automobile manufacturer	Nissan Motor Corporation	Director Marketing Netherlands
#6	Policy advisor	Municipality of Utrecht	Policy Advisor, Shared Mobility
#7	Policy advisor	Province of Utrecht	Trainee, Smart Mobility
#8	Mobility consultant	Keypoint Consultancy	Consultant, Mobility

| #9 | Mobility consultant | KPMG | Associate Director Global Strategy Group |

For the SPT-based analysis, the sample consists of 12 households (users of b2c and p2p car-sharing services and car owners) from The Netherlands (see *Tables 2 and 3*). The households are purposefully sampled via the researcher's network and car-sharing apps to obtain a fairly balanced sample covering different car-sharing services, household types, and residential areas. Additionally, the sample of households included car-sharing users and car owners in different life stages, from single, to couples with and without children, to retirees.

Table 2.

Respondents of the SPT-based analysis (car-sharing users)

ID	Name	Age	Residence	Household composition	Car-sharing services	Former car owner?
#10	Maike	30	Nieuwegein	Couple without children	SnappCar, GreenWheels	No
#11	Wietske	28	Utrecht, City Centre	Couple without children	SnappCar	No
#12	Felicia	28	Amsterdam	Couple without children	SnappCar, ShareNow, Sixt	No
#13	Klaas	30	Delft, City Centre	Single	SnappCar	Yes
#14	Dylan	29	Amsterdam	Couple without children	SnappCar, ShareNow, Sixt	Yes
#15	Joran	34	Utrecht, City Centre	Couple without children	SnappCar	Yes

Table 3.

Respondents of the SPT-based analysis (car owners)

ID	Name	Age	Residence	Household composition
#16	Mandy	28	Almere	Living at her parent's house
#17	Guus	74	Nieuwegein	Couple with children (already moved from the parent's house)
#18	Nikki	23	Nieuwegein	Single
#19	Rober & Vrouwkje	54 & 59	Heerhugowaard	Couple without children
#20	Betty	50	Nieuwegein	Couple with children
#21	Kees	60	Nieuwegein	Couple with children

The in-depth semi-structured interviews allowed for asking follow-up questions, resulting in a deeper understanding of the respondent's perspective (Bryman, 2015). Moreover, in-depth semi-structured interviews with households allowed for analysing practices, as these respondents are free to talk about their daily life, revealing actions and routines they otherwise take for granted (Hitchings, 2012).

The in-depth semi-structured interviews started with a brief introduction to the research and what is expected from the respondent. This is followed by two distinct interview guides. For the MLP-based analysis, the interview guide is structured according to the MLP framework (*Appendix A1 t/m A4*). The regime actors are mainly questioned about the regime dimensions, such as their business models and policy frameworks. The niche actors are mainly questioned about niche-building activities, such as stakeholder engagement. Additionally, the interviews with the policy advisors and mobility consultants mainly focused on the landscape and industry trends. For the SPT-based analysis, the interview started with general questions about the person's mobility behaviour for a typical day and short and long-term travelling. This is followed by two distinct interview guides based on the SPT framework (*Appendix A5*). The users of car-sharing are questioned about their decision-making process, how they use car-sharing, how the practice of car-sharing has emerged (e.g., trigger events), and how it relates to other practices. The non-users are questioned about their decision-making process, how they use their private car, how it relates to other practices, and how they perceive car-sharing.

In addition, the empirical findings of the MLP-based analysis are triangulated by comparing the interview statements with secondary data. Twenty news articles, company website blogs, and reports have been reviewed. The use of different data collection methods has validated and complemented the research's findings and allowed for an improved judgment (Merriam & Grenier, 2019).

3.3. Data analysis

The analytical process was conducted using the computer software NVIVO in six main steps. First, the interview recordings were transcribed to organize and manage the primary empirical data. Second, the transcripts were thoroughly read to familiarise the data and to unravel essential and recurrent themes. It also led to a more comprehensive understanding of the content and the context of the empirical data. Third, the relevant sentences of the interviews were assigned to codes that reflected the participant's perspective as close as possible. Subsequently, these codes were assigned to the categories of the MLP and SPT frameworks through a deductive coding process. Given that the initial codes were found inductively, a significant amount of codes did not align with any of the pre-defined categories. For example, the mobility behaviour of users is assigned to the categories of ''day-to-day mobility'' and ''non-routine mobility'', which provided an overview of the respondent's travel patterns. While these categories are not disregarded entirely in the final analysis, their significance was relatively diminished compared to the data directly related to the theoretical

frameworks of MLP and SPT. The combination of inductively and deductively coding has enabled the exploration of both straightforward and apparent processes, but it also has left room to identify other relevant processes. Fourth, the pre-defined categories were divided into more specific categories. For example, the category ''meaning'' of the SPT framework is distinguished into four sub-categories: freedom, flexibility & convenience; availability; social relations; and sustainability. These sub-categories correspond with the headers of the main pre-defined categories of the MLP and SPT frameworks in the results section. This coding process involved constant revision and refinement to ensure consistency, coherence, and accuracy and was repeated until no new categories emerged. Additionally, secondary data (e.g., news articles, reports, and company websites) have filled up some empirical gaps, and it helped to confirm or refute patterns and themes identified in the empirical data. By combining primary and secondary data, the interpretation of the findings is validated and enriched. Fifth, the transition in regimes and practices has been mapped, according to *Tables 4 and 5,* to gain insights into the specific categories of the MLP and SPT frameworks affected by the transition from car ownership towards car-sharing. Last, the MLP-based and SPT-based analyses are combined to identify the intersections between the transition in automobility regimes and practices (see *steps 4a and 4b* in *Figure 3*). For example, an embedded automobility practice could not be changed due to existing regimes (e.g., lack of infrastructure, lack of available resources, and lack of supportive regulatory framework). At the same time, the development of the car-sharing niche can be constrained due to embedded practices (e.g., bodily-mental capacities, lack of skills, lack of access, and lack of choice). This helps to understand where the automobility regimes and practices inhibit each other and prevent the sustainable transition towards car-sharing. At the same time, the intersections between regimes and practices provide new insights into the opportunities for the car-sharing niche and proto-practices to develop and establish to transform the Dutch automobility system into a more sustainable one.

Table 4.
Comparison of dimensions of dominant automobility regime and car-sharing niche

Regime dimensions	Dominant automobility regime	Car-sharing niche
Users, markets	...	...
Industry	...	...
Policy	...	...
Technology	...	...
Science, knowledge	...	...
Culture	...	...
Artefacts	...	...

Regime transitions
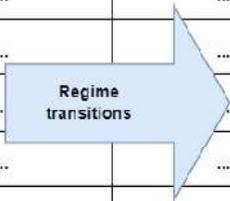
Table 5.
Comparison of embedded automobility practices and car-sharing proto-practices

Element of practice	Embedded automobility practices	Emerging car-sharing proto-practices
Material	...	...
Meaning	...	...
Competences	...	...
Practitioners	...	...
Related practices	...	...

Practice transitions
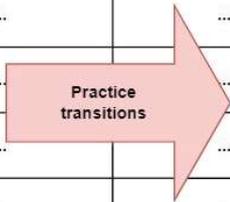
3.4. Research quality and ethics

The empirical data for the MLP-based and SPT-based analysis is collected and analysed based on the academically proven theoretical frameworks of MLP and SPT. This has guarded a valid measurement of the concepts. Moreover, the interview guides are based on a pre-determined topic list which gave each respondent the same room for interpretation, enhancing the research's reliability. Furthermore, in-depth qualitative interviews are well-suited to understand the automobility practices of households rather than generalizing the result to other people (Bryman, 2015). The external generalizability is enhanced by sampling households with diverse backgrounds and from different life stages, giving a varied perspective on the research topic (Mollenkopf et al., 2011).

Regarding the empirical data collection method, Hitchings (2012) states that conducting interviews is useful to capture practices but argues that not all people can easily talk about their everyday lives. Therefore, various scholars attempt to find different creative methodologies to develop the theory of social practice theories and enhance the ability to capture the aspects of everyday practices. From a study by Browne (2016), it became clear that a research method based on focus groups can provide new data and insights. These focus groups are informal multi-personal conservation that enables openness, humour, and curiosity, leading to the emergence of new data that talk-based research methods could not find. The study by Browne (2016) also revealed how focus groups help overcome the awkwardness of discussing everyday practices. Nevertheless, the type of practice should be considered when choosing the appropriate methodology to study practice. For example, a methodology appropriate to study the cleaning practice may not be able to capture the dynamics of the mobility practice. The cleaning practice involves more intimate and sensitive details, which might result in more awkwardness and shame to discuss in a one-to-one interview. In contrast, the mobility practice is already performed more publicly and involves less intimate and sensitive details of the respondent's daily life. Although the additional insights focus groups could provide practice-based studies, research methods based on interviews continue to be extensively used as an empirical tool to capture various aspects of daily life (Browne, 2016). Hitchings (2012) concludes that interviews should not be dismissed for studying daily life practices as this research method can help understand why and how people perform certain practices. This research has guarded the appropriateness of the interviews to study everyday practices by providing respondents with enough room to talk freely about their daily life. Further, the researcher paid attention to how the respondents reacted. This gave the research valuable insights into the respondents' subjective experiences (Hitchings, 2012).

Another key dimension of the research quality is a personal bias which can hardly be eliminated in qualitative research. Therefore, I was aware that I am in favour of a sustainable automobility transition and have kept this in mind throughout the research to minimize the researcher's influence.

Finally, this research has taken into account several ethical considerations. The interviewer has ensured informed consent from the respondents to achieve a mutual agreement to record the interview. Furthermore, all information is treated confidentially, which means that the recordings are not shared and will be deleted after the research is completed. The respondents are also asked to approve the quotes used in the results section. These steps have resulted in mutual consent between the two parties during the research. The consideration of the ethics of the research method was particularly crucial for the researcher to delve deeper into the respondent's everyday lives, which involve personal information.

4. Results

This section presents the findings of the MLP-based and SPT-based analysis. *Section 4.1* uses an MLP approach to analyse the automobility regime transition towards a more sustainable car-sharing niche. *Section 4.2.* uses an SPT approach to investigate the embedded and potentially new automobility practices from the perspective of car owners and car-sharing users.

4.1. MLP-based analysis

The MLP findings are structured as follows. *Section 4.1.1.* describes the external landscape pressures that reveal the crisis within the regime and the windows of opportunity for the car-sharing niche. Next, *Section 4.1.2.* describes the characteristics of the automobility regime and how trends influence the incumbent regime. *Section 4.1.3.* compares the characteristics of the Dutch automobility regime and car-sharing niche. Additionally, it zooms in on the niche internal processes (network formation, learning processes, and expectations) to provide evidence for niche-building activities and the extent of niche diffusion to analyse the potential of car-sharing to reconfigure the existing automobility system.

4.1.1. Landscape analysis

Environmental concerns are frequently mentioned as an important incentive to make the existing automobility regime more sustainable. The car-sharing providers consider car-sharing a mobility solution that increasingly attracts environmentally aware consumers who want to get rid of their cars. In line with this, the municipality of Utrecht and the Province of Utrecht consider car-sharing a sustainable mobility option for its citizens that might contribute to the quality of life in the cities. The emission ceilings and strict environmental requirements of cars also support a sustainable mobility transition. For example, the EU deal ensures that ''all new cars and vans registered in Europe will be zero-emission by 2035'' (European commission, 2022).

Further, the emergence of shared mobility fits into the broader development of the sharing economy, where individuals share goods rather than own them (De las Heras et al., 2021). Users do not have to invest in a car but only pay for use. This can be financially attractive for users who do not use a car regularly.

Urbanisation is a crucial development that makes public space scarce, particularly in cities. Car-sharing can offer a solution to use the public space more efficiently. According to a study from CROW (n.d.)., shared cars can replace 9 to 13 private cars on average, which releases more space for other public facilities, such as housing. Therefore, car-sharing allows cities to remove parking spots and create more public space.

On the other hand, demographic aging is an important trend that positively impacts the private vehicle fleet twofold: the elderly population is growing, and the elderly population is more vital, leading to increased car ownership of this group (SWOV, 2015). The increased

vehicle fleet is also caused by the continued population growth of 1,4 percent annually to 2030 (BOVAG & KPMG, 2022).

Further, the COVID-19 pandemic is an important development affecting the car-sharing market. During the first lockdown, people travelled less, which decreased the number of kilometres travelled. As a result, the demand for shared cars also decreased, temporarily removing 653 shared cars, particularly free-floating and business-shared cars (CROW, 2020). However, this has been recovered quickly, predominantly by the private market (CROW, 2020). In 2022, the number of SnappCar users increased by 30 percent from 2021 (SnappCar, 2022), and the number of Greenwheels users increased by 53 percent (Greenwheels, 2022). Thus, it can be suggested that the COVID-19 pandemic has altered people's mobility behaviour and habits, resulting in increased demand for shared cars. To support this, car-sharing provider Amigo explained how COVID-19 could lead to changed mobility behaviour: *''We just had the COVID-19 period, everyone is a bit in a negative spiral, making people more likely to look at their car expenses. COVID-19 and inflation could be a turnover where people start thinking about the costs of owning a car''.* (Respondent #1). Further, COVID-19 has been an essential accelerator of the digitalization of the automotive retail industry. For instance, car manufacturers have recognized the abundance of physical interaction for customer support. Instead, the consumers can also be reached through digital channels. This could make the physical showrooms no longer necessary to sell cars. (BOVAG & KPMG, 2022).

Another turnover point mentioned by multiple respondents (#1, #4, and #9) is inflation. The consequences are twofold. On the one hand, people reconsider their car ownership and are reluctant to buy a new car during economic uncertainty. This provides a window of opportunity for the car-sharing niche to offer an alternative for fewer costs. On the other hand, the borrowings for a new project become more expensive, leading to a reluctance by car-sharing providers to place more shared cars. This can result in a reduced supply of shared cars.

4.1.2. Regime analysis of the Dutch automobility system

Table 6 compares the characteristics of the existing automobility regime with the emerging car-sharing niche, according to the dimensions of the MLP framework by Geels (2002) and Geels (2004). These dimensions help to analyse how the car-sharing niche relates to the automobility regime by presenting the key differences. Despite not attempting to present an exhaustive representation of this automobility industry, the MLP theoretical framework does help to create a simplistic overview of both the regime and niche dynamics.

Table 6.

Comparison of characteristics dominant automobility regime and emerging car-sharing niche

Dimension	Automobility regime	Car-sharing niche
Users, markets	Love brand (car for life); Way of living based on private car ownership	Infrequent drivers; Pro-environment consumers
Industry	Vehicle sales; Service & maintenance; Leasing fees; Rental fees; Investments in Research & Development; Product development; Sunk costs;	Heterogenous sector; Pioneering; Subscription models; Low profit margins; Investments in car fleet; Low life-time earning per consumer; Mobility for life; Spin-offs; Diversity of services will improve the resilience
Policy	Sustainability reporting; 2030 zero emission vehicles; Parking policies; Road infrastructure investment; Car taxation; Subsidies for Electric Vehicles	Lack of policies stimulating car-sharing; Corporation schemes; Privacy data schemes; Parking arrangements; Green Deal Autodelen; Goedopweg
Technology	Electrification of vehicles; Zero emission car fleet by 2030; Alternative powertrains, connected and autonomous vehicles (CAVs); Investments in digitalization and software development; EV battery technology; EV infrastructure	Mobility hubs; Parking spots (with charging station); Multimodal network; Real-time data increases transparency; Investments in data & digitalization; AI enables capacity utilisation; Restricted-traffic area development
Science, Knowledge	Growth and progress measured by monetary measures	Social concept (cooperations); (Inter)national knowledge sharing; Knowledge gap between rural and urban areas
Culture	Capitalistic, neo-liberalism culture; Auto-minded transport; management; Customer focus; Market competitiveness; Safety and quality; Continuous learning and adaptation	Community engagement; Sustainability and environmental consciousness; Technological integration; Trust and safety; Horizontal car-sharing companies; Continuous improvement
Artefacts	Car dealerships; Infrastructure; Parking facilities; Fuel stations; Traffic signs and road markings	Car-sharing platforms and apps; Keyless entry systems; Payments systems; Signage and markings; Mobility-as-a-service (MaaS)

The automobility regime is characterised by business models based on growth and profitability. Further, the automobility industry has small inventory stocks and worldwide sourcing for a flexible, low-cost production process to ensure their high competitiveness (Saliji, 2021). As a result, the automobility industry is fragile to disruptions in the distribution process. The most recent disruption was caused by the shortage of chips, which resulted in a delay in the production of cars (Financial Times, 2022). Moreover, the incumbent regime is challenged by new policies (e.g., new zero-emission vehicles in 2035 in Europe (Europe Commission, 2022)) to move towards a cleaner, more efficient system with less congestion, fewer accidents, and less space required. The incumbents attempt to defend their market share by investing in Research & Development to innovate, such as EV battery technology and infrastructure. The respondent from Nissan stated the importance of battery technology innovation to curb the production price of electric cars: ''*Nowadays, you notice all these Chinese brands which enter the market with the more expensive electric models. No one starts with a low prices entry-level model as an electric car as you are stuck with the high costs of the current batteries. So, you often produce a larger car to recover the costs. This will soon change with the new generation of batteries.*'' (Respondent #5). In addition, he mentioned the development of the EV infrastructure and ecosystem as vital for Nissan to compete with other automobile manufacturers. For instance, Nissan will offer wall boxes for consumers to use the electricity from their cars in their homes. This illustrates the importance of investing simultaneously in the electric car and the ecosystem to defend market share. In line with this, an OEM's director of network development stated: *"You just have to be able to do several things, just selling is no longer enough.''* (BOVAG & KPMG, 2022, p.38). The respondent from Nissan mentioned how they maintain their leadership position by offering extra services around the car. He gave an example of an extra service: *"Our customers can purchase a theft tracking system. Your car will then be connected to a tracking system, if your car is stolen, we can locate the car based on GPS coordinates, and automatically send an alarm to your mobile''.* (Respondent #5). This quotation shows how automobile manufacturers shift towards mobility companies since it will be insufficient to only produce and sell cars. Further, the respondent from the incumbent automobility manufacturer Nissan mentioned the development of autonomous vehicles as an important disruptive trend for the automobility regime. The development of autonomous vehicles allows Nissan to reach their mission of having zero deadly car accidents.

However, the respondent from Nissan expressed the challenge to simultaneously invest in innovations and the current fleet of petrol cars. Therefore, the respondent from Nissan considers their collaboration with Mitsubishi and Renault for Research & Development vital to spread the costs and speed up the innovation process.

Furthermore, the incumbents will face growing challenges from trends that are critical to the development of the regime. One of the main technological developments is the adoption of electric vehicles and emission-free vehicles. This puts pressure on the aftersales business model involving maintenance and repair due to the following reasons. EVs encompass materials with extended durability leading to a decreased outflow and a lower

demand for new vehicles (BOVAG & KPMG, 2022). In addition, the market for reparation and maintenance declines, resulting in a different (lower) margin profile and higher unemployment rates (BOVAG & KPMG, 2022).

Moreover, car retailers are no longer necessary due to the fact that the linear business models alter into a complex web of interconnected business models. These development result in a growing influence of the so-called ''super retailers'' – manufacturers who can offer integrated solutions to consumers instead of only producing or selling cars (BOVAG & KPMG, 2022).

Despite these internal crises within the regime, the regime analysis suggests a relatively stable mobility industry over the years. This is illustrated by the rapport from KiM (The Netherlands Institute for Transport Policy Analysis) and IenW (Ministry of Infrastructure and Water Management), who concluded that the car is still the most valued transport mode among Dutch citizens (Harms et al., 2016). The stability of the automobility regime is strengthened by the auto-minded culture in The Netherlands, which can be observed among its users who have based their way of living on car ownership and love particular car brands. Therefore, it is difficult to reconfigure the current automobility regime as it requires a culture shift for both individuals and the wider system.

4.1.3. Niche analysis of car-sharing

The main differences between the car-sharing niche and the automobility regime relate to differences in users, technologies, policies, culture, artefacts, and values. The car-sharing niche offers a mobility service based on a subscription model and encompasses the ''mobility for life'' mindset compared to the automobility regime ''car for life'' mindset. Further, the heterogeneity of car-sharing business models improves the diversity and, subsequently, the resilience of the niche. This corresponds to the ideology of car-sharing providers working together rather than acting as opponents. Regarding artefacts, the niche focuses on the multimodality of the Dutch mobility system encompassing a diverse set of transport modes compared to the car-minded regime. Moreover, the pro-environmental and social culture of the niche is spread across all actors, from intrinsically motivated car-sharing company employees to social entrepreneurs starting a car-sharing service, as opposed to a completely different set of values of car manufacturers (e.g., bonuses).

The niche's internal processes and building activities demonstrate to which extent the niche reconfigures, transforms, reforms, or substitutes the existing regime (Geels & Schot, 2007). The internal processes are structured in the following main themes set out by Geels & Schot (2007): (a) network formation, (b) learning processes, and (c) expectations.

4.1.3.1. Network formation

Network formation refers to the extent to which a broad and aligned network of niche actors has been established. A distinction is made between (a) network composition, referring to the type of actors involved around the niche and the extent to which they collaborate, and (b) market formation, describing to what extent the suppliers and users have developed around the niche.

a. Network composition

The car-sharing providers have built a broad network of actors, including municipalities, provinces, app providers, and other car-sharing providers and cooperations. The collaboration with the municipalities is considered the most crucial as car-sharing providers stated their dependence on municipalities to obtain charging stations and reserved parking spaces. This is illustrated by car-sharing provider Century, who joined a car-sharing pilot with the Province of Drenthe and the region Groningen/Assen and described the relationship with this partner as follows: *''The collaboration with them is going very well. It really helps that we started together and no one really knows how the pilot will turn out. There is not one party with all the knowledge who keeps it for themselves. Rather, the collaboration is super open. If we encounter a problem, we also need the other parties to solve it… I think it's a very open collaboration.''* (Respondent #2). This quotation reveals the necessity for actors to collaborate to make the pilot successful. The importance of collaborations within the niche is also emphasized by car-sharing provider Amigo, who stated: *''We collect partners around us with whom we offer a complete mobility ecosystem. Because if you want to offer the appropriate mobility throughout a person's entire life, you cannot achieve this alone. So, we gather partners around us who align with our strategy, so that we can, as a consortium, offer mobility from the cradle to the grave.* (Respondent #1). This quotation reveals the interdependence between actors around the niche to implement shared cars in the existing automobility system successfully.

Moreover, the users are particularly essential for the business models based on close-community car-sharing. Car-sharing provider OnzeAuto explained that recruiting new users is demand-driven, where people have to activate their neighbours to join the closed community shared car group. Therefore, the respondent from OnzeAuto expressed the importance of providing information to these residents by organizing, for example, information evenings. Further, car-sharing provider OnzeAuto has employed neighbourhood coaches who coordinate the community cars as well as keeping personal contact with its users, as she explained: *''I am a neighbourhood coach and I feel like I know all of these people. We call every new car sharer, which is quite a time-intensive process of course … This personal contact is also an incentive for those people to introduce themselves personally in a Whatsapp group and to be more involved within the community group. And if, for example, the group wants a towbar or bicycle carriers, we will participate in thoughts with them. It is a very personal concept, I know almost all my car sharers who are in my neighbourhood personally, so that is*

very nice.'' (Respondent #4). This quotation reveals the importance of listening and communicating with users to offer the best possible service to recruit and retain users.

The respondents from the regional and municipal governments explained their involvement in a broader network of collaborations and initiatives that have emerged around car-sharing in recent years. For instance, the corporation scheme ''Goedopweg'' in which the Province of Utrecht, the municipality of Utrecht and Amersfoort, and the Ministry of IenW collaborate, is regarded as an essential programme to stimulate car-sharing. Moreover, the ''Green Deal Autodelen'' is a collaboration between public and private actors to accelerate the transition towards car-sharing (Kamp & Mansveld, 2015).

Despite the abundance of initiatives to facilitate cooperation and coordination between different actors, the respondents expressed concerns about the knowledge gap between urban and rural areas, as the respondent from the Province of Utrecht stated: *''During the first meeting of Goedopweg, it became clear that the municipality of Utrecht and Amersfoort are already at a further stage. And municipalities in rural areas ask questions, such as: What is shared mobility? Is there a demand for it? Do we have the resources? These municipalities are thinking on completely different levels. As a Province and larger municipalities, I think we have to spread the knowledge to give smaller municipalities a helping hand. I think this is a very crucial role for the Province to contribute to this.''* (Respondent #7). This quotation reveals the importance of national cooperation. Recently, a national programme is introduced to improve the harmonisation of car-sharing in The Netherlands (State Secretary for IenW, 2022). However, these connections are still in their early stages and need further development.

b. Market formation

The market formation can be distinguished between the supplier and the consumer side. The car-sharing providers consider the niche small, immature, and unpredictable. The early adopter users are reached, but the market has yet to move beyond this stage. All of the car-sharing providers recognize the difficulty of reaching this untapped market. Car-sharing provider OnzeAuto explained how they have not reached their full potential yet but lack resources to reach the great mass of users: *''We would like to reach the masses. And, especially, the power of persuasion, why those people do or do not participate and how they can be persuaded to share a car with their neighbours. We still lack knowledge to full persuade people, and I think this does not apply only to our company, but also to other car-sharing providers. The early adopters are already on board. Achieving the great masses will be a problem in the coming years because they might have completely different reasons to participate. We want to gather as much information as needed, but, at this moment, we have not yet invented the golden egg for that.''* (Respondent #4).

The respondent from the Province of Utrecht explained how the difficulties in reaching the great mass can be characterized as the ''chicken and egg'' problem, which makes any take-off difficult: *''The demand will only increase when the supply is there, if there is a good alternative. Or vice versa… There will be enough alternatives in the long term, but we are now*

in a phase without many alternatives, making it very difficult. But I think, in the end, you will reach the great mass when more alternatives arise. We have to cross that threshold.'' (Respondent #7). This quotation implies that only sufficient suppliers could increase user adoption rates. The number of suppliers determines, for instance, the availability and accessibility of shared cars, leading to a higher attractiveness for people to become car-sharing users.

However, the supply side of the car-sharing market encounters some challenges nowadays, which can constrain new market entrants and, thus, the upscaling of shared cars. For instance, the business models are risky due to the low-profit margins (BOVAG & KPMG, 2022). In addition, the car-sharing providers mentioned how the procedures of municipalities form a barrier to scaling up. Car-sharing provider Amigo describes how the slow progress in drafting new policies around shared mobility inhibits the growth of car-sharing: *"I recently spoke to the municipality of Haarlem, who said, we are going to write a shared mobility policy document, so, that everyone within the municipality knows where we stand. And then I asked when it would be finished. He responded that I should count on 2024. That will, of course, impede our growth enormously.''* (Respondent #1). This quotation reveals how the municipalities' procedures can constrain the supply of shared cars.

4.1.3.2. Learning processes

Learning processes refer to (a) knowledge development and diffusion and what knowledge is missing in the niche. Further, it demonstrates to which extent and in what ways the knowledge is shared between the actors around the niche. The various learning processes in the niche focus on: (b) policy, (c) technology & infrastructure, and (c) society.

a. Knowledge development and diffusion

The level of knowledge and expertise in car-sharing varies significantly between rural and urban areas. The respondent from the Province of Utrecht mentioned that small municipalities in rural areas lack knowledge compared to those of Utrecht and Amersfoort. The Province of Utrecht is trying to close this knowledge gap with the regional collaboration programme ''Goedopweg''. Other respondents also highlighted the importance of having a harmonized national approach. ''GreenDeal Autodelen'' is considered a vital network where diverse actors come together and share knowledge on a national level. Moreover, in 2023, a new cooperation scheme will be introduced, including local and regional governments, the Ministry of IenW, and BZK (Ministry of the Interior and Kingdom Relations). This scheme is aimed to give directions for uniform market conditions (harmonisation and standardisation) to create a coherent approach and direction for shared mobility. The respondent from the Province of Utrecht also mentioned an international cooperation scheme to share knowledge regarding shared mobility. He described the purpose of the international collaboration: *''Each party focuses on a subpart of the entire mobility story. Some parties investigate very closely how you can generate data and gain insights from it. Other parties investigate mobility hubs in rural areas and how they can increase the accessibility of a city within the region. So, all*

these international parties investigate different components. In this way, you can learn from each other; it is mainly about developing knowledge.'' (Respondent #7). The diverse set of cooperation schemes on different levels indicates a relatively high level of knowledge sharing between niche actors.

On the contrary, car-sharing providers mainly mentioned collaborations for operational objectives. The application providers are essential partners in offering customers an app with the features necessary for convenience and easy accessibility. Further, collaboration with municipalities is crucial to receiving permits for parking spots, charging stations, and other location-specific issues. Car-sharing provider OnzeAuto consider regular brainstorming session with actors from the market and municipalities crucial to stimulate knowledge-sharing. However, multiple car-sharing providers have expressed some difficulties communicating with municipalities. For instance, the car-sharing provider Amigo describes a situation where persons within one municipality take a different approach, leading to confusion. The respondent from the Utrecht municipality also considers the variety of approaches between municipalities as a problem. He did research into the implementation of new products in the supermarket and new shared mobility services and made a comparison to illustrate this problem: *''When you want to introduce a new product, you give a pitch to a supermarket, and if they approve, your product might be introduced in 300 supermarkets at one time. While, in the mobility sector, you need to talk to every supermarket manager with their own opinions and demands. In reality, these are the different municipalities with, for example, different charging station concession, and more.''* (Respondent #6). This quotation illustrates the time-intensive process for car-sharing providers to scale up. Further, he mentioned a new Amsterdam municipality approach to improve collaboration with car-sharing providers. They have introduced a separate department with innovation-minded people who can better develop knowledge about car-sharing and share it with other actors from the niche, particularly with car-sharing providers.

Nevertheless, the car-sharing niche needs to learn about users, particularly how to bridge the gap between early adopters and the masses. Therefore, car-sharing provider Century explained the importance of studying the behaviour of car-sharing users: *''It remains difficult to know what the user wants. You have to talk with them, but it is hard to find the exact channels to reach them … We are still finding out how we can estimate that customer group as accurately as possible, but that is simply not possible within 4 months, so we have to build this''*. (Respondent #3). This quotation implies that the data on current car-sharing usage is not enough, and more studies have to be conducted to understand the behaviour of car-sharing users.

Moreover, privacy regulation is a significant barrier to diffusing knowledge within the niche. The municipality of Utrecht experiences a barrier to improving car-sharing policies due to the need for consumer data. Many car-sharing providers are hesitant to share consumer data with governments and competitors. Car-sharing provider Amigo also expressed the importance of sharing data for upscaling car-sharing: *''You need a kind of data lake to which all those mobility providers are connected. Otherwise, you do not know what and when your*

customer needs something. You will be able to find that out based on data. Moreover, it should feel like one system, it has to be flawless for that customer, because if it is too difficult, people will not join.'' (Respondent #1). This quotation shows how an integrated system where different mobility providers can share their data is an important factor for car-sharing.

b. Policy & regulatory framework

Most of the car-sharing providers mentioned their dissatisfaction with current car-sharing policies. In particular, inconsistencies and incomplete policies were considered significant barriers to scaling up their fleet. Car-sharing provider Amigo explained the vital role national policies play in stimulating car-sharing: *''You see that our government system, in this area, is organized decentral. So, the province and the central government point the finger at municipalities. But shared mobility should be tackled nationally, make a statement regarding shared mobility, and make more stringent environmental policies. So, regulation is extremely important and I believe the government plays a key role in this whole thing, they can make or break it. The longer it takes for regulation to be in place, the more mobility providers and start-ups will fail.''* (Respondent #1). This quote illustrates the importance of national harmonisation in supporting local authorities and cities to draft a consistent car-sharing policy.

The respondent from the municipality of Utrecht highlighted some important developments, such as implementing p2p platforms in new policies. However, closed-community car-sharing plays a minor role in shared mobility policies. Car-sharing provider OnzeAuto expressed her concerns: *''The policies regarding the assignment of charging stations is mainly aimed at open platforms, for which everyone can register. So, the permits are often aimed at that everyone must be able to register and otherwise you do not get a permit. This policy needs to change by including close-community car-sharing platforms. Because we do not exclude people from our platform.''* (Respondent #4). In response, the respondent from the Utrecht municipality explained the complexity of closed-community sharing: *''As a municipality, it is complex to deal with closed-community sharing, because you want car sharing platforms (which are active in the public space) to exclude no one. But on the other hand, we do see potential in the closed-community shared cars, because there is a group that has the explicit need to share in a small circle.''* (Respondent #6). This illustrates the influence of local authorities and cities on the growth of the closed-community car-sharing business models.

Respondents from the provincial, municipal, and company levels consider restrictive policies as a significant instrument to discourage private car ownership. A mobility consultant explained how increasing parking norms curb car ownership: *''If you start applying lower parking standards, people suddenly will search for alternatives, because they cannot easily park their car anymore. Then, people suddenly start thinking about how they can travel more easily, for example, by train or a shared car becomes an option. This illustrates that a municipality can influence the attractiveness of shared mobility through their parking policy.''* (Respondent #8). Moreover, the Utrecht municipality discourages car ownership by building

low-traffic districts with a reduced ''parking norm'': parking spots per household. Merwede is an example of a low-traffic district where shared mobility is offered to the residents.

However, car-sharing growth would be limited if only focused on restrictive policies. Therefore, it is essential to focus on stimulating policies simultaneously. For instance, car-sharing provider Century expressed their desire for standardized and simplified procedures for requesting charging stations and parking spots: *''For another project, I do notice that it takes weeks before you have a reserved parking spot, and this hinders the placement of a shared car or that you can place it flexibly. There are a lot of procedures involved, so this should be made way easier.''* (Respondent #2). Stimulating policies should also focus on the involvement of users. Car-sharing provider OnzeAuto described how car-sharing users could be rewarded by placing trees in their neighbourhood in return for removing parking spots. This is not a policy yet, but OnzeAuto hopes municipalities will join this initiative. Some municipalities are considering this at the moment, according to the respondent from OnzeAuto. Eventually, it is essential to draft a consistent and complementary set of policies to discourage car ownership and stimulate car-sharing.

c. Technological development & infrastructure

Developments in technology are vital for the growth of car-sharing. Car-sharing provider Amigo explained how information and communication technology could help develop trust between people, which is vital for adopting car-sharing: *''I believe that car-sharing is about trusting each other. You trust the people around you, your friends, your family, because you know them. I think technology can be helpful to increase our trust in other people … A rating system where people can rate each other in a community makes the switch to another community easier. They say, this person is trustworthy, and then, another community will sooner accept new people. This results in bigger circles of trust between people. So, technology can help to grow the car-sharing concept exponentially.''* (Respondent #1). Additionally, he considers Artificial Intelligence an important technological development to ensure optimal car availability for users. Moreover, it will ensure an optimum occupancy rate allowing car-sharing providers to have a profitable business model.

Most respondents also regard the development of electric vehicles and the related ecosystem as a crucial learning process affecting car-sharing. Two of the interviewed car-sharing providers already operate a fully electric vehicle fleet, relying on the sufficiency and technological development of charging infrastructure to increase the supply of shared electric cars. Car-sharing provider Century explained how this affects their operation: *''The number of charging stations is still fairly insufficient, and we run into reliability issues. We are 100 percent dependent on charging stations since our vehicle fleet is exclusively electrically driven.''* (Respondent #2). Other car-sharing providers expressed concerns about whether the grid can handle an increasing number of electric cars. Thus, the scaling up of electric car-sharing relies significantly on the development and availability of charging infrastructure.

Another important technological development is the introduction of MaaS apps. The majority of the respondents consider MaaS apps as an important driver for shared mobility.

It makes it easier for users to travel multimodally without downloading multiple apps. Moreover, according to a car-sharing provider (Respondent #1), the MaaS app can attract new users who will use shared cars to complement other ways of travelling. This is supported by the respondent from the Province of Utrecht, who explained that car-sharing growth depends on accessibility to other modes of transport: *"Car-sharing will take place in a chain journey, where multimodal transport plays a large role. So, for example, if you take a train and for the last kilometres, you can use a shared car or a bike. We have to look more into the connections between different modes of transport."* (Respondent #7). This quotation reveals the impact of infrastructural development on car-sharing.

d. Societal learning

Various respondents (e.g., car-sharing providers, municipalities, mobility consultants) have highlighted the importance of social learning for the broader acceptance of car-sharing. The social learning processes refer particularly to changing the auto-minded culture and stimulating the willingness to get rid of the car. This societal learning process could be stimulated in a diverse set of ways. A mobility consultant explained how 'nudging' can positively stimulate people without prohibiting the ownership of cars: *"Currently, there is often a shared car somewhere in the public space which is only noticeable by its stickers. But if you build a hub, it does not even have to be a large hub, where two shared cars, a scooter, and a bike is placed. The hub will make the shared vehicles more visible. People walk by and people think, hey, shall I use it too? Nudging can improve the awareness and attractiveness of shared mobility."* (Respondent #8). Mobility hubs could eventually lead to a larger user base.

On the contrary, car-sharing provider Amigo emphasized the need for monetary incentives to stimulate behavioural change among Dutch citizens. He highlighted the embedded culture of owning a car and the low willingness of people to get rid of their cars. The high car ownership rates among Dutch citizens are an obstacle to car-sharing.

Another important aspect is trust and familiarity with car-sharing. According to car-sharing provider Amigo and OnzeAuto, closed-community sharing services can solve this based on local familiarity and community building. The respondent from OnzeAuto explained how the social barrier of sharing a car disappears in a closed-community car-sharing platform as the closed community group stimulates socially accepted behaviour without excluding anyone: *"Every neighbour is allowed to register in our system. The main thing is that neighbours get to know each other and therefore take each other into account. For example, being back on time and returning the car clean are two major advantages. In anonymous, open systems, this is not always the case."* (Respondent #4). However, the respondent from OnzeAuto also expressed her concerns about the familiarity of closed-community car-sharing, as she stated: *"The municipalities have a page on their website about shared mobility and shared car, which is a good thing. But we, as a closed-community platform, are not mentioned on their websites yet. While it is very important that people know they can share in a different way too."* (Respondent #4). As a result, many people recognize the more prominent operator's cars on the street, while the community cars are invisible.

The societal learning process can also be stimulated by offering education and information about car-sharing. According to car-sharing provider Amigo, the average car owner underestimates private car ownership costs and consequently finds car-sharing too expensive. The information about the financial expenses of different transport modes should become more easily accessible to raise awareness. Further, a mobility consultant (Respondent #8) highlighted the transition from one life phase to another as an important point to educate people. For instance, a driver's license could be an important turnover point to provide information and educate about car-sharing. In line with this, a good example should be set to convince more people to adopt car-sharing, as the respondent from the Province of Utrecht stated: ''*We need some pioneers who think it is fine to live in a low-traffic neighbourhood, and then eventually, other people might think, oh okay, but if you do it like that, then it is possible, I might also get rid of my car. Anyway, that is kind of how I hope it goes.*'' (Respondent #7). Another respondent, a mobility consultant (Respondent #8), argued the involvement of younger generations in normalizing car-sharing within society. He gives the example of placing shared cars at sports clubs. Thus, education plays a crucial role in stimulating car-sharing within society.

4.1.3.3. Expectations

Articulating expectations and visions is crucial to gaining attention and resources from other actors, and additionally, it can guide learning processes in technology, policy, and society. The success of the niche can be determined by the extent to which the involved actors have developed similar expectations and visions.

The interviews with car-sharing providers have revealed the uncertainty concerning the development of the car-sharing market. Car-sharing provider Amigo describes the car-sharing market as infantile and unpredictable: ''*It is still very unpredictable. You can work out a few scenarios and extrapolate where it goes. But this depends largely on the government, and how quickly people want to share things with each other.*'' (Respondent #1). This quotation illustrates the multitude of factors influencing the growth of the car-sharing market, making it hard to articulate expectations and visions.

Despite the niche-building activities suggesting an effective development of the car-sharing niche, the niche diffusion is rather limited. A network study of the automotive retail industry by BOVAG & KPMG (2022) has stated that the shared mobility market will grow by 26 percent annually until 2030, but the absolute size will remain limited. Additionally, the respondent from Nissan revealed some participation in car-sharing pilots and increasing competition between different incumbents but a relatively low integration of car-sharing in the current business model. This suggests a relatively minimum influence of the niche in transforming, substituting, reforming, or reconfiguring the incumbent regime.

Further, the municipality of Utrecht formulated the ambition to make shared mobility, including public transport and biking, the norm with regard to private cars. These goals and ambitions are articulated in diverse rapports, such as the ''Mobiliteitsplan 2040'', which is

developed by residents, community organisations, employers, knowledge institutions, the province, various municipalities, and the national government (Gemeente Utrecht, 2021). The municipality of Utrecht also articulated its vision in documents, such as action plans and strategies for shared mobility. These formal documents are crucial to articulate its vision to other actors from the niche and guide the niche's learning processes.

However, the interviews revealed a misalignment of expectations between the municipality of Utrecht and closed-community car-sharing providers. From the municipality's side, car-sharing services have to be accessible to everyone through open platforms. While the business model of Amigo and OnzeAuto is based on shared cars that are only accessible to a closed group of people. The misaligned vision of the type of business model could slow down the learning processes. Car-sharing provider Amigo explained how the closed-community car-sharing platform enables the social learning process of sharing a car with others: *''Car-sharing is based on trust. You lend your car to a friend, for example, but not to a random stranger on the street, because you are afraid that the car will get damaged or dirty. As a car is quite a big purchase. We believe that if you start sharing your car with people you know, you will gain trust and confidence in our model, and then, it becomes easier for people to share their car with strangers as well.''* (Respondent #1). This quotation shows how closed-community car-sharing platforms can enable the social learning process of gaining trust in the sharing concept.

Interim conclusion of MLP-based analysis
In conclusion, the MLP-based analysis reveals how the internal niche processes have led to a minimal change to the incumbent regime. Instead, the landscape pressure concerning environmental sustainability reconfigured the regime towards a cleaner and more sustainable automobility system, predominantly around the electric vehicle. Therefore, the MLP-based analysis serves as a foundation for interventions to reconfigure the automobility regime towards car-sharing, such as (a) the development of MaaS apps to stimulate multimodal transport, (b) changes in parking policies to discourage car use and stimulate car-sharing use, and (c) providing education to increase the society's trust and familiarity in the car-sharing concept.

4.2. SPT-based analysis

The practice of car ownership and car-sharing includes three elements based on the SPT framework by Shove (2003): (a) material, (b) meaning, and (c) competences. In addition, the changes in (d) practitioners and (e) related practices reveal how car ownership and car-sharing practices can emerge, grow, and end. These five main themes illuminate how everyday automobility practices are reconfigured when switching from ownership to use, presented in *Table 7*.

Table 7.
Comparison of embedded automobility practices and emerging car-sharing proto-practices

Element of Practice	Embedded automobility practices	Emerging car-sharing proto-practices
Material		
The car	Physical comfort, safety, reliability, clean car	Variety of cars, choose car based on activity, destination, or personal preferences, physical comfort, clean car
Cargo	Permanent storage, auxiliary equipment (e.g., caravan, bike), child seats	Car based on type of cargo
Technological interface	n/a	Online apps/platforms, keyless system or physical key exchange
Meaning		
Freedom, flexibility & convenience	Autonomy, fast, a basic need, mobility, access to all destinations, time-space flexibility	Pay for use, restriction on destinations and time, access to car in different cities, one-way trips, the variety is valued, use different cars for different occasions, alternative to public transport
Availability	24/7 availability, daily mode of transport, car visible from home, sense of security	Non-routine mode of transport (occasional use), car on walk/bike distance
Social relations	Social status, visit friends and family, loyalty to brand, no car-sharing users in immediate network	Community feeling, visit friends and family, car-sharing users in immediate network, (lack of) solidarity, trust
Sustainability	Car ownership is non-sustainable	Pro-environmental behaviour, do not want to own a car

Competences

Planning activities	Perceived/actual difficulty of booking a car, last-minute travel plan	Planning car trips last-minute or weeks in advance, booking experience, knowledge on available cars,
Financial capabilities	Depreciation, maintenance, insurance, fixed costs, unawareness about car expenses	Variable costs, compare expenses of different modes of transport, awareness of expenses
Use of app	n/a	Use of multiple online apps/platforms, online payments
Vehicle operation	Frequent/Experienced driver	Infrequent/less experiences driver, drive a range set of cars, electric driving, competence building, use of supporting infrastructure (e.g., parking, keys)

Practitioners

Life stage	Student, (start of) professional life, starting a family with children, retirement	Professional life, one or two person household
Trigger events	Move to a town with a poor public transport connection	Homeworking after COVID-19, live healthier, switching jobs, expensive maintenance costs

Related practices

Parking	Free parking spot nearby house, plenty parking space, private driveway	Expensive parking permit, little parking space
Residency	Living in a town	Living in Amsterdam, Utrecht, Delft
Leisure activities	Swimming once a week, playing golf 1-2 times a week, transport bicycle, day trips, long holidays	Surfing once a month, higher barrier to use a car for day trips, holiday with friends

4.2.1. Material

The empirical data of the respondents (car owners and car-sharing users) from the Netherlands related to the first theme of material included the following topics: (a) the physical entity of a car, (b) cargo, and (c) the technological interface.

a. Physical entity of a car

One of the core material elements that will change by car-sharing is removing the physical presence of a car when it is not actively being used by a practitioner. In contrast, a privately

owned car takes up space regardless of the amount of use. In line with this, car-sharing user Dylan explained how privately owned vehicles are unnecessary: *"I think it is a shame that so many people own a car. They stand still most of the time. I think there is an advantage to be made if we all divide it better. Then you need fewer cars."* (Respondent #14). This quotation illustrates how the shift from ownership to use can result in more efficient use of vehicles and reduce the number of vehicles necessary.

The material element also includes a car's physical comfort, which applies irrespectively to owning or using vehicles. Car-sharing user, Felicia, who lives in Amsterdam, emphasized the importance of physical comfort while choosing one of the many car-sharing services in her neighbourhood: *"I prefer the Sixt cars, even though they are more expensive than some alternatives. They just drive more nicely and smoothly compared to other shared cars."* (Respondent #12). The interviews with car owners also revealed the importance of physical comfort while purchasing a private car.

Next, car owners regularly state the importance of the safety and reliability of a car. Simultaneously, they expressed uncertainty about whether a shared car can offer the same safety and reliability as their own car. Recent car owner Nikki expressed her concerns about this: *"I am relatively an unexperienced driver, so when I hear something rattling, I quickly assume that the car is broken."* (Respondent #18). She further explained how she perceives her own car as safe and reliable, which does not apply to a shared car. This quotation implies that the uncertainty regarding the safety and reliability of shared cars can inhibit the shift from ownership to use. Remarkably, the interviewed car-sharing users have not expressed any concerns or inconveniences regarding the safety and reliability of shared cars.

Further, car owners are inclined to purchase a car based on personal preferences. For instance, car owner Guus explained how he chose his current car based on his physical condition: *''I am getting older, and therefore I prefer to have a car with a higher entry''.* (Respondent #17). He expressed his concerns about his ability to drive a smaller, less luxurious shared car. This quotation reveals how car owners value specific features of their private cars and could inhibit the switch from ownership to use.

Notably, the physical artifacts and infrastructures of car-sharing are similar to the existing automobility system of privately owned cars, such as vehicles and roads. Instead, the difference between car-sharing and private cars is rooted in the communication and development of new technologies, which will be discussed in *Section 4.2.1. c.*

b. Cargo

Besides the physical space of cars, it also provides space for different types of cargo. For car-sharing users, the material importance can be roughly distinguished in two ways. Firstly, shared cars are used to transport goods that are too heavy or too large for public transport, i.e., Ikea furniture, second-hand furniture, surfing board, and large groceries. Car-sharing users value the flexibility in choosing a shared car based on the type of cargo. As car-sharing user Wietske stated: *"If I want to take a surfboard with me, I choose a station wagon. But when I just go to work, I choose a Fiat 500 that drives very economically. And when I had to*

move from office, then I just chose a van.'' (Respondent #11). Secondly, shared cars are used to transport goods outside the public transport connection, i.e., holidays or weekend/day trips.

Although car-sharing users value cargo space, private car owners expressed the most substantial feelings about cargo. For instance, car owner Kees is a regular golf player who finds it convenient to use his car to store golf equipment permanently. He explained: *"I do not have to carry it from my car to my house, and the next day as well, I can just leave my equipment in my car".* (Respondent #21). Car-sharing inhibits permanent storage as everything must be removed before returning the car.

Further, a tow bar is a crucial factor in owning a private car. Car owner Guus is retired and cycles regularly across the Netherlands. He explained the importance of the presence of a tow bar to transport his bike. Similarly, car owner Betty spends multiple weekends and holidays on camp sides with a caravan and therefore owns a car with a tow bar. This indicates that the absence of a tow bar affects the potential use of car-sharing.

Additionally, child seats represent a compulsory material element for most households with small children. According to respondent Betty, it would have been inconvenient to have not a permanent space for the child seats, as she stated: *''They are heavy, and not nice to carry them from your house to the car every day, with all the stuff you are already carrying with one or two children.''* (Respondent #20). This quotation suggests that the absence of child seats in shared cars affects the potential use of car-sharing, particularly for families with young children.

c. Technological interface

Online apps and platforms are integral to car-sharing and are a critical material element of the car-sharing practice. The various car-sharing apps allow users to register, find cars, book cars, and communicate with the service provider (b2c) or car owners (p2p). The development of online apps has improved the service of car-sharing significantly. For example, it has decreased transaction costs. Car-sharing user Maike stated that she used to rent a car regularly but has noticed a significant improvement concerning time and money when switching to car-sharing. The online apps thus complement the practice of car-sharing to operate transparently, smoothly, and easily.

Furthermore, the online apps allow users to enter the vehicle through a remote electronic lock. Only p2p service providers sometimes require physical interaction with the car owners to exchange the keys at an agreed time and place. However, the p2p platform Snappcar has introduced a keyless system where physical interaction between the user and owner is no longer necessary. The keyless system has made shared cars more easily accessible. Car-sharing user Joran explained how the introduction of the keyless system has offered him more flexibility and convenience: *''This keyless system makes a difference for me, I have around 10 cars around the corner, maybe 5, which I can rent fairly easily without an appointment. In the past I have also done it by appointment, which is not a problem in itself, but then you need to coordinate when you arrive, and do the key transfer. That is way more*

difficult''. (Respondent #15). This quotation illustrates the complementary of technological interfaces with the practice of car-sharing. However, car-sharing user Maike prefers to arrange a physical meeting beforehand to build a trusting relationship with the car owners.

The car-sharing providers also play a critical role in the customer's experience regarding the keyless system and customer service. Car-sharing users have expressed the importance of communicating with the providers to access technical support, such as unlocking the car, battery problems, and lack of fuel.

4.2.2. Meaning

Car-sharing requires a shift in the meaning of mobility compared to private car ownership. The empirical data of the respondents from the Netherlands related to the meaning elements includes the following topics: (a) freedom, flexibility & convenience, (b) availability, (c) social relations, and (d) sustainability.

a. Freedom, flexibility & convenience

Existing automobility practices are associated with freedom, time-space flexibility, convenience, mobility, access to all destinations, autonomy, and a fast way to go from a to b. Above all, a private car resembles a feeling of freedom for its practitioners, which other transport modes cannot replace. For car owner Kees, a private car even feels like a necessity of life, as he stated: *''I just bought a car, I did not think about that, it is just a necessity of life, freedom, and mobility''.* (Respondent #21). This quotation indicates a private car as part of someone's identity. However, a shared car can mimic the freedom of private car ownership, as car-sharing user Joran explained: *''I feel very free to have access to a shared car at any time, walk to it, and drive away''.* (Respondent #15). For other car-sharing users, the shared car adds to the sense of freedom through its complementary with other modes of transport, such as public transport and biking. For instance, car-sharing user Felicia prefers to use a shared car instead of biking when it rains, demonstrating the additional freedom shared cars can offer their users. Regarding the time-space flexibility of the automobility practice, car-sharing user Dylan stated that car-sharing offers more flexibility relative to a private car, particularly in a city like Amsterdam, as he describes the following situation: *''… like this weekend, I had an activity which also involved drinking. And well, grabbing a shared car is then ideal, … and if you stay within the boundaries of the city, you can just park it wherever you want, and then, on the way back, I can take a cab or public transport.''* (Respondent #14). This quotation illustrates how one-way trips can improve time-space flexibility, particularly in cities.

However, the restriction on time and destinations is an essential downside of car-sharing. Multiple respondents described inconvenient situations due to time and parking restrictions, sacrificing some flexibility, freedom, and convenience. For instance, car-sharing user Felicia could not travel from Amsterdam to Utrecht with a b2c shared car. Moreover, car-sharing user Dylan was not allowed to park a shared car nearby a friend's house due to parking restrictions. Additionally, time restrictions on car-sharing apps vary, and users must consider this. Snappcar offers only cars for half or whole days, while SHARE NOW provides cars for

fifteen minutes. Therefore, car-sharing user Wietske combines multiple activities using a shared car from Snappcar to use time efficiently and save costs. However, this constrains her freedom to go whenever and wherever she wants.

b. Availability

The shift from ownership to use requires a shift in meaning from the daily use of cars to the occasional use of cars to perform daily activities. The interviewed car owners expressed the importance of private car ownership in their daily lives. As car owner Vrouwkje stated: *"If I do not own a car, I will not go to my fixed weekly swimming lesson, I refuse to bike because of my safety and wet hair."* (Respondent #19). Similarly, car owner Nikki stated: *"If I do not own a car, I would not be able to go to my work four times a week; there is no other option for me."* (Respondent #18). These quotations reveal the dependency on car ownership to perform their daily lives as they do not believe other modes of transport can replace their private car trip. On the contrary, car-sharing users use a variety of transport modes to perform their daily life and are therefore not dependent on a car. This is illustrated by car-sharing user Felicia who commutes by train and uses her bike for other daily activities. Further, car-sharing user Klaas had recently switched from car ownership to use and describes how his use of a car had significantly changed: *"When I owned a car, I did everything by car, shopping, commuting, and now I just do more on the bike and by public transport."* (Respondent #13). This quotation implies that car trips are significantly reduced and replaced by other modes of transport when switching from ownership to use.

Further, the shift from ownership to use requires a shift in meaning regarding the availability of a car. Car owners perceive a car as a mobility option that is available 24/7. Multiple car owners expressed the importance of owning a car available at any time of the day. As car owner Vrouwkje describes how a private car gives her a sense of security as she can leave with her car any minute*: "We have parents with poor health, and when they are not feeling ok, I want to be able to go there at any time."* (Respondent #19). This quotation reveals the subjective reasoning for owning a car rather than objective reasons, such as commuting or poor access to public transport. On the other hand, car-sharing users did not mention any concerns regarding the limited availability of shared cars. Various car-sharing users state that they have access to a shared car within an hour, and a car-sharing user from Amsterdam can have access within 5 minutes. It can thus be suggested that the perceived limited availability of shared cars can inhibit the practice of car-sharing.

Moreover, a car's location plays a crucial role in the shift in meaning from ownership to use. Most car owners value the presence of a car in their streets or driveway. For instance, car owner Betty explained why she prefers a car within 10 metres: *"If I have large groceries, I do not want to walk 5 minutes before I am home."* (Respondent #20). On average, car owners are willing to walk for max. 5 minutes to a shared car, while car-sharing users are willing to walk or bike for 15 to 30 minutes. The difference in willingness to travel to a car between car owners and car-sharing users demonstrates how this becomes an integral part of the car-sharing practice.

c. Social relations

The respondents associate a car as a way to maintain connections with family and friends. Car owner Betty describes how the car is the only option to visit her parents and parents-in-law: *"It is a long drive, in total approximately 5 hours, and the car is the only option to spend time with them without an overnight stay"*. (Respondent #20). Similarly, car-sharing user Klaas uses a shared car to visit his family, which is the best option for time management and connectivity. This indicates the dependency on a car for social interactions irrespective of ownership or use.

Further, car-sharing is often associated with a feeling of community. The practice of car-sharing is reinforced due to good communication with private car owners on p2p platforms. Car-sharing user Wietske describes how she enjoys being in touch with like-minded car owners, suggesting the importance of being in contact with a community and how this becomes part of the practice of car-sharing. Moreover, car-sharing users were often recruited to car-sharing based on the experiences and recommendations of family and friends. One respondent is also eager to tell his friends and family about car-sharing and is proud to be a car-sharing user. In contrast, car owners are often part of a network without car-sharing users and therefore lack the peer support and the feeling of community to switch from ownership to use. As car owner Vrouwkje stated: *"Nobody in my neighbourhood does car-sharing, so I don't do it that quickly either."* (Respondent #19). This illustrates the importance of social support and the feeling of community to recruit new users for car-sharing.

In opposition to this, the interviewed car-sharing users experienced a lack of solidarity a few times. The lack of solidarity becomes visible when the respondents are dissatisfied with other users. Dirty and stinky cars were among the most cited inconveniences of car-sharing. For instance, car-sharing user Dylan describes a situation where he was dissatisfied with the previous user: *''Sometimes you have someone who previously used the car and who went to the MC Drive in that car, and eats it right before you get in, then the whole car stinks, this is not so nice.''* (Respondent #14). Another car-sharing user, Klaas, described a situation where he first had to go to the car wash before the car was presentable to pick up some friends. These experiences from car-sharing users demonstrate how the retention of the car-sharing practice depends on the sense of solidary among the users.

d. Sustainability

There was a consensus among the respondents regarding the connection between private car ownership and environmental pollution, including the use of materials, CO_2 emissions, and air pollution. However, most car-sharing users consider the environment as a minor determinant in performing the practice of car-sharing. Remarkably, most car-sharing users feel obliged to mention the importance of the environment. In contrast, the decision to use car-sharing was often related to personal considerations, such as costs and convenience. One respondent, car-sharing user Wietske even expressed her scepticism about the perceived environmental benefits of car-sharing, as she explained: *"Because of the fact we use Snappcar, that is not really good for the environment, because if I take a car, I still don't take*

the train, and then I actually think the train is environmentally better.'' (Respondent #11). This suggests that the environment was not a significant factor in the emergence of the car-sharing practice for these car-sharing users.

However, two respondents strongly emphasized the importance of sustainability in performing the practice of car-sharing and aimed never to own a car in their lives. Car-sharing users Maike and Joran perceive car-sharing as a solution to their environmental concerns about car ownership. Car-sharing made it possible to use a car for specific purposes, such as moving large cargo or poor public transport connectivity, instead of daily use. Car-sharing user Maike described only a few situations where she uses a shared car as she prefers to use more sustainable transport options, such as public transport, biking, or walking. These environmentally aware car-sharing users demonstrate how sustainability can be an integral part of the practice of car-sharing.

4.2.3. Competences

The car-sharing practice requires a new set of competences. Based on the interviews conducted, the third theme of competences includes the following topics: (a) planning activities, (b) financial competences, (c) use of apps, and (d) vehicle operation.

a. Planning activities

Switching to car-sharing requires a new set of competences related to organizing and planning everyday life to fit around vehicle availability. In contrast, private cars are readily exclusively accessible to their owner, and skills to pre-plan and coordinate daily life are therefore unnecessary for car owners. The acquirement of these new coordination and planning skills can act as a barrier to recruiting new users in two ways. First, the interviewed car owners do not want to spend time pre-planning their activities and making car reservations. Second, the interviewed car owners do not wish to plan their everyday life around the limited availability of a car. These respondents own a private vehicle to be able to make last-minute trips and to be able to decide on their transport mode an hour before leaving based on the weather conditions, traffic jams, and public transport delays. Thus, the ability to plan last-minute trips or changes is an integral part of the embedded car ownership practice and inhibits the switch to car-sharing.

On the contrary, the interviewed car-sharing users have made the booking, reservation, and planning the car trips part of the everyday practice of car-sharing. They do not see it as a hassle or as an inconvenience. Car-sharing user Felicia expressed her thoughts on planning skills: *''I am a planner anyway, so if I know I have plans at the end of the month, then I am going to book it at the start of that month. Just to make sure there is a chill car available.''* (Respondent #12). This quotation reveals that planning was already an integral part of her daily life. Further, car-sharing user Dylan developed additional skills to be able to make spontaneous last-minute trips with a shared car, as he explained: *''My personal solution is that I have multiple car-sharing apps on my phone, and when I check all those apps, there is almost always one shared car available.''* (Respondent #14). Although car-sharing requires

pre-planning and scheduling daily activities, these quotations reveal that the users do not feel stressed or negative about this. This indicates that the competence to pre-plan and coordinate activities becomes an integrated part of their everyday life, and car-sharing users find creative ways to cope.

b. Financial competences

The shift from ownership to sharing requires a change in financial competences. The fixed costs of a private car, including depreciation, maintenance, and insurance, change to variable expenses based on a ''all-in'' price per car trip. This change has some implications for the emergence of the car-sharing practice.

First, car owners are generally unaware of the costs of owning a car and tend to underestimate it. This creates a barrier to recruiting new users, as most car owners believe private car ownership is more financially attractive than car-sharing. This is reinforced by the lack of knowledge of car-sharing costs and how much they could save by switching from ownership to use. Thus, car owners need to gain more insights into the total costs of owning a car to make car ownership less attractive.

Second, most car-sharing users need to develop additional financial competences to cope with the variable costs of car use. For instance, car-sharing user Klaas explained how he developed a new skill of saving money for his occasional car trips: ''*When I owned my car, I could estimate the monthly costs very precisely, but this has become way more difficult for a shared car since I use a car irregular.*'' (Respondent #13). Additionally, another car-sharing user Wietske stated how the transparency of the variable costs per car trip makes it less attractive to use a shared car. Wietske developed the competence of combining different errands per car trip with being more efficient and saving costs. This is also elaborated on by car owner Vrouwkje who admits that she will use a shared car way more efficiently than a private car, as she stated: ''*If you only have to pay when you use a car, maybe I will consider if I really need the car. Or do I really have to drive back and forth three times, which may also be possible at one time.*'' (Respondent #19). This quotation illustrates how the honest fee on car-sharing apps confronts its user with the relatively high costs per car trip, while car owners are less aware of the expenses per car trip. This indicates that car-sharing users must adjust to paying an ''all-in'' price per car trip and develop additional financial competences to save money.

Nevertheless, car-sharing users also mentioned some benefits of transparent variable costs. For instance, many car-sharing users expressed the comfort in knowing the ''all-in'' price of a car trip, including the insurance and maintenance costs. For many users, this has reduced the financial planning needed, as the unforeseen expenses of a private car have been eliminated. Additionally, car-sharing users can better choose the cheapest mode of transport as they can compare the ''all-in'' price of a car with other modes of transportation.

c. Use of apps

The use of smartphones in connection with transportation is a new skill that is required to perform the practice of car-sharing. The use of technology is needed to access, find, book, and pay for shared cars. The interviews made it clear that the respondents are already familiar with and experienced using smartphones for many daily-life practices, such as online shopping, sending messages to friends and family, navigation, etc. Therefore, the skill of using an online app in daily life has already been developed and can easily be used for car-sharing services.

Further, the majority of car-sharing users expressed their satisfaction with the use of car-sharing apps. For instance, respondent Wietske explained the convenience of having access to extensive information about the cars on the p2p platform ''Snappcar'', such as the presence of air conditioning, Bluetooth, and other accessories: *''I choose a car with Bluetooth to be able to listen to music, or to make phone calls.''* (Respondent #11). This additional information provided by car owners allows users to pick a car based on personal preferences. Further, the car owner has room to describe some specifics about the car, which can be necessary to drive the car. Moreover, car-sharing user Dylan has expressed his satisfaction with the pop-up function of b2c car-sharing apps that signals if a shared car is available and nearby his house. This additional feature on online apps makes finding a car on time easier without watching on the app every hour. This indicates the crucial role of online apps in making car-sharing more accessible and convenient for its users.

d. Vehicle operation

Car-sharing users must be able to drive different vehicles, particularly for p2p platforms. From the interviews with the car-sharing users, it became clear that the users prefer to use the same car as they get used to the operation and other particulars. Car-sharing user Wietske explained how using the same car enables her to build competences: *''I often choose the same car, because I have already built experience in driving this car, and it feels like my own car, since I know the car from inside out.''* (Respondent #11). This quotation reveals the importance for users to feel comfortable and secure in a car by building familiarity and competences with one or two cars. Car owner and beginning driver Nikki expressed her concerns regarding the operations of a vehicle other than her own car, as she explained: *''I am used to my own car now, I know exactly how it works, and especially with the coupling system, I am always a bit hesitant. So I would really worry about that if I would be able to drive in an unfamiliar car.''* (Respondent #18). Car-sharing users can avoid the skill of continual adjustment to a new car when car-sharing providers offer a consistent fleet of vehicles with enough choices on p2p platforms.

Car-sharing services also offer electric-driven vehicles. For example, Sixt and SHARENOW offer small electric cars in Amsterdam. Car-sharing user Felicia shared her difficulties when driving such an electric vehicle for the first time, as she stated: *''It takes some time to get used to it if you are not used to driving electric vehicles. It feels very much like you are in a bumper car. That's thrilling in the beginning.''* (Respondent #12). Further, electric

vehicles require a specific new type of skill and knowledge for charging the vehicles. Car-sharing user Dylan experienced difficulties plugging a shared electric car into the charging station. Moreover, car-sharing user Maike mentioned how she had to develop the skill for range planning, as she stated: *"I had to get used to electric driving, mainly to take into account the range and to plan when I had to charge."* (Respondent #10). These experiences from car-sharing users imply the necessity to develop new competences to use an electric vehicle to perform the practice of car-sharing.

Moreover, car-sharing users are often infrequent drivers and are, therefore, less experienced drivers. Car-sharing user Maike explained how her infrequent use of cars has affected her driving experience: *"I drive only a couple times per year and I find it scary to use the car after a while and I sometimes feel insecure."* (Respondent #10). This quotation shows how car-sharing decreases the number of kilometres driven, negatively affecting the driver's experience.

4.2.4. Changes in the practitioner

This section describes how the recruitment and reproduction of the embedded automobility practices and the emerging car-sharing proto-practices are associated with (a) life stages and (b) trigger events.

a. Life stages

The sampling of this research ensures that the respondents vary in life stages (e.g., students, professional life, family with children, retirement). The interviews clarified that every life stage entails different mobility needs and patterns. Therefore, the transition from one life stage to another asks for a change in mobility needs and habits, which might be interesting in recruiting new car-sharing users. The different life stages of the respondents will be described, and how it affects their mobility needs and patterns.

First, (starting) a professional life is often accompanied by purchasing a first car or a lease car. For instance, car owner Nikki recently began her professional life with a job in Almere. She explained how time management and convenience affected her decision to purchase a car, as she stated: *"The poor public transport connection between Nieuwegein and Almere was the main reason to buy a car. If I would have a job in my hometown, I would not have bought a car".* (Respondent #18). This quotation shows how the start of a professional life affects car ownership due to practical considerations. In contrast, car owner Vrouwkje has bought her first car only for enjoyable reasons, she explained: *"I did not need a car to go to my work, but I earned enough money, and then I thought, I like to own a car, so I bought it".* (Respondent #19). These quotations suggest that car ownership is deeply embedded in (the start of) a professional life.

After the professional life stage, the life stage of starting a family begins. The respondents stated that their mobility needs and patterns significantly changed after having children. The car was being used more intensively for regular trips to medical appointments, sports clubs, school, etc. Car owner Betty expressed the convenience of owning a car when

having children: *"We used our car mainly for activities with the children, mostly for weekly or daily activities, but also for spontaneous trips and many other things."* (Respondent #20). This quotation reveals this family's daily life being fully coordinated and planned around a private car. Similarly, the interviewed car-sharing users expressed their doubts about reproducing the practice of car-sharing while having children. This illustrates the impact of having children on the practice of car-sharing. Thus, the transition to a life stage with children significantly affects the automobility needs and, therefore, potentially the recruitment and reproduction of car-sharing practices.

Compared to the other respondents, car owner Guus is retired and has different mobility habits and needs. He uses the car mainly for leisure activities, such as visiting family and friends and transporting his bike for cycling tours. On average, he uses his car four hours a week. Still, he doesn't want to share his car or use a shared car. As he explained: *"I want to enjoy my life and I am still mobile, so if I want to go biking with my car, I am doing it without having to take into consideration other people and the availability of the car".* (Respondent #17). This quotation reveals how the life stage of retirement still asks for car ownership since the ability to go everywhere anytime without restriction plays a crucial part in reproducing the practice of car ownership.

b. Trigger events

The respondents have described various trigger events that have affected or can affect a change in their mobility needs and patterns.

Car-sharing user Dylan described how switching jobs has changed his mobility pattern as he stated: *"I had a lease car, but I could get another one with my new job, but my new job is on bike distance, so I decided to make use of a shared car instead of a lease car".* (Respondent #14). The change in jobs thus triggered Dylan to switch from ownership to use as he does not need a private car to commute daily. However, other factors could also have played a role, such as the availability of shared cars or the distance to a shared car.

Moreover, COVID-19 has caused a significant change in mobility needs for several of the respondents. This is twofold; the respondents worked multiple days per week from home, which reduced their car use. In addition, the respondents spent more time on their health by reducing their car use and spending more time walking and biking. The respondents mentioned how this changed mobility behaviour has been largely sustained up until today. The COVID-19 period has triggered the development of emerging car-sharing proto-practices, mainly from daily to occasional car use.

All of the interviewed car-sharing users are from urban areas with good public transport connections and high availability of shared cars nearby their houses. According to these respondents, relocating to a more rural area could result in new mobility needs and habits. Car-sharing user Felicia explained how the accessibility to public transport plays a crucial role in the reproduction of the car-sharing practice: *''I am going to my work in Den Haag by train every day because the train station is nearby my house and it is time efficient,*

but if I did not have this option, I would have bought a car to commute daily to my work.'' (Respondent #12). This quotation shows how the elements that constitute the practice of car-sharing potentially change in rural areas and how this can result in a shift from use to ownership. The importance of residential location will be further discussed in the next section.

4.2.5. Changes in related practices

Automobility practices, both car ownership and car-sharing, are closely interlinked with other non-mobility-related practices. Therefore, the relationship with other practices is a crucial mechanism by which the automobility practice can change from ownership to use. This section will focus on the relationship with the following practices: (a) residency, (b) parking, and (c) leisure activities.

a. Residency

This section will focus on the relationship between residential location (urban areas vs. rural areas) and mobility behaviour. The interviews made it clear that the residential location affects the modes of transport used to perform everyday life.

The respondents living in urban residencies (e.g., Utrecht, Amsterdam, and Delft) rely for a minimum on a car to perform their daily life due to the close distance to many public facilities, such as train stations and grocery stores. The interviewed car-sharing users were all from urban areas and emphasized the importance of their residency in developing car-sharing proto-practices, as respondent Dylan stated: *''The city of Amsterdam offers me a range set of transport options and most of my daily activities are on a walk or bike distance, therefore, I do not need a private car.''* (Respondent #14). Further, car-sharing user Maike stated that her current residence was mainly chosen based on connectivity with public transport and distance to public facilities. Moreover, she emphasized: *''I would never move to a town without this connectivity, I do not want to buy a car''.* (Respondent #10). This quotation illustrates how the emergence of car-sharing proto-practices partly depends on residency.

Additionally, the connection between mobility and residency reveals the meaning car-sharing users give to walking and biking – a feeling of freedom without dealing with traffic jams. As respondent Felicia explained: *''I prefer to walk and bike whenever I can in my everyday life, it gives a feeling of freedom and this is just the way of living in an urban area like Amsterdam''.* (Respondent #12). This quotation reveals how biking and walking correspond with the image of living in an urban area and plays a prominent role in developing car-sharing proto-practices.

In contrast, most car owners are from rural areas and rely heavily on their private cars to perform their daily life. This is mainly due to poor public transport connections and the large distance to public facilities. Car owner Betty stated how she could not picture a life without owning a car: *''I need a car to enjoy a nice life, because other transport options are always less convenient and less easy to use compared to a private car.''* (Respondent #20). This quotation

shows how the reproduction of car ownership practices is reinforced by residency. Therefore, the connection between mobility and residence is integral to the shift from ownership to use.

b. Parking

The practice of parking is closely connected to the automobility practice, both for ownership and use. From the interviews, it became clear that the presence of parking spots affects the shift from car ownership to car-sharing.

The interviewed car-sharing users expressed how their neighbourhoods suffer from severe parking issues. Avoiding these problems was stated as the key benefit of using car-sharing. Car-sharing user Dylan described the convenience of knowing there is always reserved space for the shared car nearby his house: *''When I had my own car, it was very difficult to find a parking spot nearby my house, but since I am using a shared car, I save a lot of time on parking.''* (Respondent #14). This quotation reveals how parking issues can discourage car use and how car-sharing eliminates this problem. Similarly, parking fees and licenses discourage car ownership and stimulate the practice of car-sharing.

In opposition to this, the interviewed car owners do not experience any stress regarding parking and can easily find a parking spot. Car owner Vrouwkje even chose her house based on the presence of a driveway. This illustrates how the ease of parking a private car affects the reproduction of the practice of car ownership.

c. Leisure activities

The practice of driving is closely interlinked with leisure practices, such as day trips, sports, and long holidays. These leisure activities are both essential for the practice of car ownership and car-sharing.

The interviewed car owners expressed their dependency on private car ownership to perform their leisure activities, as car owner Betty stated*: ''When we go on a 3-week summer holiday, we need one car with a tow hitch for the caravan, and the other car for the rest of our belongings.''* (Respondent #20). This quotation illustrates how the development of leisure practices over the years reproduces the practice of ownership. In line with this, car owner Guus stated that he depends on his car for his weekly cycling trips, demonstrating that his leisure activitiy cannot be performed without owning a car. Further, car-sharing user Wietske reflects on the car-sharing practice and is considering a private car for recreational purposes as she explained: *''I like to surf, and my boyfriend likes to mountain bike, we want to buy a car to lower the barrier to perform it more frequently.''* (Respondent #11). This quotation reveals how car-sharing can inhibit the performance of certain leisure activities.

Nevertheless, the interviewed car-sharing users have managed to coordinate and plan their leisure activities around car-sharing. Most car-sharing users do not feel restrained from performing leisure activities. Car-sharing user Dylan described how he performed the same leisure activities before car-sharing: *''When I got rid of my lease car, I do not feel any drastic*

changes in my daily life, I go equally often to my family and friends, go on day trips, and on longer holidays.'' (Respondent #14). This quotation shows how leisure activities can be sustained when switching from ownership to use. However, some car-sharing users have changed their travel behaviour accordingly and have eliminated using a car to perform leisure activities. Car-sharing user Felicia explained how she used to travel by car for long holidays, but now she travels mainly by train or plane.

Interim conclusion of SPT-based analysis

The SPT-based analysis reveals how the private car ownership practice is embedded in everyday life, making it challenging for the car-sharing niche to disrupt the strong connections between the elements (material, meaning, and competences). The SPT-based analysis guides how the established practices have developed but also opportunities for practice-interventions for the emergence and development of new proto-practices. The SPT-based analysis serves as the foundation for directing interventions, such as: providing a safe and reliable car (material), change the society's meaning to cars (meaning), and ensuring an optimum car availability and easy-to-use online app (competences). This are examples of activities that may help in developing car-sharing proto-practices.

In the next section, the intersections between the MLP-based and SPT-based analyses will be discussed to provide more comprehensive practice-interventions.

4.3. Intersections between MLP-based and SPT-based analysis

The regime and practice-based approaches to examine the shift from car ownership to car-sharing both offer valuable insights into the potential for a transition towards a more sustainable automobility system. Fundamentally, the MLP and SPT share common ground regarding the interdependency of elements for a socio-technical transition. The MLP takes a hierarchical approach to understanding societal change, resulting from the interaction from niche to the regime to landscape levels. The SPT considers a flat ontology where multiple interconnected practices horizontally circulate. Further, the MLP and SPT approaches both regard society and technology as inseparable: technology can only be understood in how they are used, and society as a whole is only fully grasped when the technologies on which it depends are taken into account (Svennevik et al., 2020). The shared conceptual foundations and the shared understanding of capturing the dynamics of potential sustainability transitions indicate the complementary between MLP and SPT. So far, MLP studies have mainly focused on socio-technological change, while practice-based studies emphasise the importance of daily lives in explaining the reproduction of practices. Hargreaves et al. (2013) and Seyfang & Gilbert-Squires (2019) are the first to investigate the added value of combining MLP and SPT in a conceptual framework. Nevertheless, more studies are needed to prove the added value of combining the two theoretical approaches to understand a socio-technical transition better.

To address this shortcoming, this section will discuss six critical intersection points between the MLP and SPT analyses for more theoretical and empirical consideration to advance the understanding of sustainability transitions. In particular, how the niche development of car-sharing is constrained by the intersections between regimes and practices. The intersection points are twofold; *Section 4.3.1.* demonstrates how the regime transition (or niche development) is constrained by embedded practices, and *Section 4.3.2.* demonstrates how practice transitions are constrained by the incumbent regimes. This includes various suggestions to convert the intersection points, preventing the transition from ownership to use, into points of opportunity, thereby guiding practitioners (e.g., policymakers, car-sharing providers, and municipalities) to change the current automobility regime while supporting the car-sharing niche – to create a more sustainable automobility system.

4.3.1. Regime transitions – the added value of the SPT-based analysis

The SPT-based analysis revealed how the car-sharing niche attempted to diffuse new elements of practice in people's everyday life performance. However, the MLP-based analysis showed a limited niche diffusion into the stable and resilient automobility system. The twin analysis of MLP and SPT goes further. It draws on both the tensions and shared conceptual foundations of MLP and SPT to identify which components of the regime transition (or niche development) are most locked into the embedded automobility practices and why they are reluctant to change. *Figure 4* illustrates how the insights from the SPT-based analysis can help inform a regime transition by identifying critical points of intersection that inhibit the transition towards a more sustainable automobility system. The following sections propose three important intersections with the following embedded practices constraining a sustainability transition: ownership practices, stacking practices in time and space, and switching practices.

Landscape level

Climate change puts pressure on the incumbent regime, while urbanisation and demographic ageing positively impact the incumbent regime

Regime level

A challenge to produce zero-emission vehicles; innovations in EV technology and infrastructure; shift towards mobility companies

Niche level

Car-sharing providers, provinces, and municipalities undertake niche-building activities; different car-sharing business models; international, national, and regional initiatives

Ownership practices

Psychological attachment, availability concerns; symbol of social status; limited customisation; limited freedom

Stacking practices in time and space

The bundling of practices reproduced in the same time and space as the embedded automobility practices

Switching practices

Life stages; trigger events; long-term car ownership

Figure 4.

Intersecting regimes with practices; the added value of SPT (adapted from Hargreaves et al. (2013) and Seyfang & Gilbert-Squires (2019).

4.3.1.1. Intersections with ownership practices

The practice of ownership – which car-sharing aims to reconfigure towards sharing – extends far beyond purchasing a car. Technological innovations have created new products and services to satisfy enduring consumer needs. However, in modern capitalist societies, consumption shifts from an ownership paradigm to a 'sharing economy.' (De las Heras et al., 2021). New questions are raised regarding the interplay between keeping and sharing, altering our perceptions of ownership. Car-sharing is one of these product-service systems facilitating the sharing of products and services.

From the SPT-based analysis (*Section 4.2.2.)*, it became clear that car ownership is often associated with a sense of personal freedom, convenience, control, social status, reliability, and brand love. In contrast, car-sharing is often associated with limited choice and availability, pay-for-use, and booking in advance. Thus, the practice of car-sharing illustrates a whole different set of images and meaning around a car. Overcoming these differences requires changing attitudes and perceptions towards ownership and mobility.

Here a critical point of intersection is revealed between the car-sharing niche that struggles to develop a new image around cars due to the embedded ownership practices entrenched in today's consumption societies. The ownership practices can inhibit regime

change in the following ways. First, car-sharing needs to disrupt the psychological attachment to ownership, the feeling that a car should be privately owned. Second, individuals might hesitate to rely on shared cars due to the perceived concerns regarding availability, accessibility, and convenience. Third, owning a car is often seen as a symbol of social status and success which does not adhere to car-sharing. Fourth, individuals find it difficult to use a shared car due to the limited possibility to personalize it according to their preferences. Last, owning a car is often linked to a sense of freedom to go on spontaneous trips and to be flexible in scheduling. Car-sharing requires scheduling and making pre-planned trips which can be perceived as a hassle.

Fortunately, car-sharing is well-suited to urban lifestyles where car ownership is less useful and flexible in densely populated cities due to high parking fees, lack of parking space, and congestion problems. The interviewed practitioners living in cities prefer car-sharing as it provides flexibility regarding pay-per-use, one-way trips, access to cars in multiple cities, and ease of parking.

The embedded ownership practices must be reconfigured towards sharing practices to foster growth in the car-sharing niche. Possible solutions include promoting awareness about the benefits of car-sharing through education campaigns. Individuals need to be educated about the availability, reliability, and convenience of car-sharing services to address misconceptions and build trust. The respondent from the municipality of Utrecht stated their responsibility to keep control over the car-sharing providers to ensure a consistent, accessible, and affordable car-sharing system, which is vital for the image of car-sharing. In particular, they should improve the availability and choice of shared cars in rural areas. This could enable reframing the long-term and embedded narrative of cars as a private possession. Instead, society should move away from consumption and ownership and adopt a new image of cars as something that is being shared and not owned by private persons.

Moreover, developing ownership practices can also be supported by designing user-centric apps where users can address their concerns related to car-sharing services. Further, the booking system can be enhanced by offering flexible travel plans and ensuring a consistent fleet of vehicles. These measures will make it more attractive to share a car.

This change in perception about sharing could be enabled by closed-community car-sharing providers who facilitate the sharing practice by offering a platform where users know each other. As a result, the solidarity among the users improves, which strengthens the community's trust and willingness to share a car. Because if car-sharing and other shared goods and services want to gain popularity, the car-sharing platforms must seek a good balance between institutional trustworthiness and interpersonal trust to prevent a lack of trust among the users.

By supporting the development of sharing practices, it becomes possible to overcome the lock-in of the established automobility regime and facilitate a transition towards a more sustainable automobility system.

4.3.1.2. Intersections with stacking practices in time and space

From the SPT-based analysis *(Section 4.2.5.),* it became clear that the automobility practices are closely interlinked with a wide range of other practices, such as residency, parking, and leisure activities. The relationships between these practices are interlinked in complex co- and interdependent ways (Watson, 2012), meaning that practices can both support and compete with each other. The car ownership practice has emerged and sustained through a bundle of practices that facilitate the reproduction of this mainstream practice. For example, short and long-term holidays and car commuting are planned and performed around car ownership. Hence, the shift from ownership to use implies changes to other daily life aspects beyond mobility practices. To support this, (Shove et al., 2012) revealed the importance of spatial and temporal ordering for practices to be reproduced. Therefore, the development of car-sharing practices depends on how much they fit and coordinate with other non-mobility-related practices that are reproduced at the same time and space. Re-organising bundles of practices in time might be necessary to fit the car-sharing practice within the existing competing and interdependent practices. This reveals the tension between the car-sharing niche and existing automobility practices spatially and temporally connected with other non-mobility-related daily life practices in a way they hold each other in place. This is supported by the empirical data showing how car owners tend to structure and plan daily life activities (e.g., work, sport, shopping) around car ownership, resulting in a dependency on a private car.

The above arguments represent a critical intersection between the embedded car ownership practice substantially constituted and reproduced by daily life and routinised practices of travellers, and the limited niche diffusion in the automobility regime. This intersection point needs to be addressed by the car-sharing niche to recruit more practitioners. Possible solutions include a better understanding of the bundling of practices in daily life which might provide opportunities for small interventions but with potentially significant effects. For example, the empirical data showed how households perform different activities with their private car stacked in both space and time, from routinized to spontaneous and irregular trips (*Section 4.2.3.*). Therefore, coordination challenges will arise when a household has to share a car through a car-sharing service. Flexible booking systems offering extended rental periods and flexible time slots could accommodate a variety of lifestyles and non-mobility-related practices stacked in time and space.

Moreover, the empirical data from the practitioners indicate a difference in willingness to travel to locate cars between car owners and car-sharing users – where car-sharing users tend to travel 15-30 minutes and car owners want to travel max. 5 minutes and preferably within walking distance (*Section 4.2.2.).* The spatial proximity between daily life practices (e.g., shopping, working, sport) and the dedicated parking spots is vital for developing and reproducing car-sharing practices. Therefore, the ability to locate the shared cars nearby places where daily-life activities are performed is key for the development of the car-sharing niche.

Additionally, the non-mobility-related practices need to be re-designed in space and time to establish a strong linkage with car-sharing. For example, the removed parking spaces

can release more public space to provide everyday facilities (e.g., supermarkets, schools, sports clubs, work, etc.) close to the residential areas. Eventually, this will result in a lower car dependency, lowering the threshold to switch from car ownership to car-sharing.

However, the car-sharing users also indicated how a range of existing links to related practices is retained when switching from ownership to use - for example, visiting family outside the city, going on day trips, or long holidays. Car-sharing is also reproduced in the same spatial location as car ownership, such as driving on the same roads, fuelling at the same petrol stations, and parking at similar parking spots. Compared to other transport modes, such as train or bus travel, car-sharing is better connected to an existing co- and interdependent bundle of practices interlinked with mobility.

By integrating car-sharing into existing practices linked in time and space, car-sharing becomes more convenient and aligned with individuals' routines. As a result, it becomes possible to overcome the lock-in of the established automobility regime and facilitate a transition towards a more sustainable automobility system.

4.3.1.3. Intersections with switching practices

The growth and diffusion of car-sharing depend on recruiting new users. However, this research shows how car owners hesitate to eliminate their private car(s) and switch to a more sustainable transport option like car-sharing. The process of gaining knowledge of the car-sharing service, signing up, and adjusting to the car-sharing models is perceived as a hassle by the respondents, especially those who are already used to the convenience and independence of car ownership. However, from the SPT-based analysis *(Section 4.2.4.)*, it became clear that car owners are more inclined to switch to car-sharing during a significant change affecting their daily life, such as switching jobs, moving, and COVID-19, or a smaller (unexpected) 'trigger' event, such as increased maintenance costs, and introduction of high(er) parking fees. Otherwise, car owners tend to keep their cars, planning their everyday life around private car use, and subsequently become locked in the practice of car ownership. In contrast, critical moments for locking-in car ownership practitioners are starting a professional life, having children, or when they have complaints about public transport. The private car becomes an integral part of their daily lives, making switching from ownership to use difficult. Car-sharing providers struggle to interfere in this locked-in process. Therefore, enhancing the switching practice from ownership to use for niche diffusion is crucial. However, the inertia of long-term car ownership practices creates a barrier to breaking through embedded practices and generating new elements of practice which are taken up in everyday performances. Despite the marketing efforts of car-sharing providers and municipalities, private car ownership practitioners are reluctant to switch to car-sharing due to the perceived inconveniences, such as reduced time-space flexibility, freedom, and unfamiliarity with the car-sharing concept.

The difficulty for car-sharing providers to interfere with the locking process of private car ownership reveals a critical intersection between the car-sharing niche and the embedded automobility practices. Possible solutions to stimulate switching include introducing supportive transportation plans by companies, such as bicycle plans, offering public

transportation subscriptions, and pool cars. To illustrate this, the empirical data showed how cycle commuting had become a vital component for a household's daily travel behaviour to go from two to one car - to save money and enable exercise and plays a role in the transition from ownership to use.

Other possible solutions include interferences on the transition points to another life stage or significant life-changing events, such as applicants for a driving license, people starting a professional life or a family. In addition, teenagers and young adults should be familiarized with car-sharing to generate a positive meaning around car-sharing. Educating the younger generation could redefine the current automobility system towards a more sustainable one, involving environmentally aware customers willing to switch from ownership to use. Herein, the Dutch government plays a crucial role in reframing the role of private cars in society by prioritizing sustainable transport options.

Further, the development of MaaS apps plays a crucial role in the diffusion of car-sharing in everyday life performances. An integrated, smoothly operating MaaS app allows users to plan, book, and pay for many transport options on one app, lowering the threshold to switch from ownership to use. Moreover, pilot projects can enhance the switching practices, allowing individuals to experience car-sharing to resolve any concerns or doubts without shifting from ownership to use completely.

By lowering the perceived threshold of switching from car ownership towards car-sharing, it becomes possible to overcome the lock-in of the established automobility regime and facilitate a transition towards a more sustainable automobility system.

4.3.2. Social practice transitions – the added value of the MLP-based analysis

The SPT-based analysis demonstrates the effort of the car-sharing niche to challenge the links between the elements of existing practices. However, the existing car ownership practices are stable due to the strong interlinkages between the three elements (material, meaning, and competences), and other domains of practice (residency, parking, and leisure activities). The car-sharing niche struggles to disrupt these interlinkages and to incorporate new car-sharing elements of practice into everyday life. Herein lies a critical role of wider systems and regimes that develop and maintain the established, 'unsustainable' practice of owning a car, revealing the limitations of solely applying a horizontal, practice-based analysis. Therefore, the twin analysis of MLP and SPT will identify the most prominent regimes which inhibit the practice transition from ownership to use. *Figure 5* illustrates how the insights from the MLP-based analysis can help inform a practice transition by identifying critical points of intersection inhibiting the transformation towards a more sustainable automobility system. The following sections propose three important intersections with the following regimes constraining a sustainability transition: urban planning regime, transport regime, and economic regime.

Systems of practices

Reframing the role of cars in society

Urban planning regime

Difficulty to eliminate car ownership because of supportive frameworks for car ownership

Practices

Disrupt the links between existing practices, e.g., residency and leisure

Transport regime

Hard to avoid car ownership due to low integration between private and public transport systems

Elements of practice

MaaS introduces new, more sustainable, elements (material, meaning, competences) - a transparant, multi-modal, user-friendly transport app

Economic regime

The economic ecosystem promotes car ownership by the tax system, existing economic infrastructure, employment, financial support

Figure 5.

Intersecting practices with regimes; the added value of MLP (adapted from Hargreaves et al. (2013) and Seyfang & Gilbert-Squires (2019).

4.3.2.1. Intersections with the urban planning regime

The urban planning regime locks in existing embedded automobility practices through the supportive infrastructure for private cars, inhibiting the development of new car-sharing proto-practices that involve reducing the number of private cars (material), sharing a car in a community (meaning), and a consistent and convenient car-sharing service (competences).

The embedded automobility practices are held in place by free parking spots and an extensive road network – key components of the existing urban planning regime – demonstrating the difficulty of disrupting existing automobility practices. Therefore, the current urban planning regime makes the establishment of new car-sharing proto-practices related to occasional car use and interpersonal trust more difficult. At the same time, the lack of supportive infrastructure in residential districts and cities for car-sharing constrains the development of new proto-practices. For instance, car-sharing providers and users struggle to request a reserved parking spot or a charging station, hindering car-sharing practices (*Section 4.1.3.2.*). Further, multiple respondents argued how dangerous cyclist roads and an inadequate public transport system obstruct their attempts to decrease car use (*Section*

4.2.5.). In particular, rural areas lack a well-functioning public transport system, leading to increased car dependency for daily-life performances.

These examples reveal a critical intersection between the car-sharing proto-practices and the embedded automobility practices rooted in the current urban planning systems mainly based on private cars. Possible solutions should focus on urban planning that prioritizes clean and shared mobility. This is supported by the respondent from the municipality of Utrecht, who argued how urban planning significantly influences people's travel behaviour. This could involve the introduction of lower parking norms, higher parking fees for private cars, and car-free districts to discourage private car use. Designing and developing new neighbourhoods focusing less on cars and more on alternative sustainable transport modes will gradually change travelling habits and behaviour. Indeed, build a residential area around cars, and more cars will appear. But a residential area built around people and pedestrians will see cyclists appear on the streets.

Additionally, the car-sharing practices could be further established by re-designing the freed parking spaces into green spaces and public services (e.g., supermarkets, schools, sports, and work) within a short distance of access to all residents, resulting in a lower car dependency.

Further, supportive regulatory measures for creating reserved public space for p2p-shared cars and closed-community shared cars would enable the car-sharing practices to recruit more practitioners. In particular, closed-community sharing platforms enable the development of new practices related to interpersonal trust, stimulating the recruitment and retaining users.

Another alternative approach would involve infrastructural interventions that promote more sustainable transport options (e.g., public transport, biking, and walking), away from the car-minded infrastructure. Possible interventions include moving towards a network of nodes to enable a multi-modal transport system. For example, mobility hubs could be implemented in residential areas to increase the attractiveness and visibility of car-sharing while supporting a low-traffic district. In addition, creating bicycle-friendly infrastructure is vital to decrease car use, for example, by constructing special bicycle bridges, free bicycle parking places, and wide bicycle streets.

Addressing these infrastructural barriers makes it possible to overcome the lock-in of established automobility practices and facilitate a transition towards a more sustainable automobility system.

4.3.2.2. Intersections with the transport regime

The previous section discussed how the current urban planning regime is designed to support private car use and therefore reproduces embedded automobility practices. Here, an additional essential point of intersection will be discussed in which the transport regime poses constraints on the further development of car-sharing practices. Today's transport can be distinguished by two regimes: private and public transport. Public transport influences the transport regime by considering users as 'citizens' from a certain region or city. In contrast,

the private transport regime regards users as 'consumers' who can choose their preferred transportation mode. These two transport regimes operate separately and have little integration (Truffer, 2003). Car-sharing can potentially influence both transport regimes as it complements public transport or replaces a (second) car. As a potentially new mobility regime, car-sharing can bridge the gap between these transport regimes to achieve a sustainable transport system. However, the embedded automobility practices are locked in by the supportive frameworks for the private transport regime, including energy supply, maintenance, education, regulatory frameworks, tax systems, and more (Zijlstra et al., 2022b). Further, the continuing rise of car ownership leads to the growth and increased stability of the private transport regime, and vice versa, lowering car ownership carriers. The growth of the private transport regime results in a less attractive public transport regime, inhibiting the development of new practices involving travelling intermodally (meaning) and occasional car use (meaning). This is illustrated by a study conducted by Jeekel (2011) on the car-dependent society, which showed that public transport takes at least twice as long to travel than by car in 90% of all cases in The Netherlands. Specifically, the transport system in rural areas is inadequate, leading to relatively high car ownership rates in rural areas compared to urban areas (Zijlstra et al., 2022a)

This reveals a critical intersection between the emergence of car-sharing proto-practices and the embedded automobility practices entrenched in the existing transport regime prioritizing private transport. Possible solutions include measures to close the gap between the private and public transport regime inhibiting intermodal travelling by practitioners. For example, mobility hubs at the edges of cities could improve the transfer from private to public transport. The mobility hubs also assist proto-practices in recruiting more users by offering multiple shared vehicles (e.g., car, bicycle, step, scooter) to reach their destination as fast, convenient, and flexibly as a private car. MaaS apps can also incentivize and simplify car-sharing services by providing a seamless multi-model transport system where users can plan, book, and pay for their travel plans in one app.

Although mobility hubs and MaaS apps could create better integration between the public and private transport regime, the private transport regime still locks in travelling practices depending on car ownership. Regulatory interventions are necessary to make the public transport regime attractive to citizens. In particular, public transport in rural areas should be significantly improved by increasing its availability and accessibility to disrupt the embedded practice of car ownership and car dependency. On the other hand, the established automobility practices can be discouraged by creating more barriers to private car usage, such as limiting the maximum speed, abolishing travel allowances, and increasing petrol costs.

Encouraging the integration of the private and public transport regime makes it possible to overcome the lock-in of the established automobility practices and facilitate a transition towards a more sustainable automobility system.

4.3.2.3. Intersection with the economic regime

The intersections with the urban planning and transport regime showed the central role given to private cars in the current regimes. The economic regime also focuses on car ownership and inhibits the transition towards car-sharing in the following ways related to costs, market dynamics, employment, and subsidies.

Car ownership is often perceived as a relatively cheap modality with limited costs for the government due to the duties and taxes that compensate for the infrastructure and social costs (de Kleuver et al., 2022). The same applies to the users due to the affordable vehicle prices and low-interest car loans. In contrast, car-sharing services require a subscription fee or pay for usage, which is considered less financially attractive for individuals who frequently use a car. Increased awareness of the long-term cost savings and benefits of car-sharing is required to change the perception of car ownership as a more affordable option compared to car-sharing. These economic incentives for owning a private car create thus a barrier to develop new car-sharing proto-practices.

Further, the MLP-based analysis indicated a well-established car industry in The Netherlands consisting of various car manufacturers, car dealers, and other businesses. This economic ecosystem promotes the ownership-based model based on profit growth. In contrast, car-sharing requires a whole new business model based on ''mobility for life'' and threatens traditional business models and revenue streams based on ''car for life''. Due to the dominance of car ownership in the existing economic infrastructure, car-sharing services often struggle to establish a competitive market presence and reach a critical mass of users.

Moreover, the automobility industry is vital for employment and economic activity in The Netherlands. The industry provides jobs, such as manufacturing, maintenance, and repair services which has a significant impact on the national economy (Zijlstra et al., 2022b). Therefore, the economic regime supports this private car-based industry, holding the existing automobility practices in place. Instead, the car-sharing niche is considered a threat to businesses associated with car ownership as it might disrupt the established employment rates, creating a barrier for the car-sharing niche to establish.

Finally, the economic regime plays a role in financing and subsidizing the existing mobility system based on car ownership. These measures make it more financially attractive and accessible for individuals to sustain the practice of car ownership. In contrast, the economic regime provides limited financial support for car-sharing services. The difference in financial support impedes individuals from switching from car ownership to car-sharing.

These various points reveal a critical intersection between car-sharing proto-practices and the embedded practices entrenched in the economic system prioritizing car ownership. The government plays a critical role in rethinking the role of cars in our economic system. Possible solutions include making alternative sustainable transport modes more financially attractive. This could include subsidies or reduced insurance rates for individuals who use a car-sharing service instead of owning a private car. At the same time, private car ownership should be discouraged by implementing higher taxes on private car use, congestion pricing, or

higher parking fees for private cars. These supporting and discouraging measures could make car-sharing more economically attractive compared to car ownership.

Moreover, shared mobility policies should also focus on the involvement of the users by emphasizing the social and environmental benefits of car-sharing compared to private cars. For example, neighbourhoods should be rewarded with trees or playgrounds in return for the removed parking spots. Car-sharing services also provide households with an extra transport option, increasing their mobility and improving the opportunities to participate in society. The environmental and social returns of the car-sharing niche might increase its legitimacy and familiarity.

Besides the proposed government's interventions, industry players can contribute to a smoother transition from car ownership to car-sharing. Possible solutions include the creation of partnerships between car manufacturers, car dealers, and car-sharing providers to promote the integration of shared vehicles into their product offerings. This could increase the accessibility and diversity of shared cars for individuals.

Addressing these economic barriers makes it possible to overcome the lock-in of the established automobility practices and facilitate a transition towards a more sustainable automobility system. However, it should be noted that rethinking the economic regime requires a further scope than changing the automobility regime.

5. Discussion

This section is structured as follows. *Section 5.1.* discusses this research's theoretical and methodological implications, followed by the societal and practical implications in *Section 5.2.* Further, *Section 5.3.* discusses the avenues for future research. Finally, *Section 5.4.* discusses the limitations of this research.

5.1. Theoretical and methodological implications

Using the conceptual framework by Hargreaves et al. (2013) has advanced previous studies solely analysing innovation in regimes or practices for sustainability transitions. This research has combined and connected the MLP-based and SPT-based analysis to demonstrate the added theoretical value of the identified intersections. Although some authors point out the existing field of tension between these two prominent approaches, several studies already proved the complementary and added theoretical value of connecting the two theories. For instance, Watson (2012) contributed to this field of research by emphasizing that socio-technical changes cannot be reduced to individual choices. Instead, he emphasizes the link between changes in what people do and the broader socio-technical system. This research also sheds light on the dynamics between individual behaviour, social practices, and systemic change. More specifically, the identified six intersection points show how a sustainability transition will not be accomplished by either individual practice changes or broader regime changes. Instead, the regimes and practices are locked together, creating a linkage and dependency between regimes and practices to unlock the transformative potential of the transition towards car-sharing. On the one hand, the intersection points between the regimes and practices reveal that the niche development is mainly constrained by different everyday practices and systems of practices – demonstrating that the limited car-sharing diffusion is not inherent to the car-sharing niche and its users itself. On the other hand, the intersection points show that the attempts to develop new proto-practices are mainly impeded by the wider system and regimes holding the status quo in place. Thus, this research shows how the intersection points result in a deeper understanding of the mechanisms that shape sustainability transitions - proving the added value of combining MLP and SPT without losing the strengths of each theoretical lens. Hence, this research is a contribution to theory.

The identified intersection points of this research and the possible strategies for interventions are predominantly supported by other studies. For example, Julsrud & Farstad (2020) concluded that car-sharing relies on well-functioning alternative transport systems because daily life involves various non-mobility-related activities which are hard to manage without a privately owned car. The intersection points of ''Transport Regime'' and ''Stacking practices in time and space'' from *Section 4.3.* align with the above policy implications from the study of Julsrud & Farstad (2020). The intersection of the ''Transport Regime' acknowledges the need for a better connection between the public and private transport regimes to facilitate car-sharing. Further, the intersection of ''Stacking practices in time and space'' highlights the difficulty of managing non-mobility-related practices in space and time

without a privately owned car. Further, the study by Svennevik et al. (2021) concluded that interventions should not solely focus on car-sharing itself but rather on urban mobility as a whole, including infrastructure and social norms. This conclusion supports the theoretical relevance of the identified intersection points (e.g., transport, infrastructure, and bodily-mental capacities) as these points emphasize the interplay between the wider systems and user practices in the transition towards car-sharing.

Despite the foundational differences between the two approaches to understand how a niche attempts to become part of the regime, this research has shown the theoretical and methodological compatibility between the MLP-based and SPT-based analyses. They both allow for a flexible research design. They both allow for conducting in-depth interviews. They both are qualitative approaches to explaining social phenomena. They both recognize that context matters and that transitions are not universal or uniform across all contexts. They both allow for a cyclic and iterative data analysis process. They allow for the same data collection process, where qualitative interviews are the most common to gain an in-depth understanding of a certain social phenomenon. They both allow for a deductive and inductive data coding process. Therefore, the research design for the MLP and SPT were complementary, enhancing the ability to fuse the two analyses in a conceptual framework.

5.2. Societal and practical implications

The twin analysis from *Section 4.3.,* resulted in various suggestions for intervention strategies, showing how these critical points of intersection points can be transformed into points of opportunity to create more sustainable regimes and practices. These strategies for intervention align with the broader discourse on sustainable mobility and the recognition of the need to move away from the traditional automobility system towards more sustainable forms of mobility. This shift has been driven by concerns over climate change and urban congestion. Car-sharing has gained traction as a viable solution to achieve a more sustainable automobility system. This research provides insights into the challenges and opportunities of the transition from car ownership to car-sharing, thereby informing practitioners (e.g., policymakers, car-sharing companies, and municipalities) to shape a more sustainable mobility system to benefit the environment and society.

However, Svennevik et al. (2020) showed that car-sharing does not always lead to more sustainable outcomes. Car-sharing supports the maintenance of car-dependent activities in some scenarios, leading to increased use of cars (Svennevik et al., 2020). This research focused on connecting the wider system and user practices to understand the barriers and opportunities for the car-sharing niche. Therefore, car-sharing's (negative) side effects were not part of this research's scope. Nevertheless, it might be important to consider multiple scenarios where car-sharing leads to increased use of cars and, therefore, might diminish the environmental benefits of car-sharing.

Moreover, from a user's side of the environmental benefits of car-sharing, the research's findings suggest that the environmental awareness and concerns of the users have little effect on recruiting new practitioners but involve financial and practical reasons. Truffer

(2003) and Polk (2000) also concluded that practical reasons are more important than environmental reasons for adopting car-sharing. This observation is essential for a better understanding of how routinized behaviour emerges and develops, which is central to what a practice is. In addition, the observation that environmental concerns are not likely to change user behaviour can guide policymakers and car-sharing providers to support car-sharing more effectively.

Further, the research's focus on the intersections between regimes and practices might overlook the more obvious interventions from an MLP-based or SPT-based analysis. This involves some implications for practitioners (e.g., policymakers and car-sharing companies). For instance, the horizontal circulation of different domains of practices revealed the interlinkage of automobility practices with leisure practices. Multiple respondents explained how the performance of leisure activities has become embedded in private car use. To be more specific, additional personal features of a private car (e.g., child seats and a towing hook) are considered prerequisite components necessary to perform leisure activities. Since these features are often absent in a shared car, the switch from ownership to use is constrained. The car-sharing providers can relatively easily address these interventions without considering the wider system. Similarly, the nested hierarchical framework of MLP focused more on the interaction of the incumbents actors with the developers of the car-sharing innovation, and the role of political governance in a socio-technical transition. Central to the MLP-based analysis was the insufficient sharing of consumer data among stakeholders. As a result, the municipality lacks a holistic overview of the car-sharing market and its developments. The intervention strategy would relate to improving the knowledge sharing within the niche whereby the municipalities could act as a network manager to address the current knowledge gaps and ensure knowledge is shared among all stakeholders. In contrast, the connections between the MLP-based and SPT-based analysis revealed more nuanced and comprehensive ways in which regimes and practices block each other, providing more effective interventions.

Last, the research's findings can guide practitioners (e.g., car-sharing providers) by providing valuable insights into the barriers and opportunities of the transition towards car-sharing. The twin analysis showed that the limited diffusion of the car-sharing niche into the incumbent regime is not inherent to the car-sharing niche itself and involves wider systems and regimes. For example, the twin analysis demonstrated how everyday automobility practices become entrenched in the transport system and infrastructures. Therefore, the research's findings can be used by car-sharing providers to advocate for supportive policies and regulations from governments and local authorities that go further than improving their service offerings.

5.3. Future research

This research is a valuable first step to applying and testing the conceptual framework by Hargreaves et al. (2013) in a new empirical context. Nevertheless, developing the conceptual framework further might be valuable through further theoretical exploration. First, the conceptual framework does not offer a comprehensive understanding of the social and power dynamics that occur within the regime and the niche, and between them. Further research could extend the practical value of the framework by analysing the power structures and subsequently identifying the actors who can drive or impede change. This results in concrete suggestions for policymakers, car-sharing providers, and practitioners on improving and structuring stakeholder cooperation and creating more politically feasible interventions.

Moreover, it could be interesting for further research to ask more in-depth theoretical questions beyond the scope of this research to improve the framework by Hargreaves et al. (2013). For example, are there connections between the different intersection points, and if so, how do they help or constrain each other? How many intersection points can be identified, and how can they be structured meaningfully?

Further, the practical value of the twin analysis has yet to be proved in real-life examples, and some questions could guide this future research: Do the intersection points result in efficient and effective interventions? Which combination of interventions leads to the most effective and efficient outcomes? How do the intersection points change over time and place? Which actors should lead in addressing these intersection points: niche or regime actors or practitioners?

5.4. Limitations

The theoretical approaches of MLP and SPT both recognize the significant role of context-specific factors in shaping transitions, allowing for research based on a case study of the Dutch automobility system. Therefore, the research's findings are not generalizable to other geographical contexts. Other countries or specific cities have different socio-demographic characteristics, cultural meanings, technical infrastructures, transport systems, car-sharing services, and political governance involving other niche activities and user practices. Another geographical context could, therefore, lead to new findings as these factors play a significant role in shaping the pace and trajectory of this transition. Nevertheless, this research aimed to identify contextually relevant and specific intersections between regimes and practices in the Dutch automobility system. This allowed for understanding and exploring the potential of car-sharing in-depth. Although the research's findings are gained from a single context, it informs the application of the novel conceptual framework of Hargreaves et al. (2013) to serve as a basis for additional research on the regime and practice intersections to new empirical topics, such as EVs or other domains where technology, society, and policy are interlinked. Hopefully, this will result in new insights to unlock the transformative potential of various sustainability transitions.

Further, the car-sharing innovation is currently in the innovator phase, where diffusion is primarily limited to innovators and early adopters. This represents a critical phase where a lot can change concerning the willingness of the early adopters to overcome different obstacles and reproduce the car-sharing practices (e.g., limited availability, planning car trips, and limited control of a car). Additionally, a lot can change concerning the efforts of private and public actors (e.g., car-sharing providers and municipalities) to stimulate car-sharing as a sustainable transport option. Therefore, more research is needed in the next years to follow the developments of the market. Moreover, the interactions between the car-sharing niche and emerging niches would be a promising area to investigate further.

In addition, the theoretical frameworks of MLP and SPT both attempt to understand complex social phenomena using a relatively simple heuristic framework. On the one hand, a simplification of the Dutch automobility system to study the transition from ownership to use has proven useful and valuable since it addresses the differences and similarities between the incumbent automobility regime with the car-sharing niche, and the embedded automobility practices with the car-sharing proto-practices, allowing for a helpful categorization of the different themes. However, one should carefully consider the variety of car owners, car-sharing users, municipalities, and car-sharing providers to avoid oversimplification. The description of the regime and niche components and the embedded and proto-practices are typologies and, therefore, could contain some interpretation from the researcher and might provide only part of the picture.

6. Conclusion

This thesis is guided by the following research questions to address the theoretical and empirical gap in combining the multilevel and social practice approach to study a socio-technical transition:

1. What are the intersections between transitions in the automobility regime and automobility practices towards car-sharing in the Dutch automobility system?

2. How can these intersections between transitions in the automobility regime and automobility practices be transformed into points of opportunity to facilitate a more sustainable Dutch automobility system?

This research is guided by the conceptual framework by Hargreaves et al. (2013) to identify the intersections between the transition in regimes and practices. This framework combines the theoretical lenses of MLP and SPT to understand sustainability transitions better. Although the MLP and SPT theories are considered competing approaches in the literature, this research has proved the added value of combining, respectively, a top-down macro and bottom-up micro approach to gain a more comprehensive understanding of the transition towards car-sharing. Based on in-depth interviews with various practitioners (e.g., car-sharing providers, provinces, municipalities, car owners, car-sharing users, and mobility consultants), this research presents new empirical findings from a qualitative case study of the Dutch automobility system and b2c and p2p car-sharing services.

This research has identified six critical intersection points where regimes and practices constrain each other and demonstrated how these intersections could be transformed into opportunities. Policymakers can leverage these potential opportunities to develop supportive frameworks, remove regulatory barriers, and implement incentives that facilitate the growth of car-sharing as a sustainable transportation alternative.

On the one hand, three intersection points reveal how the SPT-based analysis added value to the regime transition by identifying how the car-sharing niche faces constraints from embedded automobility practices, including ownership practices, stacking practices in time and space, and switching practices. First, the twin analysis showed how ownership practices involving social status, control, availability, and freedom, inhibit car-sharing growth. Therefore, policies promoting closed-community car-sharing providers could play a significant role in supporting sharing practices because these closed-community platforms have the right balance between institutional worthiness and personal trust. This fosters trust and solidarity within the community and enhances the willingness to share cars. However, it should be noted that these closed-community platforms have to be guarded on inclusivity and diversity to ensure fair car-sharing systems. Second, the twin analysis highlighted the tension between the growth of the car-sharing niche and existing automobility practices deeply intertwined with other non-mobility-related practices. These other practices are reproduced in the same time and space as existing automobility practices, inhibiting the switch to the car-sharing practice. Policy implications arise from understanding the importance of the spatial proximity between daily life practices and car-sharing parking spots. Therefore, locating shared cars in convenient

locations should be prioritized over private parking spots. Additionally, stacking practices in time leads to coordination problems which can be solved by flexible booking systems that accommodate diverse lifestyles and time constraints. Last, the twin analysis showed how significant life events or transitions can create opportunities for individuals to switch from car ownership to car-sharing. Policy implications arise from identifying and using these transition points for targeted interventions to promote car-sharing. This could include awareness campaigns during the driver's license application process or school educational programs.

On the other hand, three intersection points reveal how the MLP-based analysis added value to the practice transition by demonstrating the role of wider regimes in developing car-sharing proto-practices, including urban planning, transport, and economic regimes. First, the urban planning regime involving roads and parking spaces plays a significant role in the reproduction of car ownership practices due to its focus on private cars. Therefore, policy implications arise from reconfiguring urban planning policies to prioritise sustainable transport modes and create an environment that supports car-sharing. This includes reducing private parking spaces, increasing parking fees, and reallocating the freed-up space for public facilities or alternative sustainable transport infrastructure. Second, the current diversion between the public and private transport regimes plays a significant role in reproducing car ownership practices. When car-sharing is integrated with the existing transport system, car-sharing services will be more user-friendly and convenient. Policy implications arise from promoting and supporting the integration of car-sharing services with the existing transport system. For example, Mobility-as-a-Service (MaaS) apps can provide a seamless multi-modal transport system by allowing users to plan, book, and pay for various transport modes in one user-friendly app. Additionally, mobility hubs can play a significant role in enhancing the intermodally between public and private transport. Besides improving the integration between the private and public transport regimes, it is vital to improve the availability and accessibility of the public transport system and discourage private car usage by increasing petrol costs and abolishing travel allowances. Last, the central role of car ownership in the economic regime inhibits the development of car-sharing practices due to the perceived cost advantage, the dominance of the car industry, the employment rates, and the financial support. Facilitating car-sharing growth within the current economic regime holds important policy implications. The government could subsidize car-sharing to make it more financially attractive for users. At the same time, the government could increase the taxes on private car use to discourage the reproduction of car ownership practices.

To conclude, this research demonstrates that the development of the car-sharing niche is more complex than initially expected. Prior research on car-sharing has focused solely on transitions in regimes or practices. This research highlights the complementarity of the theoretical lenses of MLP and SPT, indicating that a combined analysis provides a more comprehensive understanding of the socio-technical transition from car ownership to car-sharing. These points of constraints between the regimes and practices should not be considered barriers but catalysts for change. By leveraging these points of constraints, the full potential of car-sharing can be unlocked to achieve a more sustainable automobility system.

This requires a multifaceted approach that combines regulatory measures, technological advancements, and cultural shifts to create an ecosystem that supports and encourages the adoption of car-sharing.

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Appendix A. Interview guides

A1. Interview guide for car-sharing providers

1. Introduction
- Briefly explain the research and the interview's aim.
- Ask for permission to record the interview.
- The role/function/responsibility of the interviewee within the organization.

2. Questions about landscape, niche, and regime level (MLP framework)

Dimension	Indicator	Questions
Landscape	Stabilizer	Which trends/exogenous shocks help stabilize the current regime of privately owned cars?
	Destabilizer	Which trends/exogenous shocks put pressure on the current regime of privately owned cars and create windows of opportunity for car-sharing?
Niche	Network formation	Who are the most important stakeholders for the company? And why?
		Which stakeholders would the company like to work with in the future? And why?
		How would you describe the relationship with other niche stakeholders? What do you share? (technology, knowledge, access to the market, etc.)
		Which initiatives is the company participating in? How does this help you? Who has more power in these transactions?
		What is the current state of the market from the consumer side and supplier side?
		What is the expected future market size? Will this be sufficient?
		What is the potential for car-sharing to scale up? What are the barriers or drivers to scale up?

		Does replication take place within the niche? If yes, how does this contribute to the growth of car-sharing? If not, why not? Does translation of niche ideas into the regime take place? What inhibits this process of translation?
	Learning processes	How is knowledge shared among the different stakeholders? Is this sufficient? If not, what knowledge is missing that is required for the sector to grow? Which research should be done? Do you also share the company's data with municipalities or other niche actors? What is the current state of technological development and infrastructure of car-sharing? (zone floating, monitoring to match demand and supply (algorithm), electric cars, MaaS platforms) How does this influence the growth of car-sharing? How do consumers perceive car-sharing? Are they aware of it? If not, how can this be improved? How do the current policy and regulatory frameworks influence the growth of car-sharing? (parking spots, allowing one-way trips to other cities) What adjustments should be made to enable car-sharing?
	The articulation of expectations or visions	What are the company's expectations/visions of car-sharing in the near future? Are these expectations/visions aligned with other niche stakeholders? How does the car-sharing niche articulate its vision?
Regime	Users, markets	How would you describe the market/a consumer of the company?

		Industry	What is the business model of the company?
			Does the company have many competitors? Do they have the same market size?
			What does the decision-making process look like within the company? (e.g., centralized, democratic).
			Does the company have access to capital and experience?
			Is it easy for a new company to enter the car-sharing market? (e.g., sunk costs, required specific knowledge & experience, imitation)
		Policy	What regulatory and policy framework supports the company? (e.g., parking spots only for car-sharing, subsidies)
			What is the role of the local government?
		Technology	Which technologies or infrastructure supports the company? And what is still lacking? (e.g., parking spots for car-sharing only, supply and demand dynamics, apps, safe & transparent payment services).
			How does the current mobility system/regime inhibit the diffusion of car-sharing?
		Science, Knowledge	How is the company's growth measured?
			How important are the social and environmental benefits compared to the financial benefits?
		Culture	How would you describe the culture within the company? (e.g., bonuses, loans)
			Who has the most power within the company? (e.g., shareholders).
			What is the cultural difference between private car owners vs car-sharing users? (e.g., identity, status, freedom, etc.)

	Artefacts	Which artefacts support the company? (e.g., apps

4. Conclusion

a. What are in your opinion the most important challenges for car sharing/the company now? And in the near future?

b. What are in your opinion the biggest opportunities for car sharing/the company now? And in the near future?

c. How do you see the future of the mobility system in the Netherlands in 2050?

d. Do you have anything to add?

e. Do you have any useful documents that could be useful for my research?

A2. Interview guide for private car ownership stakeholders

1. Introduction
- Briefly explain the research and the interview's aim.
- Ask for permission to record the interview.
- The role/function/responsibility of the interviewee within the organization.

2. Questions about landscape, niche, and regime level (based on the MLP framework)

Dimension	Indicator	Questions
Landscape	Stabilizer	Which trends/exogenous shocks help stabilize the current regime of privately owned cars?
	Destabilizer	Which trends/exogenous shocks put pressure on the current regime of privately owned cars?
Regime	Users, markets	How would you describe the market/a consumer of the company?
	Industry	What is the business model of the company? What is the company's vision and strategy? Does the company have many competitors? How does the company protect its market share? What does the decision-making process looks like within the company? (e.g., centralized, democratic). Does the company have access to capital and experience? (e.g., from a mother company) Is it easy for a new company to enter the private car ownership market? (e.g., sunk costs, required specific knowledge & experience, imitation)
	Policy	What regulatory and policy frameworks support the company? (e.g., influential lobbying, political support, regulation)? What regulatory and policy frameworks inhibit the growth of the company?

	Technology	Which technologies or infrastructure supports the company?
		Which technologies or infrastructure form a threat for the company?
	Science, Knowledge	How is the company's growth measured?
		How important are the social and environmental benefits compared to the financial benefits?
	Culture	How would you describe the culture within the company? (e.g., bonuses, loans)
		Who has the most power within the company? (e.g., shareholders).
		How would you describe the meaning/culture private car owners give to a car?
	Artefacts	Which artefacts support the company? (e.g., networks, apps)
Niche		How does the car-sharing niche influence the company?
		How does the company respond on this? (e.g., replication)
		Does the company feels threaten by the niche innovation of car-sharing or other innovations?

3. Conclusion

a. What are in your opinion the most important challenges for the company now? And in the near future?

b. What are in your opinion the biggest opportunities for the company now? And in the near future?

c. How do you see the future of the mobility system in the Netherlands in 2050?

d. Do you have anything to add?

e. Do you have any useful documents that could be useful for my research?

A3. Interview guide for policy advisors

1. Introduction
- Briefly explain the research and the interview's aim.
- Ask for permission to record the interview.
- The role/function/responsibility of the interviewee within the organisation.

2. General questions
- How does the organisation relate to other provinces, municipalities, and the state?
- What are the tasks/responsibility of the organisation with regard to shared mobility?
- To what extent is the organisation's influence on shared mobility policies?
- What is the underlying motivation of the organisation to promote car-sharing?
- How does the organisation stimulate car-sharing?
- What challenges does the organisation encounter in this process?

3. Questions about landscape, niche, and regime level (based on the MLP framework)

Dimension	Indicator	Questions
Landscape	Stabilizer	Which trends/exogenous shocks help stabilize the current regime of privately owned cars?
	Destabilizer	Which trends/exogenous shocks put pressure on the current regime of privately owned cars and create windows of opportunity for car-sharing?
Regime		What are the most important developments in the Dutch mobility system? And how do they affect car-sharing? How does the current mobility system hinder the upscaling of shared cars? How does the current mobility regime deal with this change to car-sharing? Are they already participating? Does replication take place within the niche? If yes, how does this contribute to the growth of car-sharing? If not, why not? Does translation of niche ideas into the regime take place? What inhibits this process of translation?

Niche	Network formation	Who are the most important stakeholders of the Province of Utrecht? How would you describe the relationship with other stakeholders? What do you share? (technology, knowledge, access to the market, etc.) Which initiatives is the company participating in? How does this help the company? Who has more power in these transactions? What is the current state of the market from the consumer side and supplier side? What is the expected future market size? Will this be sufficient? What is the potential for car-sharing to scaling up? What are the barriers or drivers to scale up?
	Learning processes	How is knowledge shared among the different actors/experts (e.g., universities, government, businesses, etc.)? Is this sufficient? If not, what knowledge is missing that is required for the sector to grow? Which research should be done? Do car-sharing providers and other niche actors share data with your organisation? What is the current state of technological development and infrastructure of car-sharing? (zone floating, monitoring to match demand and supply (algorithm), electric cars, MaaS platforms with all car-sharing services) How does this influence the growth of car-sharing? How do consumers perceive car-sharing? Are they aware of it? If not, how can this be improved? How do the current policy and regulatory frameworks influence the growth of car-sharing? (parking spots, allowing one-way trips

		to other cities) What adjustments should be made to enable car-sharing?
	The articulation of expectations or visions	What are the organisation's expectations/visions of car-sharing in the near future? Are these expectations/visions aligned with other niche stakeholders? How does the organisation articulate its vision?

3. Conclusion

a. What are in your opinion the most important challenges for the organisation to scale up car-sharing? And in the near future?

b. What are in your opinion the biggest opportunities for the organisation to scale up car-sharing? And in the near future?

c. How do you see the future of the mobility system in the Netherlands in 2050?

d. Do you have anything to add?

e. Do you have any useful documents that could be useful for my research?

A3. Interview guide for mobility consultants

1. Introduction
- Briefly explain the research and the interview's aim.
- Ask for permission to record the interview.
- The role/function/responsibility of the interviewee within the organisation.

2. General questions
- What's the role of the company within the mobility sector? And what role does shared mobility play in this?

3. Questions about landscape, niche, and regime level (based on the MLP framework)

Dimension	Indicator	Questions
Landscape	Stabilizer	Which trends/exogenous shocks help stabilize the current regime of privately owned cars?
	Destabilizer	Which trends/exogenous shocks put pressure on the current regime of privately owned cars and create windows of opportunity for car-sharing?
Regime		What are the most important developments in the Dutch mobility system? And how do they affect car-sharing? How does the current mobility system hinder the upscaling of shared cars? How does the current mobility regime deal with the transition towards car-sharing? Are they already participating? Does replication take place within the niche? If yes, how does this contribute to the growth of car-sharing? If not, why not? Does translation of niche ideas into the regime take place? What inhibits this process of translation? What consumer trends do you see in the mobility sector? Does shared mobility play a role in this?

Niche	Network formation	Who are the organisation's customers?
		What are the main challenges these customers face?
		Who are the organisation's main stakeholders/partners?
		What is the expected future market size of car-sharing? Will this be sufficient?
		What is the potential for car-sharing to scale up? What are the barriers or drivers to scale up?
	Learning processes	How is knowledge shared among the different actors/experts (e.g., universities, government, businesses, etc.)? Is this sufficient? If not, what knowledge is missing that is required for the sector to grow? Which research should be done?
		What is the current state of technological development and infrastructure of car-sharing? (zone floating, monitoring to match demand and supply (algorithm), electric cars, MaaS platforms with all car-sharing services) How does this influence the growth of car-sharing?
		How do consumers perceive car-sharing? Are they aware of it? If not, how can this be improved?
		How do the current policy and regulatory frameworks influence the growth of car-sharing? (parking spots, allowing one-way trips to other cities) What adjustments should be made to enable car-sharing?
	The articulation of expectations or visions	What are your expectations/visions of car-sharing in the near future?
		Are these expectations/visions aligned with other stakeholders? How does the organisation articulate its vision?

3. Conclusion

a. What are in your opinion the most important challenges for the organisation to scale up car-sharing? And in the near future?

b. What are in your opinion the biggest opportunities for the organisation to scale up car-sharing? And in the near future?

c. How do you see the future of the mobility system in the Netherlands in 2050?

d. Do you have anything to add?

e. Do you have any useful documents that could be useful for my research?

A4. Interview guide for households (users and non-users)

1. Introduction
- Briefly explain the research and the interview's aim.
- Ask for permission to record the interview.

2. General questions
- Who is part of the household? Any children? (age?).
- Where do you live?
- Do you own a car? If yes, how many?
- Do you (also) use a shared car? If yes, for how long?

Daily mobility practices
- Can you describe your daily travel pattern?
- How often do you travel with a (shared) car?
- Do you also use other travel options? (e.g., bus, tram, bicycle, walk). How often?
- How do you decide what travel option to use? (e.g., distance, rain, traffic jams, season, activities, etc).

Other mobility practices
- Can you describe your holiday travel pattern?
- Can you describe your travel pattern for a weekend trip/day off? (e.g. visiting people, etc.).
- For which other purposes are you using a (shared) car? (e.g., errands, shopping, etc). And for which not?
- Are there recent changes in your mobility pattern? (frequency, type of transport mode, etc.).

3a. Specific questions for households who use **car-sharing**
- Did you own a private car before? Or a leased a car? If yes, why did you get rid of the private car?
- When did you start using car-sharing? How did your situation change when you started using a shared car?
- Which car-sharing services do you use? How do you decide which one to use?
- What is the average distance from your house to a shared car? How do you perceive this?
- Why did you start using car-sharing? (e.g., financial, environmental reasons).
- Has the option to use a shared car affected your decision to now own a car?
- Do you consider car-sharing as long-term or temporary mode of transport?
- When would you consider to buy a private car?
- How did your travel pattern/daily life change when shifting to car-sharing?
- Did car-sharing affect the use of other transport modes? (e.g., walking, cycling, public transport).
- What are the benefits of car-sharing compared to your previous situation?
- And what are the downsides of car-sharing compared to your previous situation? Did you have to sacrifice certain things?
- Do you have struggles while using car-sharing now or in the past?
- Do you discuss car-sharing in social settings?

Concept	Dimension	Questions
Element of practice	Material	Do you need an app to access car-sharing? How do you experience this? Was it hard to learn? Does it always work? How do you pay for the service? Does this work well? (e.g., safety, transparency, fair, etc.) How do you get access to the vehicle? Is this convenient? What does the parking infrastructure look like? Is it close to your house? How do you experience this? What about the access to child seats? How do you experience this? Do you think shared cars are comfortable and luxurious enough? How do you experience this? Does it bother you that you have to remove all the cargo? How do you experience this?
	Meaning	What meaning do you give to a car in general? *When the respondent owned a car before:* Has this meaning changed? What meaning do you give to car-sharing? (e.g., environmental sustainable, flexible, cheap, etc.)
	Competences	What skills did you need to acquire for car-sharing? How does planning your trip works for you? Do you perceive any difficulties with this? What about financial planning? How do you experience variable costs?
	Practitioner	Did you start using car-sharing in a certain life stage? How did this stage of life make you switch to car-sharing? (e.g., partner, children, work etc.)

| | | What life event / trigger event caused the switch to car-sharing? (e.g., new hometown, new job, financial problems, etc.) |
| | Related practices | Which other practices are influenced by the use of a shared car? (e.g., shopping, short/long-term vacations, visiting people, etc.); <u>in other words:</u> How did your daily-life change when using car-sharing?

Do you also perform sharing on other platforms? |

3b. Specific questions for households who own **a private car**
- When did you buy your first private car? How did your situation change when you bought a car?
- Why do you own a private car?
- How did your travel pattern/daily life change when you bought a car?
- Did the ownership of a private car affect the use of other transport modes? (e.g., walking, cycling, public transport).

Concept	Dimension	Questions
Element of practice	Material	What does the parking infrastructure look like? Is it close to your house? How do you experience this? In terms of material, what should a car look like? (luxury, safety, big/small, etc.). Are you loyal to a specific car brand? And why?
	Meaning	What meaning do you give to owning a private car? (e.g., freedom, security, convenience, safety, status, flexibility, social, etc.) Would this meaning also fit with a shared car? If yes/no, why?
	Competences	What skills did you need to own a private car?
	Practitioner	Did you buy a car in a certain life stage? How did this stage of life make you buy a private car? (e.g., partner, children, work etc.).

		What life event / trigger event made you buy a private car? (e.g., new hometown, new job, financial problems, etc.)
	Related practices	For which other practices do you use your car? (e.g., go to work, shopping, recreation, visiting family/friends, etc.) Do you think these practices are still possible when switching to a shared car? If yes/no, why?

- Do you know what car-sharing entails?
- Have you considered using car-sharing? If yes/no, why? (e.g., when parking spots are only available for shared cars)
- Would you consider car-sharing in another situation? If yes, in which situation?
- What are the potential downsides of car-sharing compared to owning a private car?
- What are the potential benefits of car-sharing compared to owning a private car?
- How do you think your travel pattern/daily life has to change when switching to a shared car?
  - How hard is it to change your daily life accordingly? (e.g., just a hassle or stronger barriers)
  - Are you willing to change your daily life accordingly?
- How far are you willing to travel to a shared car?
- What is needed for you to start using car-sharing? (e.g., financial incentives, policy support, etc).