

**From automobility to (auto)mobility:
Studies of car-sharing practices in sustainability
transitions of mobility systems**

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Art That Reclaims the Ignored



Illustration: Peter Fischli and David Weiss, Waiting for the Elevator, from Suddenly This Overview (1981–2012) © Peter Fischli/David Weiss. Courtesy Glenstone. Photo credit: Jason Klimatsas ¹

Significant, trivial, and ridiculous events in the history of the world are given equal weight in *Suddenly This Overview* (1981–2012), a mini-encyclopaedia of small unfired clay sculptures. Undeniably handmade, the sculptures are rooted in the physical world; the unfinished nature of the unfired clay foregrounds their materiality and invites the possibility of being remodelled, pointing to the open-ended nature of any attempt to map the world (Lynch & Lynch, 2016).

Their subject is the everyday, or real, world that we all see but rarely pay much attention to: random notions and musings pass through our minds and are forgotten. Gentle, playful, and ironic, these little clay sculptures seek to reshape ordinary and omnipresent objects and thoughts – without, in the process, losing sight of their ordinariness. Their ultimate point could be a kind of reclamation of the ignored (Schwartz, 2016).

¹ <https://www.artagencypartners.com/suddenly-this-overview/>

Preface

This PhD thesis is funded by the Research Council of Norway under the ENERGIX project TEMPEST, grant number 255430. The research has been conducted with partners in the project and at the Institute of Transport Economics (TØI) during my employment as a doctoral candidate at the TIK Centre for Technology, Innovation and Culture at the Faculty of Social Sciences, University of Oslo, from May 2017 to July 2021.

The thesis consists of an introductory chapter and five published/accepted/submitted papers.

Svennevik, E. M. C. (2019). The existing and the emerging: car ownership and car sharing on the road towards sustainable mobility. *International Journal of Automotive Technology and Management*, 19(3–4), 281–300.

Svennevik, E. M., Julsrud, T. E., & Farstad, E. (2020). From novelty to normality: reproducing car-sharing practices in transitions to sustainable mobility. *Sustainability: Science, Practice and Policy*, 16(1), 169–183.

Svennevik, E.M, Dijk, M., & Arnfalk, P. (2021). How do new mobility practices emerge? A comparative analysis of car-sharing in cities in Norway, Sweden and the Netherlands. – Manuscript accepted for publication in *Energy Research & Social Science*.

Svennevik, E. (2021). Providers and practices: How suppliers shape car-Sharing practices. *Sustainability*, 13(4), 1764.

Svennevik, E.M (2021) Practices in transitions: Review, reflections, and research directions. – Manuscript submitted for review to *Environmental Innovation and Societal Transitions*.

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Elisabeth M.C. Svennevik

Summary

Studies of car-sharing practices in sustainability transitions of mobility systems: System reconfigurations, Social Practice Perspectives, and a proposal for a Practice Innovation System (PIS) approach

What happens to the mobility system when alternatives to the dominance of car ownership appear? How can we understand the dynamics of change and continuity when new alternatives to the dominant ways of doing things arise? This thesis provides analyses of such dynamics.

While existing automobility-based transportation systems provide numerous benefits, the negative societal impacts are enormous, and innovations that could change them have the potential to combat or reinforce the status quo system of ‘automobility’ (Axsen & Sovacool, 2019). Lock-ins in automobility, the emergence of car-sharing services, and the development of the sharing economy have motivated this research.

The objective of the thesis is to understand how car sharing relates to and affects current mobility systems. The research material consists of four empirical studies of car-sharing practices as regards changes towards sustainable mobility, plus a review of literature on practices in transition studies. Qualitative methods, with data from stakeholder workshops and household interviews in Norway, Sweden, and the Netherlands, and interviews with providers in Norway, are used for the studies.

The overall research question guiding this thesis is: *How do car-sharing practices influence the dynamics of change and continuity towards environmental sustainability in established mobility systems characterized by the dominance of car ownership?*

The following research questions are addressed in the five studies:

1. How does the use of car sharing in Oslo today relate to and influence the established use of privately owned cars? Are these relations part of a transition towards sustainable mobility?
2. Under which conditions are car-sharing practices reproduced, and what are the implications of this reproduction for a transition to sustainable mobility?
3. How does car sharing emerge differently in different places, amid particular local, established mobility practices?
4. How do car-sharing providers shape car-sharing practices, and with what implications?
5. How are theories of social practice applied in sustainability transition research?

Paper 1 studies how car sharing interferes with car-owning. Presenting examples of the household use of car-sharing, with three forms of reconfiguration – competing, co-existing and complementary – I explain the relationship between the new use of car-sharing and the established dominance of car-owning.

Paper 2 studies how car sharing is stabilized in the current mobility system, with three specific ways of reproducing car-sharing practices: (a) FUSS: Frequent, Unplanned, Short-term, and Small-car use, (b) POLL: Planned, Occasional, Longer-term, and Larger-car use; and (c) PERC:

Purpose Elected from Range of Cars. These practice-as-performances are essential for understanding the conditions under which the practices are reproduced.

Paper 3 studies how the introduction of car sharing affects established mobility practices by bringing changes in shared elements and actor-specific elements for travelling, regulating and operating. Comparative analysis of the cases of Rotterdam, Malmö, and Oslo shows that new digital technologies and regulations are important, affecting business models and the social meaning of mobility towards broader acceptance of access-based transportation.

Paper 4 studies how providers contribute to various kinds of car sharing, and how car-sharing providers shape car-sharing practices. More services lead to a broader understanding of what car sharing entails – explained as practice-as-entity – and contribute to shaping practices in the recursive relationship between practice-as-entity and practice-as-performance.

Paper 5 is a literature review of 83 articles that studies how social practices theories (SPTs) are applied in sustainability transition research and proposes a Practice-Innovation-System (PIS) approach. The review shows how SPTs are applied in studies of system change by i) considering change and continuity in practice elements, niches and regimes, ii) connecting consumption and production, iii) going beyond user practices, iv) mapping diffusions of innovations in daily life and v) examining policy implications and interventions. I propose a ‘3x3’ conceptual PIS framework consisting of three elements (meaning, material and competence), three levels (niche, regime and landscape), and three layers (practice-as-performance, practice-as-connections and practice-as-entity). I propose the PIS approach to conceptualize the practice paradigm for innovation studies and sustainability transition research. The approach is aimed at not only studying practices but also studying innovations and system change through a practice-theoretical perspective.

I discuss how the papers study reconfigurations of regimes and practice elements and, with this, show how car sharing plays a role in reconfiguring the automobility system to an (auto)mobility system through change and continuity. The () parentheses in the title of this thesis indicate the changing role of the auto; the car is still part of the mobility system but plays a less dominant role. With ‘a car-sharing reconfiguration’, the (auto) is still part of this system, both through car-sharing and through a continuation of car-ownership. This is in line with previous research stating that car-sharing is both immersed in, and distinct from, the regime of automobility. Car-sharing contributes to reconfiguring the automobility system into an (auto) mobility system by providing access to cars, whereby car use becomes an occasional practice rather than a daily one.

Instead of taking the demand for cars as fixed and striving to meet that demand through EVs, this thesis can serve as an alternative approach to studying what can change the expected ‘normality’ of car demand. I show that car-sharing is not about adding more cars to solve the same needs: rather, it contributes to changing the perception of ‘normality’ or expectations of the taken for granted demand for cars.

This has implications for policy and society. First, I show how some households repeatedly use car-sharing, and these lessons can be helpful for those who want to engage more with car-sharing. Second, I suggest that car-sharing should be treated as Access-Based Car (ABC) use, going beyond ‘sharing-economy concepts’. This is relevant for the debate on policy support for car-sharing

actors, especially regarding the differences between cooperatives and other providers. Third, I hold that *specific* actions targeted *indirectly* at car-sharing would be valuable to promote car-sharing practices further. Changing existing mobility practices – such as increased walking, cycling, public transport, home deliveries, or working-from-home solutions – to encourage the occasional use of cars would pave the way for acceptance of access-based models, among travellers, operators and planners alike. For car-sharing to contribute to environmental sustainability in personal urban mobility, it is essential to work on different ways of reducing the daily use of cars, so that car-sharing can become a viable option.

Paper 1 finds that car-sharing acts help to promote reduced car-ownership, and changing and reducing the overall use of cars. However, there are limits to its contribution to environmental sustainability because of the continued use of fossil fuel cars in car-sharing services and the continued dependence on privately used cars. Paper 2 supports a cautious view, in the shift from owning to accessing, car-sharing is linked to other stable practices that still require personal car use. Paper 3 further shows that car sharing connects to the reduction of the daily use of cars. Car sharing is a viable option for the occasional use of cars. Meaning that the reduction in *daily* car use is reliant on changes beyond the introduction of car sharing. Interventions should thus not only be directed at car-sharing per se: rather, it should be on urban mobility in general. Further, in some places, car-sharing is a solution for accessing EVs and a step towards car-free cities. Paper 4 further supports this, showing that car-sharing is part of ‘moving mobility’ with many ongoing changes, including access-based mobility, towards a ‘system of mobility’.

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Elisabeth M.C. Svennevik

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- Paper 2: Svennevik, E. M., Julsrud, T. E., & Farstad, E. (2020). From novelty to normality: reproducing car-sharing practices in transitions to sustainable mobility. *Sustainability: Science, Practice and Policy*, 16(1), 169–183.
- Paper 3: Svennevik, E.M., Dijk, M., & Arnfalk, P. (2021) How do new mobility practices emerge? A comparative analysis of car-sharing in cities in Norway, Sweden and the Netherlands. – Manuscript accepted for publication in *Energy Research & Social Science*.
- Paper 4: Svennevik, E. (2021). Providers and practices: How suppliers shape car-Sharing practices. *Sustainability*, 13(4), 1764.
- Paper 5: Svennevik, E.M (2021) Practices in transitions: Review, reflections, and research directions. – Manuscript submitted for review to *Environmental Innovation and Societal Transitions*.

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PART I

Introductory chapter

1 Introduction: Automobility in transition

Cars play an important role in exacerbating the climate crisis and environmental challenges. Current car-dominant mobility systems are unsustainable, involved in creating problems of emissions, congestion, and land use (Banister, 2005). However, together with other innovations like electric vehicles, car sharing may well help to change this, perhaps becoming part of a completely new mobility system (Sperling, 2018).

In this thesis, I follow the concept of a ‘system of automobility’ that describes the continued, self-reinforcing dominance of privately-owned, petroleum-powered vehicles used primarily by single occupants (Axsen & Sovacool, 2019; Urry, 2004). While today’s automobility-based transportation systems provide numerous benefits, the negative societal impacts are enormous. Innovations that could change this situation have the potential to either combat or reinforce the status quo (Axsen & Sovacool, 2019). From the end of the 19th century, the ‘system of automobility’ resulted from path-dependent mobility patterns centred around private cars.² Economies and societies became ‘locked in’ to the steel-and-petroleum car, as social life was irreversibly linked with the mode of mobility generated and presupposed by automobility. Automobility gave rise to new forms of commuting, family life, community, leisure, the pleasures of movement, and so on (Urry, 2004). Although this mode of mobility is neither socially necessary nor inevitable, breaking away from it has seemed impossible (Urry, 2004).

Because car-based mobility dominates in developed countries, transitions to sustainable transport cannot avoid taking automobility into account (Geels et al., 2011). Automobility is deeply embedded in Western lifestyles and stabilized through sunk investments and interests vested in its continuation. However, in view of the many problems associated with its development, change is required. This raises the question of the role of cars in a future transport system that is more environmentally sustainable. Will a future transport system be based on ‘green cars’? Or will this system look very different from today’s transport systems, with intermodal linkages between various sub-systems and less prominence accorded to cars? Electric Vehicles (EVs) have been promoted in order to reduce the negative environmental problems of car dominance – but are there other alternatives? Can car sharing help to solve the environmental problems associated with today’s car-dominant transportation system?

Considerable research has been done in transportation studies about ‘greening’ the car and sustainable mobility. For example, Banister’s (2008) sustainable mobility paradigm proposes alternatives such as not making trips, shortening trip lengths with land-use planning, a modal shift to public transport, walking and cycling, and vehicle efficiency. But something is missing here. The dominant approach, in research and in policy, has focused on public transport, vehicle electrification or other alternatives such as cycling. In Norway, for example, EVs have been the focus of research and policy. However, concerns have also been raised about the limited contribution of such technological substitutions to a sustainable mobility system. Technological substitutions and vehicle electrification are not by themselves enough for sustainable mobility, as they will only promote a continuation of the auto-owning culture (Sperling, 2018). Car sharing has recently come into focus as a possible solution for environmentally sustainable mobility.

Some researchers have argued that replacing ownership with temporary access can be part of a transition towards a more sustainable mobility system (Münzel, 2020; Frenken, 2013). Some research has started to focus more on car-sharing *practices* (Dowling et al., 2018; Kent &

² In this thesis I use the terms ‘auto’ and ‘car’ interchangeably.

Dowling, 2013) and how practice theories can inform the transition to a decarbonized transport system (Kent, 2021; Watson, 2012). It is within this discourse that my research is positioned.

A growing body of literature in the field of sustainability transitions has proposed various conceptual and theoretical frameworks for understanding socio-technical change. Many of these studies focus on industries that develop and diffuse new technologies for sustainability; there have been fewer studies on the social context of how technology is used and the role of practices in these transitions. Lately, the role of practices and everyday life has received increased attention in transition studies. It is suggested that users can contribute beyond a consumer position in system change towards sustainability. Concepts of practices – originating from social practice theories in particular – have been deemed useful for handling these additional aspects of users, and therefore there has been growing interest in practice-based perspectives on system change. The advantage of such an approach lies in the focus on everyday life and the use of technologies and factors contributing to continuation, stability and resistance to change. However, despite the richness and valuable insights of the growing body of literature of practices in transitions, this field still lacks a coherent approach that can capture the role of practices in transitions conceptually. Also, despite the swelling mass of literature on the uptake of car sharing, research has not fully explained the system dynamics at work in this uptake, or connected these new practices to the established systems.

The ambition of this thesis is to contribute to mitigating these shortcomings. By examining how car-sharing practices are part of changing mobility systems dominated by the privately-owned car, I hope to deal with these deficiencies. The thesis addresses theoretical and empirical research gaps of insufficient understanding of the role of car-sharing practices in the transition to sustainable mobility and the limited focus on practices in transition studies. This is indeed a story of change and continuity. My analysis shows how shared mobility practices contribute to stability and instability in current mobility systems dominated by car ownership. I combine Social Practices Theories (SPTs) and concepts from the Multi-Level Perspective (MLP) on socio-technical transitions to address such dynamics.

Let me illustrate this point by the example of plant-based meat substitution products. It is relevant to find out who buys plant-based products and why these products are used. But what happens to the established meat-dominant diet when plant-based substitutions are introduced? What happens to the normality of eating meat daily – how can a vegan diet reconfigure the food system? (Laakso et al., 2021b). Answers to these questions can shed light on the objective of not only understanding the uptake and diffusion, but also grasping how a new practice can cause changes to an established system.

My research presented in this thesis aims to study such dynamics, through four empirical studies of car-sharing practices for environmentally sustainable mobility and a review of literature on practices in transition studies. The studies draw on literature from SPT and transition literature. Qualitative methods, with data from stakeholder workshops and household interviews in Norway, Sweden and the Netherlands, and interviews with providers in Norway, are used for the studies. Guided by the motivation for studying the broader implications of implementation of car sharing, I ask:

How do car-sharing practices influence the dynamics of change and continuity towards environmental sustainability in established mobility systems characterized by the dominance of car ownership?

I follow the definition of car sharing as ‘a practice whereby registered members of an organization or platform can rent and operate vehicles on a self-access basis for short and medium-term use’ (George & Julsrud, 2018). The studies include various types of car-sharing business models, including for-profit and not-for-profit, business-to-consumer, or Peer-to-Peer models, offering round trips or one-way trips through station-based or free-floating schemes. I examine passenger road transport mobility systems in three areas of interest – Oslo in Norway, Malmö in Sweden and Rotterdam in the Netherlands.

All five papers are positioned within sustainability transition research. The first paper examines relations between car sharing and car ownership by using the MLP and pathways of reconfiguration. The second, third, and fourth papers use SPT to study how car sharing relates to, and changes, the mobility system. The fifth paper is a literature review of practices in transitions, suggesting a Practice Innovation System (PIS) approach.

The thesis connects to, and builds on, empirical research on car-sharing practices and automobility (Kent & Dowling, 2013), how theories of practice can inform the transition to a decarbonized transport system (Kent, 2021; Watson, 2012), transitions in practice (Shove, 2012), theories of social practice in sustainability research (Maller, 2015) and reconfigurations in sustainability transitions (Hodson et al., 2017; Laakso et al., 2021a).

The artwork that opens the thesis is meant to show that I am interested in investigating and modelling social interaction with technology, highlighting the ordinariness of everyday life, and accepting the open-ended nature of any attempt to map the world.

The table below gives an overview of paper titles, short titles, numbering of the five papers, plus an overview of the authors, journals, and the publication status of the papers. Three of the papers are single-authored; two are co-authored. The table also gives an overview of the research questions and data applied in the papers.

Short title and title	RQ	Data
<p>1 Existing and emerging The existing and the emerging: car ownership and car sharing on the road towards sustainable mobility Elisabeth M.C. Svennevik Published in <i>International Journal of Automotive Technology and Management (IJATM)</i></p>	<p>How does the use of car sharing in Oslo today relate to and influence the established use of privately owned cars? Are these relations part of a transition towards sustainable mobility?</p>	<p>Interviews with households in Oslo</p>
<p>2 Novelty to normality From novelty to normality: reproducing car-sharing practices in transitions to sustainable mobility Elisabeth M.C. Svennevik, Tom Erik Julsrud, Eivind Farstad Published in <i>Sustainability: Science, Practice and Policy (SSPP)</i></p>	<p>Under which conditions are car-sharing practices reproduced, and what are the implications of this reproduction for a transition to sustainable mobility?</p>	<p>Interviews with households in Oslo</p>

<p>3 Emerging mobility practices How do new mobility practices emerge? A comparative analysis of car-sharing in cities in Norway, Sweden and the Netherlands</p> <p>Elisabeth M.C. Svennevik Marc Dijk, Peter Arnfalk Manuscript accepted for publication in <i>Energy Research and Social Science (ERSS)</i></p>	<p>How does car sharing emerge differently in different places, amid particular local, established mobility practices?</p>	<p>Household interviews and stakeholder workshops in Oslo, Rotterdam and Malmö</p>
<p>4 Providers and practices Providers and practices: How suppliers shape car-sharing practices Elisabeth M.C. Svennevik Published in <i>Sustainability</i></p>	<p>How do car-sharing providers shape car-sharing practices, and with what implications? The research objective is to explore how business models and platforms contribute to shaping car-sharing practices.</p>	<p>Household interviews and stakeholder workshops in Oslo Interviews with industry</p>
<p>5 Practices in transitions Practices in sustainability transitions: Review, reflections, and research directions Elisabeth M.C. Svennevik Submitted to <i>Environmental Innovation and Societal Transitions (EIST)</i></p>	<p>How are social practice theories applied in sustainability transition research?</p>	<p>Literature review, 83 articles</p>

Table 1: Overview of authors, journals, and publication status of papers.

This thesis is organized into seven sections. In the first section, I introduce the theoretical and empirical motivation. Section two elaborates on the research contexts by presenting sustainability challenges for the current automobility system, describing shared mobility and car sharing, and arguing why this is needed to solve these challenges. Here I present the state-of-the-art of car-sharing research. In section three, I position the thesis theoretically within the sustainability transition literature in innovation studies, and discuss SPT relevant to my analysis. In section four, I explain my choice of a qualitative approach; I present the research design, the data collection and the ethical considerations, and position the research within the philosophy of science. Section five offers a summary of the findings of the five papers. In section six, I discuss how the findings contribute to answering the overall research questions. Section seven presents the conclusions and the implications for theory, policy and practitioners, with suggestions for further research.

2 Research context and empirical setting

This chapter introduces the research context and empirical setting of the study. I describe the motivation for the empirical studies – and the positioning within social practice theories and sustainability transitions research – by presenting state-of-the-art research on car sharing in system change towards environmentally sustainable mobility. I note the sustainability challenges entailed in the present automobility system, with key concepts, definitions and the development of car sharing and the sharing economy.

2.1 Sustainability challenges in the present automobility system

Car-dominant automobility systems are unsustainable as they contribute to problems of resource use, emissions, congestion, land use, and deaths and injuries from road accidents (Banister, 2005). Unsustainable modes of production and consumption are accelerating the global destruction of natural habitats, depletion of resources, the release of greenhouse gases, and other forms of pollution. Transport is responsible for almost 30% of the EU's total CO₂ emissions, of which 43% come from passenger cars (Fevang et al., 2021). The continuous rise in demand for road transportation significantly exacerbates Europe's oil dependency and emissions of greenhouse gases (Pasaoglu et al., 2012). Therefore, car transport is a crucial sector for developing strategies to curb the upward trend in CO₂ emissions in Europe (González et al., 2019).

Parking and driving take up land, thereby preventing alternative use. Moreover, instead of being used, cars are parked most of the time. For example, in the UK, the average car spends about 80% of the time parked at home, is parked elsewhere for about 16% of the time, and is thus only actually in use (i.e. moving) for the remaining 3–4% of the time (Bates & Leibling, 2012; Marsden, 2014). The illustration shows distressing features of using land for cars: city streets are seen as holes, crossings as wobbly planks, and pavements as thin lines – demonstrating how little space is accorded to pedestrians in a typical street intersection.

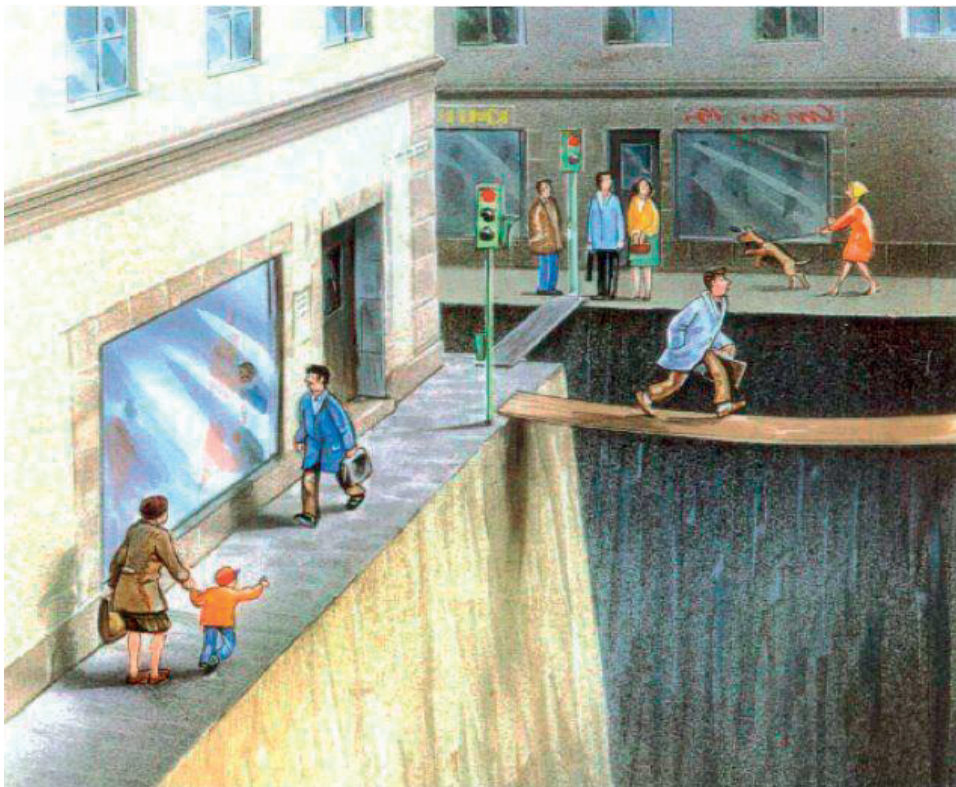


Illustration 1: Karl Jilg/Swedish Road Administration

Innovations, particularly electric vehicles and shared mobility, are expected to add sustainability to this system (Axsen & Sovacool, 2019). Automated driving can also have implications for the sociotechnical system of automobility (Fraedrich et al., 2015). These innovations are known as the ‘Three Revolutions’ (Sperling, 2018) or ‘New Mobilities’ (Sheller & Urry, 2016), or are referred to by other collective terms like CASE – for connected, automated, shared, and electric vehicles (Axsen & Sovacool, 2019).

However, vehicle electrification alone is not enough: it will only promote the continuation of the auto-owning culture (Sperling, 2018). Technological innovations such as EVs are expected to reduce emissions compared with fossil-fuel vehicles, but these developments are not enough to solve the problems of the current automobility system. Many studies have focused almost solely on EVs (Wu et al., 2021). Energy savings and environmental and social benefits can be achieved through steering the development of automated, shared, *and* electric vehicles; and one key to a sustainable transportation future is sharing cars and ensuring that vehicle seats are filled by more passengers (Sperling, 2018).³

Nevertheless, innovations are of little importance if they are not diffused and become part of people’s everyday lives. Delivering a sustainable transport system is not just a matter of adopting various technological innovations to improve performance. A broader structural and societal transition is needed – in technology and institutions, behavioural patterns, and the economy as a whole (van Nunen et al., 2011). In mobility systems, the technical aspects of the transport system (vehicles, infrastructure, etc.), the organizational models (e.g. individual car ownership, car and bike sharing, or ticketing schemes), the regulatory framework and user habits are all co-evolving. These interactive dynamics create path dependencies that make it difficult to alter the overall direction of the development. Making the mobility system sustainable thus requires technical and non-technical developments to align in mutually reinforcing processes (Geels et al., 2011).

Mobility systems in Western countries are dominated by the car and the socio-technological ‘regime of automobility’ (Geels & Kemp, 2012). This self-expanding ‘system of automobility’ (Urry, 2004) is taking hold across the globe: and the effect is often ‘car dependence’ (Mattioli, 2014) of individuals and locations. ‘Peak car’ has been used as a short-hand label for phenomena of slower rates of growth, levelling off, or reduction in various measures of car use (Goodwin & Van Dender, 2013). Despite indications of change in car-use growth, there are many uncertainties and dependencies linked to the future of cars. Reasons for and attitudes to car use in everyday life are being questioned –whether this is a real choice, or a matter of structural pressure (Nordbakke & Lunke, 2021). Car ownership, or at least access to cars, becomes necessary for social inclusion and participation. Studies from Australia show that social exclusion threatens not only car-deprived persons but also people who suffer from economic stress caused by the costs of ‘forced car ownership’ (Currie & Delbosc, 2011), including ‘oil vulnerability’: vulnerability to rising fuel costs (Dodson & Sipe, 2007). Moreover, public-transport users in car-dependent areas often suffer from ‘time poverty’ due to long travel times (Berger et al., 2014).

2.2 Car sharing in system change towards environmentally sustainable mobility

Car sharing represents a step that can play a role in the broader socio-technical transition towards more sustainable mobility systems (Julsrud & George, 2020). Several studies indicate

³ While Sperling (2018) focuses on carpooling and ride sharing as ‘shared’ activities, in this thesis ‘shared’ does not include carpooling and ridesharing.

that car-sharing helps to promote environmental sustainability (Firnkorn & Müller, 2011; Frenken & Schor, 2017; Hildermeier & Villareal, 2014; Rabbitt & Ghosh, 2016; Sovacool & Axsen, 2018). Such sustainable mobility transitions rely on a relationship between the development of vehicle and fuel technologies and the provision of mobility services, in addition to information technology and transport policy (Dowling & Kent, 2015; Nykvist & Whitmarsh, 2008). Here I show how research on upscaling, diffusion, adoption patterns, car-dependent practices and city contexts are relevant. Then I explain how this gives rise to some critical concerns, and present common indicators used for determining the environmental impacts of car sharing.

Two doctoral theses that have studied the *upscaling* of car sharing find that sustainability transitions cannot build solely on technological innovations but also require disruptive new services and business models (Meelen, 2019; Münzel, 2020). Upscaling entails a certain degree of reconfiguration of existing socio-technical regimes. In the phase of upscaling, the innovation may get confronted with barriers to growth that relate to the current dominant system. These regime barriers include vested interests or institutions that are not compatible with the innovation. For example, the status often attached to personal car ownership can hamper the transition to car sharing (Meelen et al., 2019; Truffer, 2003).

The *diffusion* of car-sharing business models is found to be enabled by digital technologies and related to the emergence of peer-to-peer marketplaces (Münzel et al., 2018; Vaskelainen & Münzel, 2017; Vaskelainen et al., 2021). *Adoption patterns* of car sharing are affected by the relation between niche innovations of car sharing and the socio-technical regime of private car ownership (Meelen et al., 2019). *Car-dependent practices* can further be used to identify car- and mobility-intensive activities, showing why certain activities are more difficult to switch away from cars (Mattioli et al., 2016). The interconnections between mobility and other everyday practices are therefore essential (Christensen et al., 2021), and everyday mobility and giving up car ownership are found to be connected to mobility routines (Laakso, 2017b) and shifting meanings of mobility (Meinherz & Fritz, 2021). The challenges of curbing unsustainable travels also relate to increasing participation in socially desirable practices (Hui, 2011). Studying mobility practices provides opportunities to study the *practices* that are being undertaken, rather than focusing on the individual undertaking the action (Williams, 2014). Understanding the dynamics of practices offers an opening into transitions towards sustainability, as illustrated by the examples of cycling (Spurling et al., 2013) and low carbon policy linked to social practices (Shove, 2014a). Policies that transform practices (Heiskanen & Laakso, 2019) include, for example, transport policies that consider how the elements of practices – materials, meanings and competencies – link together in moving towards more sustainable mobility practices of car sharing (Dowling & Kent, 2015) and cycling (Larsen, 2017). Car sharing works because it is a practice that bundles existing elements together in new and subtly different ways (Kent & Dowling, 2013).

City contexts and business models also play a role. There are high expectations on sharing cities and sharing business models as ways to drive sustainable development (Martin, 2016; Münzel et al., 2018). Car sharing is situated in the urban transport system (Banister, 2008; Botsman & Rogers, 2010; Degirmenci et al., 2017; Urry, 2004). Further integration between shared mobility operators and cities is needed to increase sustainability (Cohen & Kietzmann, 2014) as business model innovation transforms user mobility practices (Sarasini & Langeland, 2021). In the case of Norway, differing socio-demographics and residential built environments – directly and indirectly conveyed through personality traits, attitudes and car ownership – affect the willingness to engage in car sharing (Hjorteset & Böcker, 2020). Thus, the totality of sharing business models in a city context and how these relate to each other needs to be better

understood (Bocken et al., 2020). Car sharing may be a sustainable solution, but it often encounters barriers stemming from local contexts, regulatory environments, or lack of political support or consumer awareness, as well as the interdependency of these obstacles (Terama et al., 2018).

Car sharing for environmental sustainability also gives rise to critical concerns. Some argue that car sharing is unlikely to drive a transition towards sustainability if it follows the pathway of continued consumption (Martin, 2016). Others point out that efforts to achieve sustainable mobility take various forms and are shaped by local actor constellations (Berger et al., 2014). Some studies question the environmental sustainability of access-based car use, investigating the intentions and impacts of the use, and finding both positive and negative effects (Dill et al., 2019). In particular, some question free-floating services with (overly) easy access, as that might lead to *more* car use (Becker et al., 2017). Also, various combinations of motivations affect the implications of the use (Böcker & Meelen, 2017). The environmental sustainability implications thus depend on how car sharing relates to the urban transport system (Akyelken et al., 2018) and the complex, interdependent, and collective organization of (mobility) practices (Laakso, 2019). Shared mobility can change personal transportation by reducing the need for private cars (Boyer, 2016; Hasselqvist & Hesselgren, 2019; Schwanen et al., 2012). For example, studies have found evidence that households relying on shared cars instead of private ones drive less and take fewer trips (Ferrero et al., 2018; Martin & Shaheen, 2011).

The most common indicators used for determining the environmental impacts of car sharing are vehicle holding at the household level, vehicle km travelled (VKT), GHG emissions and modal splits between car sharing and other modes of mobility (George & Julsrud, 2018). The impact of car sharing on vehicle holding is not as straightforward as a simple yes or no; sometimes, membership can delay purchasing a car. A study of car-sharing users in Switzerland found that 8% of free-floating users and 19% of station-based users would have purchased a car if they were not members of the car-sharing scheme (Becker et al., 2017). A study in Germany found that one additional station-based car is associated with a reduction of about nine private cars (Kolleck, 2021). In most studies, car-sharing is associated with a decrease in VKT (Cervero et al., 2007; Loose, 2010; Martin & Shaheen, 2011; Meijkamp, 1998; Steininger et al., 1996). For example, a study of the effects of car sharing in the Netherlands found that users drove 15–20% fewer km than they did before becoming car-sharing members (Nijland & van Meerkerk, 2017). As cars become more energy-efficient, the share of carbon footprint derived from land use and material consumption is also changed (Doka & Ziegler, 2000). The carbon impact is marginal if the money saved from car sharing is used on a distributed set of consumables – carbon reduction diminishes if it is spent on, for example, air travel (Briceno et al., 2005). European studies indicate that between 15.6 and 34% of participants sold a vehicle after joining a car-sharing programme (Shaheen & Cohen, 2013). Table 2 shows reported social and environmental impacts due to car sharing, presenting a reduction in Carbon Dioxide emissions of 29% to 54% and vehicle replacements (sold/forgone purchase) of 4 to 10 cars (Shaheen & Cohen, 2013).

Impact	Europe
CO₂ emissions reduction	29% to 54%
Number of private cars a car-sharing vehicle replaces (sold/forgone purchase)	4 to 10 cars
Sold vehicle due to car sharing	15.6% to 34%

Table 2: Summary of social and environmental benefits due to car sharing

2.3 What is car-sharing? Defining car-sharing practice

In this thesis, I follow the definition of car sharing as ‘a practice whereby registered members of an organization or platform can rent and operate vehicles on a self-access basis for short and medium-term use’ (George & Julsrud, 2018). This definition follows a basic principle of car sharing: people gain the benefits of a private automobile without the responsibilities and costs of car ownership (Shaheen & Cohen, 2013). The key distinction between car sharing and other forms of ‘access without ownership’ is who operates the car (Truffer, 2003). Other associated shared vehicle notions are ridesharing or carpooling, whereby additional passengers are added to a pre-existing trip on a non-commercial basis (Harms & Truffer, 1998, p. 9) and ride-sourcing services that connect passengers with drivers who use personal, non-commercial, vehicles (Parzen et al., 2015, pp. 5–8). This difference is relevant for the research in this thesis. The studies in my research do not investigate car-pooling, ride-sharing, ride-hailing or taxi, or hitchhiking-like arrangements. Instead, the studies include variants of car-sharing schemes where the user operates the vehicles, such as car collectives, peer-to-peer platforms, and station-based and free-floating services. In addition, I chose to focus on formal car sharing and not informal car sharing through lending or borrowing cars.

Shared use vehicle schemes take many forms to fit various mobility purposes (Barth & Shaheen, 2002). There are variations of access and payment in these schemes. Users can, for example, be members with monthly subscriptions or pay hourly rates. Car-sharing operators manage their services with advanced technologies, including automated reservations, instant reservations, vehicle type and point of departure reservations, smartcard vehicle access, real-time vehicle tracking, and equipment that facilitates one-way trips (Shaheen et al., 2006). More specific definitions depend on the type of car-sharing schemes, memberships, locations, payments, and market segments. For example, individuals can access car-sharing vehicles by joining an organization that maintains a vehicle fleet in a network of locations. Vehicles are typically deployed from parking spaces or points of departure in neighbourhoods, universities, major employment centres, and public transit stations (Shaheen et al., 1998; Shaheen 1999). Since 1995 there has been an increase in car-sharing business models, including personal vehicle sharing (use of privately-owned autos in shared-use vehicle services); transit-based; government and institutional fleets; college- and university-based; and residential neighbourhoods (Shaheen & Cohen, 2013). Transaction models can describe the dynamics of access, ownership, supply, and demand. For example, business-to-consumer (B2C) is where businesses own the assets and facilitate transactions amongst users, and peer-to-peer (P2P) is when assets are owned and exchanged directly from person to person (Botsman, 2013). The services can offer cars on station-based or free-floating arrangements, for one-way or round trips.

2.4 Car sharing and the sharing economy

This definition and delimitation also relate to *sharing economy* concepts. I follow the definition of car sharing as a practice of access to vehicles. The provider’s business model varies; thus, the definition I follow does not see car sharing as only about sharing surplus resources. This definition of car sharing, therefore, goes beyond a narrow understanding of the sharing economy. Due to the considerable variation in sharing economy definitions, I follow the earlier stated definition of *car sharing* and relate it to business models and transaction types of accessing car sharing. I consider the sharing economy an umbrella concept, comprising many stakeholders, markets, and activities (Acquier et al., 2017). Here I elaborate on the development of sharing economy definitions.

The sharing economy remains a contested phenomenon lacking a definitional precision (Curtis & Lehner, 2019; Ertz & Leblanc-Proulx, 2018; Gurău & Ranchhod, 2020), and various terms

are used, e.g. collaborative consumption, access-based consumption, collaborative or peer economy (Mont et al., 2020). The sharing economy is a highly dynamic, complex, disruptive, and controversial phenomenon, which has grown exponentially since the Internet was introduced (Gurău & Ranchhod, 2020). The activities and organizations commonly referred to as the ‘sharing economy’ are also labelled as ‘collaborative consumption’ (Botsman, 2013; Botsman & Rogers, 2010) or ‘access-based consumption’ (Bardhi & Eckhardt, 2012; Belk, 2014b). The Internet makes many sharing forms available, and the Internet itself is a giant pool of shared content that anyone can access (Belk, 2014b). Accordingly, several other sharing concepts are also emerging, in particular in consumer research. Belk (2014b) mentions several related sharing activities, for example, ‘connected consumption’ (Dubois et al., 2014; Schor, 2016; Schor & Fitzmaurice, 2015), ‘commercial sharing systems’ (Lamberton & Rose, 2012), ‘the mesh’ (Gansky, 2010), ‘co-production’ (Humphreys & Grayson, 2008) ‘prosumption’ (Ritzer & Jurgenson, 2010) and ‘product-service systems’ (Mont, 2002).

The labels ‘sharing economy’ and ‘collaborative economy’ have in common that they rely on the Internet and involve temporary access and non-ownership models of utilizing consumer goods and services (Belk, 2014b). The terms are often used interchangeably, but some research presents distinct differences in the definitions. For example, collaborative consumption encompasses community-based services where sharing access to goods and services is coordinated through community-based online services (Hamari et al., 2016). ‘The platform economy’ concept is also emerging, and the utopian or dystopian impact of the platform economy is debated as an extension of a discussion that began in the early days of the IT revolution (Kenney & Zysman, 2016; Sutherland & Jarrahi, 2018). The platform economy focuses on digital marketplaces and provides socio-technical infrastructures that facilitate new forms of Internet intermediation between buyers and external sellers (Kirchner & Schüßler, 2019). ‘Stranger sharing’ is another way of describing sharing platforms that enable sharing among people who do not know each other and who lack friends or connections in common (Schor, 2016). Consequently, this entails a higher degree of risk, and for many of these platforms, the situations are pretty intimate – sharing one’s home or car. The digital platforms can make stranger sharing less risky and more appealing because they source information on users via ratings and reputations (Schor, 2016).

Frenken et al. (2015) present a much-used definition of the sharing economy as consumers granting each other temporary access to under-utilized physical assets (‘idle capacity’), possibly for money. Tools, cars, and homes are typical goods that are being shared. For example, consumers can avoid buying a new drill by using one of four platforms: you can buy a second-hand drill from an individual (eBay), you can rent a drill from a company (Home Depot), you can hire someone on-demand to drill the hole in your wall (Taskrabbit), or you can ask an individual to share a drill (Peerby). For cars, the same logic applies. You can buy a second-hand car using a site (eBay/Finn), you can rent a car at a car-rental company (Car2Go/Hertz), you can hire on-demand an individual to drive you (UberX), or you can rent a car from a private individual (Relayrides/Nabobil) (Frenken et al., 2015)⁴. Frenken et al. (2015) explain that once one understands the sharing economy category at the intersection of three more generic economic trends, one can also derive the types of economies occurring at the intersection of two of the three trends, as shown in Figure 1. The figure shows the sharing economy and related types of economies: the second-hand economy, the on-demand economy, and the product-service economy (Frenken, 2017; Frenken et al., 2015). It elaborates on how the sharing economy occurs when these three parts meet: each tendency in itself encompasses much more than just the sharing economy. The second-hand economy is where *peer-to-peer* and *circular*

⁴ I have added Norwegian Platforms to the car examples.

are meeting, the on-demand economy is where *peer-to-peer* and *access* meet, and the product-service economy is where *access* and *circular* are meeting. The sharing economy can be conceptualized as occurring in intersections of these tendencies.

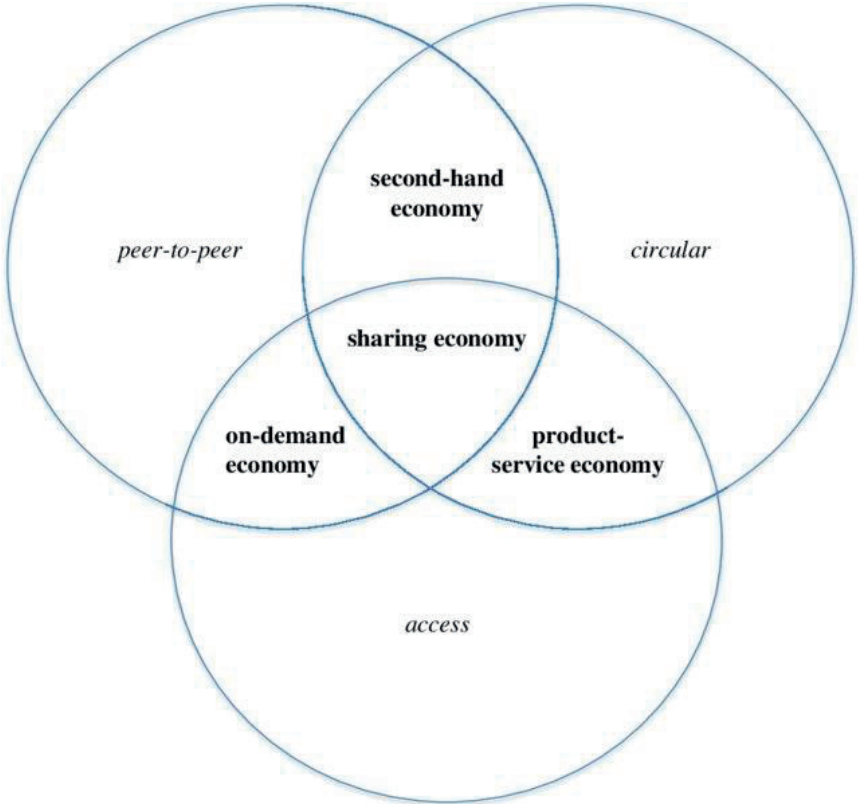


Figure 1: Sharing economy of the second-hand economy, the on-demand economy, and the product-service economy (Frenken, 2017)

This figure can be helpful in categorizing how car-sharing schemes relate to the sharing economy concept by giving an overview of alternative ways to get access to car mobility beyond the standard of buying a new car (Münzel, 2020). For example, in the second-hand economy, access to a car is provided permanently through the transfer of ownership by selling a car on a second-hand marketplace using digital platforms, reducing transaction costs. In the on-demand economy, a peer drives a passenger to a destination as an on-demand trip. Such ride-sourcing or ride-hailing services are offered by peers giving access to a car by providing a taxi service using their own car. This differs from regular taxi rides, as it uses unlicensed chauffeurs and two-sided online platforms matching peers. In the product-service economy, a car is accessed temporarily and is owned by a company, such as through car rental, car leasing, and B2C car-sharing. A drawback with this classification is that some platforms are better understood as mixes, falling within different types of economies. For example, on Airbnb, some people occasionally rent out their own home when they are not using it themselves (sharing economy), but some landlords own multiple homes and use Airbnb to run rent out rooms in the form of hotel services (product-service economy) (Frenken, 2017). The same goes for P2P car-sharing, where the online platforms enable rentals of cars bought for business purposes and also private individuals putting their own car up for rent when they are not using it themselves.

Although this classification and the examples clearly illustrate the platforms and possibilities for sharing, there has been widespread ambiguity and even confusion about the term ‘the sharing economy’ among academics and the public (Frenken & Schor, 2017). Schor states that coming up with a solid definition of the sharing economy that reflects common usage is nearly

impossible, and self-definition by the platforms and the media describes ‘who is in and who is out’ (Schor, 2016). Thus, there is no ‘shared’ consensus on what activities comprise the ‘sharing economy’: (a) there is no consensual definition and (b) the overwhelming majority of the available definitions are ‘ostensive’ (pointing out examples) rather than ‘intentional’ (indicating the attributes that the word connotes) (Codagnone & Martens, 2016). Definitions by exemplification tend to be all-encompassing and trivial as they often group together items that are similar with regard to a few characteristics and dissimilar with regard to many others. They are over-inclusive to the point that it is difficult to identify digital platforms that should not be considered part of the ‘sharing economy’ (Codagnone et al. 2016). In a few cases, on the other hand, under-inclusive definitions either stressing access over ownership or distinguishing between ‘sharing’ and ‘pseudo-sharing’, leave out platforms that are in practice considered part of the ‘sharing economy’ (Bardhi & Eckhardt, 2012; Belk, 2014a, 2014b). The challenges of sharing economy definitions are conditional on the research areas and stakeholders involved in using them. For example, proposed characteristics of the sharing economy for sustainability are ICT-mediated, display non-pecuniary motivation for ownership, involve temporary access, and cover rivalrous and tangible goods (Curtis & Lehner, 2019).

2.5 Car sharing in Norway and Europe

The empirical setting of this research is mainly car sharing in the urban area of Oslo, Norway, as papers 1, 2 and 4 study car sharing in that area. The study in Paper 3 includes Rotterdam in the Netherlands and Malmö in Sweden. The three areas are located in north-western Europe and have some similarities of being urban areas with extensive private car use with well-functioning public transportation systems. But they also have differences in mobility patterns, not least regarding policies and the use of EVs and bicycles. In the papers, I elaborate on the mobility patterns and policies relevant to the place-specific situation for car sharing. Here, I present the car-sharing development in a Norwegian and European context and parts of Norway’s transport system, emphasizing policy instruments.

Oslo, Malmö, and Rotterdam have in common that they are cities in north-western Europe with well-functioning infrastructures with access to living environments, workplaces, health services, education and places for social interaction. The well-developed infrastructures in the areas are relevant for car sharing and other related aspects such as the possibilities for buying cars, charging and fuelling cars, parking cars, and other means of transportation such as public transportation and cycling. Services and associated transportation infrastructures with roads, bridges and tunnels, telecommunications with internet access and power serve to fulfil needs such as mobility and power generation (Rodrigue et al., 2016). Norway, Sweden and the Netherlands are representative democracies and among the top 30 countries in the world in terms of political rights and civil liberties. They are social democratic welfare states where the government provides social services (Enjolras, 2018).

Alternatives to cars such as public transportation and cycling with cargo bikes and electric bikes are growing in popularity (Pucher & Buehler, 2008; 2017). This growth is linked to developments in policy and technology aimed at reducing car use and emissions from transport. Several measures and initiatives to decarbonize transport have been introduced in Europe and the Nordic countries. EU legislation was enacted in the late 2000s to reduce vehicles’ CO₂ emissions per kilometre, and as a result, Nordic countries started to establish policy measures in the form of subsidies and tax reductions for the purchase of low-emission vehicles and fuels (Kivimaa & Virkamäki, 2014).

2.5.1 Norway's transport system, policy instruments, and EVs

The broader discussions of policy instruments in the transport system are complex and debated due to Norway's position as an oil economy. How financial policy instruments are environmentally effective also relates to cost-effectiveness in a broader global climate policy setting (Ramjerdi et al., 2014, pp. 24–25). The consequence for the transport sector has been a strong emphasis on the use of economic instruments due to cost-effectiveness, combined with regulations to improve energy efficiency and reduce greenhouse gas emissions. From the 1980s, the transport sector in Norway was affected by climate change and climate policies, aiming to restructure political and economic institutions to reduce climate gas emissions and limit the probability of climate change. The climate policies in the transport sector must be seen as part of the Norwegian government's response to the political competition and ambitious targets for Norwegian climate policies in the late '80s. These represented a potential threat to Norway's strategic role and position as one of the world's largest oil and gas producing countries. This threat immediately prompted the Ministry of Finance to take action to ensure that cost-effectiveness became the primary criteria in climate policy, thus out-manoeuvring the Ministry of the Environment and its claim for authority in climate policies. Thus, very briefly summarized, cost-effectiveness became the primary criterion in climate policy. The predominance of the cost-effectiveness criterion and the character of the problem in the transport sector, with its many emission sources, led to an emphasis on general instruments and taxation in climate policy (Ramjerdi et al., 2014).

The national government and municipalities later set several goals for decarbonizing the road transport system in Norway, considering both cost-effectiveness and environmental effectiveness (Meld. St. 33, 2016–2017 Prop. 195/16). Oslo city, for example, aims to gradually phase out fossil fuel-based vehicles by 2030 and replace these with zero-emission vehicles based on electricity or hydrogen⁵. The state has implanted many economic incentives to promote fossil-free transport, and on the national level, there is a political agreement that only zero-emission vehicles should be on the market from 2025 (Langeland et al., 2018). The financial incentives are exemptions from relatively heavy taxes affecting vehicles equipped with an internal combustion engine (ICE). There are special regulations for EVs and fossil fuel cars with tax exemptions and reductions for EVs, and differentiation in road tolls as part of these efforts. For the period 2011–2020, EVs have been subject to reduced road tolls and reduced ferry fares. They are also allowed to travel in bus lanes and given free charging in many public parking lots (Fevang et al., 2021).

The subsidy policy for EVs has led to a change in the fleet of private cars and new car sales. These policies focus on EVs for sustainable mobility: the positive environmental effects of EVs are taken for granted because some 96% of all electricity in Norway is produced from renewable sources (Figenbaum et al., 2015). Electricity prices have also been low, contributing to the lower user cost. The Norwegian policies and incentives have changed the distribution between internal combustion engine vehicles and battery electric vehicles (BEVs) in the Norwegian auto market. For example, the five major vehicle energy technologies – gasoline, diesel, ordinary hybrid, plug-in hybrid, and battery electric – had market shares, respectively, of 29%, 31%, 11%, 13%, and 16%, as of 2016. Figure 2 shows the development of new passenger cars registered in Norway by powertrain technology from 1992 to 2019 and shows the total sales of new passenger cars per year (Fridstrøm & Østli, 2021). In 2020 52.2% of new passenger cars

⁵ In this thesis I use the term EVs for electric vehicles. This can include different types of both battery electric vehicle (BEV) and plug-in hybrid electric vehicle (PHEV)

registered in Norway were battery electric vehicles (BEV), and another 20.4% were PHEVs (Fevang et al., 2021).

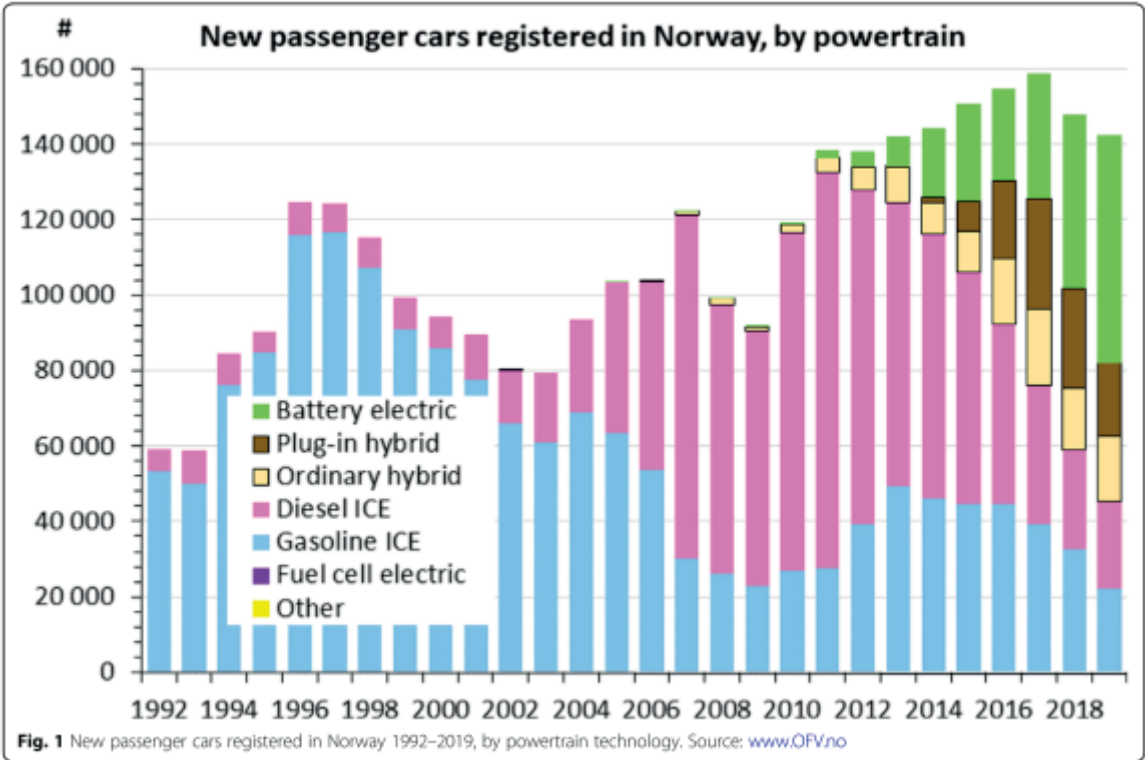


Figure 2: New passenger cars registered in Norway 1992 – 2019 by powertrain technology

Since 2012, the Norwegian Government has promoted a so-called ‘zero-growth’ objective, stating that increasing passenger transport demand caused by the rapid population growth in the largest Norwegian urban regions shall not cause growth in car travel (Tennøy & Hagen, 2020). This means that the expected growth in passenger transport should take the form of public transport, walking or cycling. The goal was first stated in the Parliament’s climate agreement (Ministry of Local Government and Modernisation, 2012) and later in two subsequent National Transport Plans (Ministry of Transport and Communications, 2013, 2017). Hence, two governments comprising different political parties have promoted the objective. As the population in the urban region grows, achieving the zero-growth objective requires a reduction in daily car traffic volume by fewer trips occurring on average, or shorter trips, or a lower share of trips by car drivers (Tennøy & Hagen, 2020). The plans focus on traditional forms of transport – the use of public transport and private cars – and less has been said about new forms of mobility and transport such as car-sharing or combinations of public transport and private transport, such as the Mobility as a Service (MaaS) concept in which public and private transport is combined (Langeland & Nielsen, 2017).

Parking is another relevant topic for car-sharing. Local authorities regulate parking, and parking regulations affect land use and transport (Christiansen et al., 2017), particularly the tendency to own cars (Christiansen et al., 2017; 2016). Other policies include restrictions on free parking and the introduction of residential parking regulations, and differentiated parking fees. A hearing suggested that when it comes to parking regulations for new dwellings, city developers should get a reduction in the minimum space set aside for parking lots if there is parking for car sharing (Høringsforslag sak 201516232) (Plan- og bygningsetaten, 2015).

2.5.2 Development of car-sharing services

Car sharing has existed in Norway since the mid-1990s, and by 2020, more than 11 services or platforms were offering it (George & Julsrud, 2018; George & Julsrud, 2019; Hjortset & Böcker, 2020; Uteng et al., 2019). Four periods show the development of car sharing in Norway: (1) the emergence of car sharing and the prevalence of the cooperative model; (2) the entry of corporate and international players into the market; (3) the rise of peer-to-peer (P2P) organizations and expansion beyond large cities; and (4) hybrid service provision and the blurring of boundaries (George & Julsrud, 2018). These periods build on each other, meaning they are not separate but show the development of service providers in the market (George & Julsrud, 2018). Figure 3 shows these four periods (George & Julsrud, 2018).

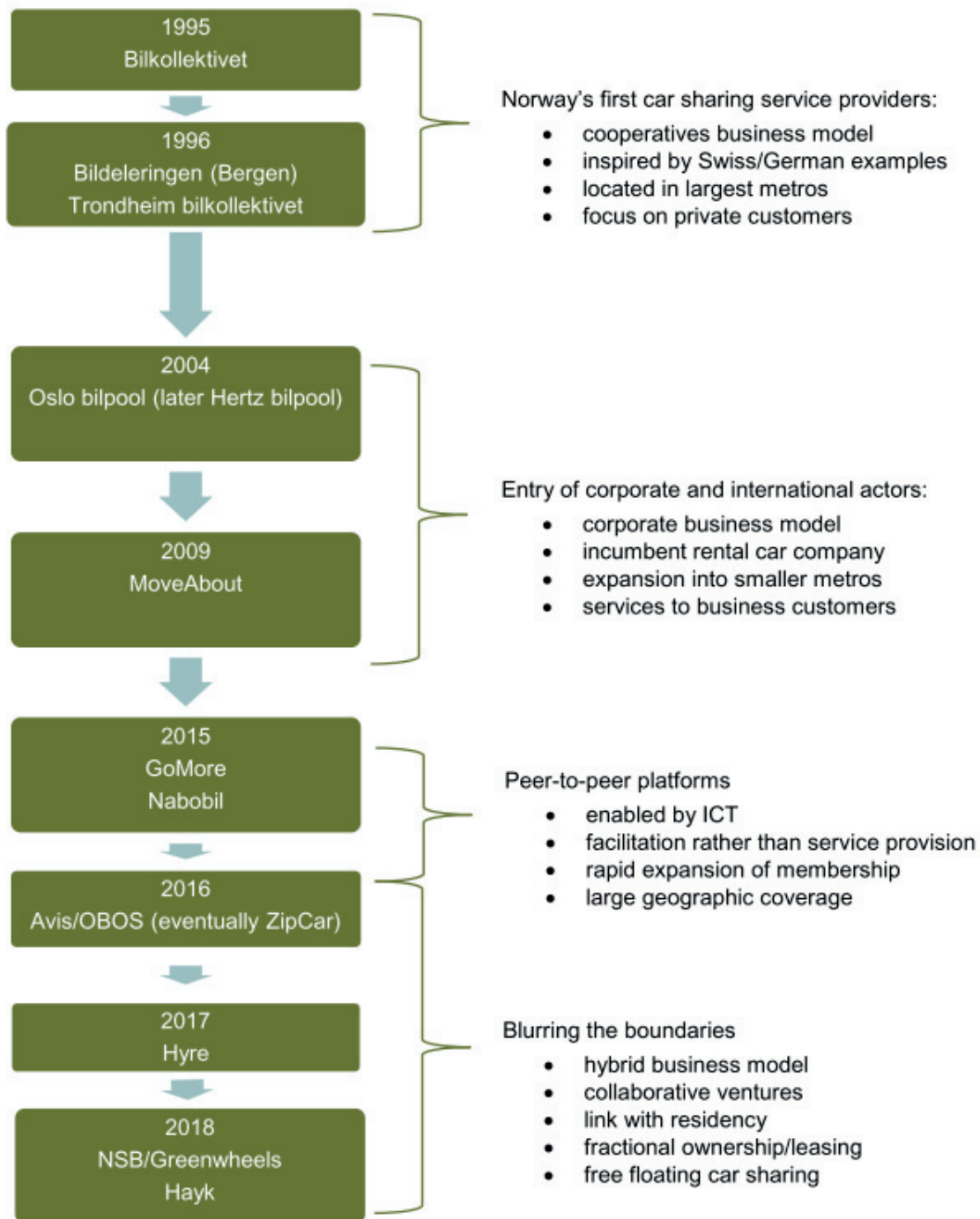


Figure 3: The emergence of the Norwegian formal car-sharing sector from 1995 to 2018

Car sharing in Sweden has also been increasing, and cooperatives, B2C, and P2P models have emerged (Bocken et al., 2020). With national government support, car-sharing models began to proliferate from the late 1990s. This was further facilitated by technology, as more recently, users have been able to book cars through apps. Car-sharing membership doubled approximately every two years, and more competition between car-sharing businesses emerged (Akyelken et al., 2018). In Sweden, car sharing can be traced back to the mid-1970s, rooted in the cooperative movement and local community initiatives when some neighbourhoods collectively purchased vehicles to share. In 1976 the first private car-sharing company – Bilpoolen – was established in Lund. It was a peer-to-peer service that matched car owners with users who wanted to rent cars. But this initiative ended just three years later. In 1978 the government saw the promise in these types of initiatives, and some were financially supported. In 1980 another company, Sambil, was established in Stockholm using the same model. The first business-to-consumer car-sharing service was Vivallabil, established in 1983 based on funding from the Swedish Transportation Communications and Research Board. In 1998, Sunfleet was established in Gothenburg and expanded to other cities in the early 2000 (Noll, 2017). In 2003 City Car Club came to Gothenborg and Stockholm from Finland. In 2009, these were in multiple cities, having almost 15 000 registered car-sharing users and over 500 shared cars available. There were around 45 different car-sharing services that year, but only seven had more than 100 members, and most were small city or neighbourhood-based initiatives. After this, Sunfleet expanded and was purchased by Hertz and Volvo in 2011 (Loose, 2010). Figure 4 shows the development of car sharing over time in Sweden, and Figure 5 summarizes the evolution of car sharing in Malmö where orange indicates cooperatives; dark blue: B2C car-sharing; light blue: P2P or carpools (Bocken et al., 2020).

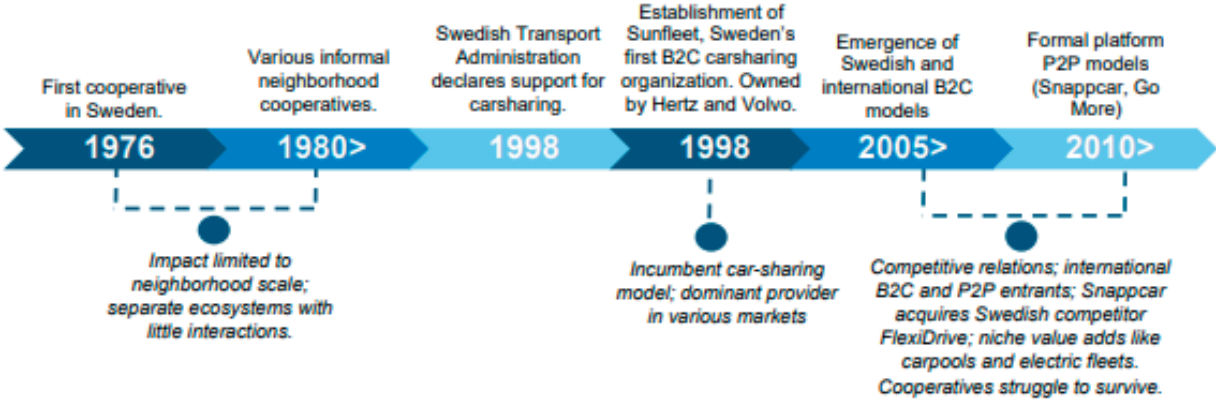


Figure 4: How car sharing developed over time in Sweden

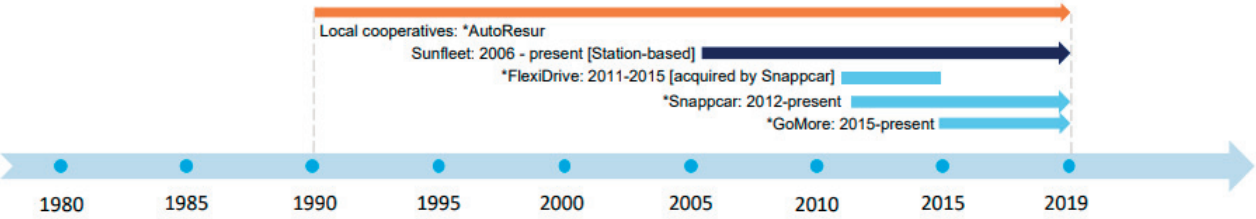


Figure 5: Malmö car-sharing evolution

In the Netherlands, there were approximately 400 000 users and 41 000 shared cars in 2018, increasing from 31 000 cars just the year before (Münzel et al., 2019). Car sharing started in 1973 with Witkar ('white car'), but this ended in 1988 because of lack of success. From 1990 car sharing slowly grew and was stimulated by governmental organizations because of the possible environmental advantages (Nijland & van Meerkerk, 2017).

European experience with formal car sharing began with a cooperative known as Sefage, which started in Zurich, Switzerland, as early as 1948 and operated until 1998 (Shaheen & Cohen, 2007). In the 1970s and the beginning of the 1980s, some car-sharing arrangements were launched but later ended. These included Procotip in France, Witkar in the Netherlands, and Green Cars in Great Britain (Britton, 1999; Harms & Truffer, 1998; Shaheen & Cohen, 2013; Shaheen et al., 1999).

In the late 1980s, the first viable car-sharing initiatives started in Switzerland and Germany with small projects run by environment-minded groups (Münzel et al. 2019; Shaheen et al., 1998; Truffer, 2003). These early organizations were arranged as for-profit or not-for-profit B2C schemes owning a fleet of cars and renting these out to their customers with round-trip systems, meaning the cars were parked at the same parking place at the end of the trip (Münzel et al., 2019). Around 2009, a new type of B2C car-sharing business model emerged when some organizations developed a One-Way system (Car2Go being the most well-known worldwide) where the cars did not have to be returned to the spot where the trip started but could be dropped off either anywhere in a designated city area (free-floating) or at a different station of the provider (station-based). Around 2011, online peer-to-peer (P2P) platforms on which car owners can rent out their own car to fellow consumers ('peers') was introduced a new business model. The platform takes a fee for matching supply and demand and usually offers additional services like insurance (Shaheen et al., 2012). P2P car sharing operates in a round-trip manner as the car is picked up from, and returned to, the car owner. Fleet size is significantly different across business models. For example, in Germany, these range from a few cars in cooperatives in small towns, to a few hundred in B2C roundtrip schemes in larger cities, to over a thousand in B2C one-way in largest cities, and up to many thousands in P2P across the country (Münzel et al., 2018). By 2010 formal car sharing was operating in more than 1,100 cities in 26 countries worldwide (Shaheen & Cohen, 2013).

3 Theoretical foundations

With the Multi-level Perspective (MLP) from transition studies and the elemental approach from Social Practice Theories (SPT), I study how car-sharing practices influence dynamics of change and continuity towards environmental sustainability in the established mobility system characterized by the dominance of car ownership. This chapter presents the academic traditions of these two approaches to explain the foundations of the theoretical frameworks applied in the studies.

This thesis is situated within the interdisciplinary field of sustainability transition studies, originating from innovation studies (Markard et al., 2012; Smith et al., 2010). The focus is on studying the complexities of system transitions, as these transitions involve both change *and continuity* in technology, and in institutions, regulations, infrastructure and consumer behaviour. MLP and SPT are suggested as useful theories and concepts for explaining such socio-technical change (Sovacool & Hess, 2017). Paper 1 uses concepts from transition pathways concerning forms of reconfiguration. Papers 2, 3 and 4 use niche and regime dynamics concepts from the MLP with concepts from the elemental approach in SPT. As a literature review, Paper 5 looks at SPT in transition studies. This paper suggests a ‘Practice Innovation System’ (PIS) approach. To show how I position the PIS approach, I also present the background of innovation systems (IS) approaches in this chapter.

In this chapter, I present the thesis's core theoretical concerns and contributions; how to use SPT for transition and transport studies. In 2012, Matt Watson outlined how SPT can inform a transition to decarbonize the transport system (Watson, 2012). Ten years later, SPT has been referenced, deployed and debated by transport scholars seeking to understand and advise how to make transport sustainable. A recent paper provides a concise synthesis of how practice theory has been applied to questions of sustainable transport transitions (Kent, 2021). At the beginning of this chapter, I go beyond the empirical focus on transport and delve deep into the core matter of how SPT contributes to a practice paradigm in transition studies. I start with the main positioning for the contribution of this thesis, and then later in chapter 3, I provide the reasoning behind this.

3.1 The practice paradigm in sustainability transitions

3.1.1 Socio-technical sustainability transitions

Socio-technical transitions are generally understood as major changes in technological, organizational and institutional means for both production and consumption (Geels & Schot, 2010). Socio-technical transitions involve a broad range of actors and typically unfold over considerable time spans. In the course of such a transition, new products, services, business models, and organizations emerge, partly complementing and partly replacing existing ones (Farla et al., 2012). Socio-technical systems concern the realization of ‘societal functions’ that cover basic needs such as energy, food, mobility, or housing (Smith et al., 2010). Established socio-technical systems can shift to more sustainable modes of production and consumption, with systemic changes in long-term, multidimensional, and fundamental transformation processes (Markard et al., 2012). This may involve changes in environmental performance, economic prosperity, and societal equity (Truffer & Coenen, 2012).

Systemic changes are often called ‘socio-technical transitions’ because they involve alterations in the overall configuration of transport, energy, and agri-food systems which encompass technology, policy, markets, consumer practices, infrastructure, cultural meaning, and scientific knowledge (Elzen et al., 2004; Geels, 2004). These configurations are reproduced, maintained, and transformed by actors such as firms and industries, policymakers and politicians,

consumers, civil society, engineers, and researchers. Transitions are, therefore, complex and long-term processes comprising multiple actors (Geels, 2011). The ‘socio-technical’ refers to the co-evolution of social and technological relationships. ‘Transitions’ refers to the dynamics of fundamental changes in these relationships. ‘Sustainability’ used in the transition context can imply environmental or social sustainability, and the meaning varies depending on the context and whether its use stems from a social, economic, or ecological perspective. ‘Transitions approaches’ is an overarching term covering various theoretical approaches that analyse the development of such ‘socio-technical transitions’. These approaches to studying social and technological change originate in science and technology studies (STS), evolutionary economics, and innovation studies (van den Bergh et al., 2011).

The growing research field of sustainability transitions, initially with a dominant focus on industries, has attracted increased attention towards transitions in everyday life practices (Köhler et al., 2017). Seeking to meet the call for a deeper understanding of practices in transition studies, some scholars have sought to integrate SPT and proposed fruitful ways of combining these approaches for empirical studies (Hargreaves et al., 2013; Huber, 2017; Jalas et al., 2017; McMeekin & Southerton, 2012; Watson, 2012; Welch & Yates, 2018). SPT is put forward as useful for sustainability transition research and not limited to sustainable consumption research (Geels et al., 2015; Liedtke et al., 2013). MLP and SPT have emerged as approaches for understanding the complexity of socio-technical change (Hargreaves et al., 2013). For example, after sketching out a theory of practice, Watson (2012) explored the potential of a practice theory approach to illuminate systemic change in transport. He confronted two key criticisms of practice theories. First, their apparent difficulty in accounting for change; second, their allegedly limited ability to move beyond a micro-level focus on people’s actions.

The primary motivation for research on sustainability transitions is based on the recognition that environmental problems such as climate change are grand societal challenges. These challenges result from unsustainable consumption and production patterns in socio-technical systems such as electricity, heat, buildings, mobility, and agro-food.⁶ Technological solutions and incremental improvements cannot solely address these problems. Instead, they require radical shifts to new socio-technical systems, shifts known as ‘sustainability transitions’ (Elzen et al., 2004; Grin et al., 2010; Köhler et al., 2017; Smith et al., 2005). A fundamental objective of transitions research is to conceptualize and explain how such radical changes can occur in ways that fulfil societal functions. Therefore, the unit of analysis is situated at the so-called ‘meso’ level of socio-technical systems (Geels, 2004). For that reason, the focus of research on sustainability transitions differs from sustainability debates at the ‘macro’ level (e.g. changing the nature of capitalism or nature-society interactions) or the ‘micro’ level (e.g. changing individual choices, attitudes, and motivations) (Köhler et al., 2017).

Similarly, SPT are proposed in order to avoid the pitfalls of the individualist and systemic paradigms dominating sustainable consumption research (Spaargaren, 2011). Individualist and systemic approaches have limited scope to provide the deep understanding necessary for breakthroughs towards sustainability. Thus, there is a need to find a more balanced approach that pays attention to agency as well as structure, which provides room for (combining) both bottom–up and top–down dynamics of change, and which recognizes the mutual influencing and co-shaping of human actors on the one hand, and objects and technological infrastructures on the other (Spaargaren, 2011, p. 815).

⁶ In this thesis, I use the terms Sustainability Transition and Socio-Technical Transition interchangeably.

The MLP proposes that transitions occur through dynamic processes with interactions between the three *levels* of niche, regime, and landscape (Geels, 2011; Geels, 2012). Niches are the locus for radical innovations, regimes are the locus of *established practices* and associated rules that stabilize existing systems, while the landscape is the broader context which influences niche and regime dynamics (Geels, 2011; Rip & Kemp, 1998b). ‘Transition’ is generally understood as a change from one established regime and its *practices* to a new regime with new rules and *practices* (Geels et al., 2015).

SPT adopts a flat ontology where practices are the primary unit of analysis. In contrast, MLP has been said to view practices as having graded levels of structuration, causing a discussion on the incompatibility of the two approaches due to this allegedly hierarchical view (Geels, 2011, p. 37). Geels explains that the niche, regime, and landscape levels in the MLP are often incorrectly referred to as micro, meso, and macro levels, whereas the levels are correctly defined as referring to different degrees of structuration of local practices, which relates to differences in scale and the number of actors that reproduce regimes and niches. Levels refer to differing degrees of stability, which are not necessarily hierarchical (Geels, 2011, pp. 37–38).

How we conceptualize the dynamics of change and continuity is relevant for policy interventions. Food practices, energy practices, and transport practices are systemic and global (Twine, 2017). For environmental sustainability, policymakers need to gain a better understanding of everyday practices since the ways in which we dwell our houses, drive our cars and go for a holiday are significant if substantial reductions in overall CO₂ emissions are to be realized (Dietz et al., 2009; Spaargaren, 2011). A core concern is how different ways of conceptualizing social change can result in different strategies for policy intervention (Watson & Southerton, 2015). Whereas the set of policy tools proposed by the MLP often focuses on nurturing and diffusing technological innovations, policies informed by SPT seek to intervene in the evolving fabric of social practices in a way that helps the spread of sustainable practices and hastens the decline of undesirable ones (Watson & Southerton, 2015).

3.1.2 Conceptual crossovers and ontological challenges

The MLP is characterized not as a grand or unifying theory that synthesizes all available theories but as a middle-range theory that makes crossovers to some ontologies and not to others (2010, p. 495). SPT assumes a ‘flat’ ontology and a relational view of the world. Geels holds that the MLP makes crossovers with interpretivism/constructivism ontologies, that the crossovers to the ontology of relationism encounter challenges because of the assumed flat view, and that causal mechanisms are relations and ongoing interactions. He further states that relationism forms an intriguing ontology by itself that can perhaps develop alternative ways of investigating transitions. Thus crossovers to the MLP may be possible.

The MLP originates from quasi-evolutionary theory (Rip, 1992; Rip & Kemp, 1998a; Schot, 1992) and aims to make evolutionary variation–selection–retention mechanisms more sociological via crossovers interpretivism/constructivism (Geels, 2010, p. 504). The MLP has also been inspired by relationism – for example, via Rip and Kemp (1998b), who operate with a socio-technical focus where social and technical elements co-construct each other, emphasizing ongoing processes, linkages and alignments (Geels, 2010, p. 507). Also, some of Geels and Schot's (2007) transition pathways build on such dynamic concepts (Geels, 2010, p. 507).

Discussing crossovers to the ontology of relationism and the MLP, Geels (2010) explains how relationism sees the constant relations among actors as causal agents, where the relationships’ dynamics are more important than the individual actors. Relationism assumes that the identities,

preferences, and interests of individual actors are fluid and constituted by relations and ongoing interactions. Therefore these relations and interactions represent the causal agent. Relationism is a non-essentialist process ontology, which criticizes other ontologies for assuming that people have foundational attributes, and for (fruitlessly) searching for ultimate causes (p. 502).

Geels (2010) further elaborates on some of the main criticisms of relationism. Whereas relationism criticizes other ontologies for reification and essentialism, other ontologies criticize relationism for relativism and limited explanatory power. Relationist theories involve no exogenous causes, because everything is endogenized in terms of networks and ongoing relations, the world is conceptualized as 'flat', and the concept of institutions or structural levels is contested (Geels, 2010, p. 502).

In the same article, Geels (2010) presents his views on the compatibility between the MLP and SPT (Shove et al., 2012). He states that there might be opportunities for further investigating how the two approaches can complement each other in their views on enduring and stable practices, because of like-minded trajectories referring to relatively stable and predictable structures. This idea of stability challenges the flat ontology, and SPT has been claimed to be a flatter model characterized by multiple relations rather than hierarchical levels. According to Geels (2010, p. 507), even within the practice approach, it is possible to investigate relations between emerging fluid structures and existing stable ones. In that sense, there may be similarities with the MLP that could be further explored rather than rejected outright.

Geels (2010) further notes that SPT scholars ask for more analytical attention to the 'socio' in socio-technical transitions and for an analysis of the creation of 'normality'. This is revealed, for example, in how Shove and Walker (2010) have called attention in environmental debates to transitions in user practices and everyday life, and in Røpke's (2001) argument that the environmental debate is skewed towards supply-side issues at the expense of examining major, unsustainable, demand-side changes.

3.1.3 Action paradigms for agency in the rule-based MLP model

Here, I present the foundation for the need for a practice paradigm. Later in this chapter, in section 3.2, I elaborate on the background for this by explaining the development of the rule-based model of action in the MLP and the typologies of transition pathways. Agency in the rule-based model of action is the foundation for the need for a practice paradigm. According to Geels and Schot (2007), a rule-based model of action, on which the MLP is based, incorporates different ways of conceptualizing agency. Rule-based action involves various types of rule-following, -using, -creation and -alteration.

These relate to four foundational paradigms. The first is *rational action*, with conscious attempts to determine the best action among possible choices. This entails rule-using because cost-benefit calculations are only possible when formal, normative and cognitive rules provide a stable frame for calculation (Callon, 1998; Hodgson, 1997). The second is *interpretative action* with interpretations and sensemaking that involve rule-using, such as through cognitive frames and rule-creation and rule-alteration. The third is *power-based action* with formal rule-alterations, for example, through lobbying and institutional entrepreneurship from collective actors, such as professional societies, industry associations, and social movements. The fourth paradigm concerns *routine actions*, where deep structures are usually reproduced through routine action that consists of rule-following.

This implies that this rule-based model of action is multi-dimensional. Geels and Schot (2007) follow Giddens (1984) in understanding rules as recursively reproduced structures because they

are used and changed by actors. This agency-structure dynamic thus can account for different kinds of actions – detailed multi-level studies will reveal combinations of these four types of actions: rational, interpretative, power-based and routine.

These forms of agency are simultaneously present, either contributing to change, stability or forming a taken-for-granted backdrop. Their contributions to transitions can vary depending on the unfolding pathway. Transitions can be induced through rational action, as well as through changing interpretations or power struggles. So while the multi-level perspective provides an overall ‘global’ framing for all transition pathways, the narrative event-sequences are always enacted and leave space for different ‘local’ subplots (Geels & Schot, 2007).

The Practice Paradigm

From global to local transitions, from historical to present and future

MLP and pathway typologies (see section 3.2.5) were initially intended to systematize pathways of transitions that had so far been merely empirically observed. Thus, there is a need and a possibility for another paradigm here – the practice paradigm. Practice theory may better account for past, present and future *local* actions that are not covered by the four other action paradigms.

The strengths and weaknesses of the MLP and pathways typologies support the reasoning behind this. The MLP provides a way of addressing stability and change as the core analytical puzzle of transitions. Existing systems are characterized by stability, lock-in, and path dependence, which gives rise to incremental change along predictable trajectories (Geels & Kemp, 2012). Examples of lock-ins are consumer lifestyles, regulations, and laws that create barriers to market entry, sunk investments in machines, people, and infrastructure, low costs because of economies of scale and resistance from vested interests (Unruh, 2000; Walker, 2000). There are also exit barriers and resistance to change on the part of some sectors, such as the car industry (Wells et al., 2011). At the same time, radical alternatives are proposed, developed, and tried by pioneers, entrepreneurs, social movements, and relative outsiders to the existing regime. They face struggles against the stable regime because these alternatives can be more costly, cannot take advantage of economies of scale, require changes in user practices, face a mismatch with existing regulations, or lack appropriate infrastructure (Geels & Kemp, 2012).

The core puzzle in transitions centres around this (dynamic) stability and (radical) change, notably their interactions that unfold on multiple dimensions. Later studies have indicated that transitions may shift between pathways, depending on struggles over technology deployment and institutions (Geels et al., 2016). Although the multi-dimensionality of niche–regime–landscape interactions is a strength of the MLP, this is conceptualized in a general and heuristic sense. The MLP could therefore benefit from conceptual extensions of multi-level interaction on various dimensions, exploring possible crossovers to the other ontologies (Geels, 2010).

This ‘global’ model of the MLP has been accused of various shortcomings (see Kanger, 2021). These include its structuralist mode of explanation, with no place for agency (Berkhout et al., 2004; Shove & Walker, 2010; Smith et al., 2005), neglecting power and politics (Kern, 2011; Meadowcroft, 2006; 2009), the possible omission of institutions and ideologies (Meadowcroft, 2011), excluding the spatial dimension (Coenen et al., 2012), conceptual vagueness (Markard & Truffer, 2008), inconsistency in methodologies (Genus & Coles, 2008) and neglecting economic variables (Foxon, 2011). Of particular interest is the lack of policy intervention in

practices (Shove & Walker, 2007) and the charge that the MLP lacks a conceptualization of practices that spans the three levels and regimes (Hargreaves et al., 2013).

To remedy some of these limitations, the MLP has been extended in various directions. We may note the development of local models for niche formation (Geels & Raven, 2006; Raven & Geels, 2010), and regime destabilization (Penna & Geels, 2012; Turnheim & Geels, 2013), refining the methodology of transitions research (Köhler et al., 2018; Papachristos, 2018), specifying the geography of transitions (Boschma et al., 2017; Hansen & Coenen, 2015), giving different consideration to actors and power (Avelino et al., 2016; Avelino & Rotmans, 2009; de Haan & Rotmans, 2018; Hoffman, 2013; Schot et al., 2016) deliberate development through Strategic Niche Management (Kemp et al., 2000), and multiplicity (Hodson et al., 2017). Of particular interest is the recognition that the three levels refer to ‘different degrees of structuration of local practices’ and are meant as heuristic, and thus do not have ontological meaning (Geels, 2011). This means that the levels refer only to differing ‘degrees of stability’, and niches are not conceived to be emerging ‘within’ any particular regime. This concretization may overcome the allegedly incompatible epistemologies and ontologies between practices theories and the MLP.

3.1.4 Reconfigurations in and across regimes and practices

Here, I present concepts of reconfiguration relevant for both SPT and MLP. Later in this chapter, in section 3.2, I elaborate on the background for this when explaining the typologies of transition pathways.

In a review article, Laakso et al. (2021a) examine how research on socio-technical transitions and social practices has employed the concept of reconfiguration, and elaborate on the differing definitions of reconfiguration. Basically, they identify two main ways in which concepts of reconfiguration are used:

- a) To describe an evolutionary process that happens due to niche–regime interaction in the MLP, when developments at multiple levels link up and reinforce each other, eventually leading to substantial changes in the regime.
- b) To refer to multiple interactions and reinforcing processes in practices and their constituent elements in SPT, with the dynamics of reconfiguration in practices.

These definitions provide different specific perspectives on reconfiguration relevant for this thesis.

Transitions research has defined reconfiguration in several ways at various times. It is possible to identify developments from reconfiguration as a pathway to reconfiguration as a whole-systems change. The interactions between niche and regime actors, and between regime destabilization and contextual arrangements, play important roles (Laakso et al., 2021a, p. 19).

In research with a theoretical background in SPT, reconfiguration is most frequently used to illustrate the dynamic process through which parts or elements of practices are reorganized, replaced, or rearranged into a different form or combination to change the prevailing practices. Reconfiguration refers to changes in the organization of a practice or relations between practices. Provoking long-term transformation in what counts as a normal and acceptable way of life depends on reconfiguring the elements of practice; the relations between practices, and patterns of recruitment and defection (Shove, 2014b, p. 419; Laakso et al., 2021a, pp. 20–21).

They further elaborate on and categorize seven possible contributions of SPT to the understanding of reconfiguration in MLP. Their findings underline ‘how the concept of reconfiguration is increasingly used as part of attempts to overcome the hierarchical separation of reality into macro, meso and micro levels (as in MLP) or to go beyond changes in individual elements of the practices (as in SPT) when interpreting the dynamics and processes of change. For both theoretical approaches, the concept of reconfiguration enables an interpretation of the dynamic, parallel process of change taking place concurrently’ (Laakso et al., 2021a, pp. 22–23). Here I recap parts of their seven suggestions that are relevant for how I use SPT and MLP in studies of reconfiguration in the studies:

SPT can contribute to understanding reconfigurations *within* regimes

(1) Because the old is always present in the new, elements may be regenerated instead of emerging *de novo*. Niches may also incorporate elements from historical practices that are not necessarily considered innovative. This underlines how the old is always present in the new (Bui et al., 2016; Geels, 2018; Hodson et al., 2017). There is no need to generate meanings and competence from scratch: they can be regenerated as part of the reconfiguration process (Shove et al., 2012).

(2) Regimes or practices are never singular or stable. Thus, attention should be paid to tensions in various practices relevant to regime change. There is an increasing focus on complementing the niche-to-regime dynamics with an analysis of regime-to-niche dynamics and the internal dynamics within niches (Lazarevic & Valve, 2020) and regimes (Geels, 2018; Hodson et al., 2017; Huang et al., 2018). Regimes are not merely stable (Turnheim & Geels, 2012), but SPT is more eager to question stability by emphasizing that practices are not static – ‘the performance of practices are slightly different each time, making practices dynamic and adaptable’ (Warde, 2005, p. 138). ‘Enduring and relatively stable practices and complexes of practices exist because they are consistently reproduced,’ assert other SPT proponents, ‘not because they have achieved some kind of closure’ (Shove & Walker, 2010). Established practices can be reconfigured in various ways (Devaney & Davies, 2017; Kaljonen et al., 2020; Roysen & Mertens, 2019; Shaw & Ozaki, 2016; Spurling et al., 2013). Looking more closely at the tensions, frictions, and windows of opportunity – not only within the specific regime but also within the many practices that take place *in* and are integral to that regime – could indicate potential avenues for change. These tensions in practices are also critical for keeping the practices primed for change (Kaljonen et al., 2019; 2020).

SPT can contribute to understanding reconfigurations *across* regimes

(3) The horizontal circulation of elements in practices and across regimes can add to the range of elements available for horizontal integration *across* regimes. These dynamics are parallel rather than hierarchical. Effective innovation in practice is likely to be the outcome of various dynamics: producing, promoting, adopting and aligning technologies, cultivating novelties within existing regimes, enlisting users, and adding to the range of elements available for integration in the complexes of practices (Järvensivu, 2017; Roysen & Mertens, 2019; Shove & Walker, 2010). A transitions-in-practice approach need not be limited to investigations of consumption or everyday life. It can, for example, examine systems of agri-food (Parodi, 2018), service-provisioning (Lazarevic et al., 2019; Pelli & Lähtinen, 2020), and design (Shaw & Ozaki, 2016; Öztekin & Gaziulusoy, 2019).

(4) The ‘stickiness’ of practices as connected to horizontal integration with other practices can address the transition-enabling or transition-preventing interlinkages. SPT’s understanding of stickiness in practice can contribute to analyses of how and when niche innovations manage to

reconfigure regimes (Parodi, 2018). From the perspective of MLP, this stickiness can exist both within and between regimes. From the perspective of SPT, for emerging new practices to take hold, they must recraft or replace the prevalent practices that maintain and reproduce the regime. Gradual reconfiguration of practices can take place when changes in some elements of practice accumulate into changes in the rest of the elements – and when reconfiguration in one practice leads to changes in surrounding practices (Green et al., 2018; Järvensivu, 2017; Roysen & Mertens, 2019; Öztekin & Gaziulusoy, 2019). Therefore, it is critical for transition scholars to engage with constellations and complexes of practices as the key components of transitions, either working to slow down the transition due to sticky constellations or enabling transformative change.

SPT can contribute to an understanding of the interplay of people and practices

(5) SPT could offer a more nuanced picture of how practitioners are, or might be, recruited into new practices.

(6) SPT could show the various roles of actors in reproducing practices. System reconfigurations could be investigated from the perspective of the key practices, their elements, and the different roles the actors play in these practices rather than labelling them as mere proponents and opponents of particular solutions. For example, the role of distributors, vendors, and advertisers could be investigated.

SPT can contribute to an understanding of the changes in norms

(7) The understanding of social norms as deeply embedded in practices is open for reflection and change through performances. Changes in cultural and social norms could preferably be seen as processes occurring through the performance of practices, rather than as homogeneous and stable pressures springing from an abstract landscape level.

3.1.5 Practices, households, and everyday life

I conceptualize households as social units. In papers 1, 2, 3 and 4, I use data from interviews with households. Households offer a suitable empirical focus for studies using SPT and the MLP because they can serve as an in-between unit between individual and meso-level scales in the transitions literature, as with community-scale (Seyfang & Smith, 2007) or social movements (Geels & Penna, 2015).

The conceptualization of households in sustainability transitions research is not strongly or coherently defined. However, I follow a proposed definition underpinned by an understanding of the household as i) a social unit linked with a dwelling that has material characteristics and a geographical location, ii) made up of one or more householders who can be characterized in terms of their relationship to one another, as well as in socio-demographic terms, iii) exercising agency within particular configurations of space, place and scale, iv) a node within larger social and material systems that operates as an important mediator between individuals and aspects of social, cultural, political and material phenomena, not least through the social influence of family members and v) a site for the co-production of policy arrangements and outcomes (Raven et al., 2021).

SPT research ranges from viewing practices within households as focused on routinized, unconscious and ‘unsustainable’ consumption (Welch & Warde, 2015; Welch & Yates, 2018) and concerned with how unconscious consumption practices co-evolve with wider systems of provision, supply chains and production (Røpke, 2009), to seeing everyday household activities like bathing, laundry and heating as evolving with rising social expectations (Shove, 2003; Spurling et al., 2013). SPT perspectives support the idea that the socio-technical elements co-

produce outcomes where they intersect at the household level (Boamah & Rothfuß, 2018; Fam & Lopes, 2015; Judson et al., 2015; Karvonen, 2013; Khalid & Sunikka-Blank, 2020; Maréchal & Holzemer, 2015; Strengers, 2011). Households are dispersed and mobile social units in which everyday domestic life is increasingly resource-intensive (Shove, 2003; Southerton, 2006). Actions at the household level may have recognizable similarities across time and sites but may also exhibit wide variety, reflecting how human activity and social structure mutually constitute each other (Gram-Hanssen, 2008; Maréchal & Holzemer, 2015).

3.2 Innovation studies and sustainability transition studies

The emerging field of sustainability transitions is characterized by a wide range of topics, approaches, and methodologies (Markard et al., 2012). A general feature – originating from innovation studies – is that transitions towards sustainability are framed from a *systems perspective*.

3.2.1 Innovation studies and innovation system approaches

Innovation systems were developed as a policy concept in the 1980s when a range of system approaches emerged in the context of disputes over industrial policy in Europe. Following evolutionary economics (Fagerberg, 2003), innovation system thinking responded to the alleged defects of neoclassical economics (Jacobsson & Bergek, 2011; Sharif, 2006). Coming from the earlier work of Schumpeter (1934; 1943), who is known as the founder of innovation theory, this followed from his ideas of innovation as a central driver of the economy and his rejection of the neoclassical ideas of static equilibrium. In the evolutionary or Schumpeterian school of economics, the world is driven forward by technical change and innovations. This dynamic worldview contrasts sharply with the neoclassical model of the world economy, where the central feature is the static equilibrium of supply and demand (Reinert & Riiser, 1994).

Innovations, and later also environmental considerations, took centre stage. Neoclassical environmental economics perspectives see the challenge of environmental innovation as resting predominantly on adjusting the price signals for goods and services. Because costs and prices fail to internalize environmental externalities, and consequently fail to generate effective demand for cleaner innovations, environmental considerations are poorly served by existing markets. Innovation studies rooted in evolutionary economics are thus an alternative that can investigate innovations for environmental sustainability in a different way from the perspectives of neoclassical environmental economics (Smith et al., 2010).

Innovation systems studies go beyond studying independent products, processes, or technologies (Smith et al., 2010). What we think of as a single innovation is often the result of a lengthy process involving many interrelated innovations (Fagerberg, 2004). Firms generally do not innovate in isolation but in collaboration and interdependence with other organizations, such as other firms or suppliers, customers, competitors, or non-firm entities such as universities, schools, and government ministries. The behaviour of organizations is also shaped by institutions – such as through laws, rules, norms, and routines that constitute incentives and obstacles for innovation. These organizations and institutions are the components of systems for the creation and commercialization of knowledge. Innovation emerges in a *system of innovation* (Edquist, 2005).

This systemic concept of innovation understands the system of innovation as consisting of the various determinants of innovation processes – the all-important economic, social, political, organizational, institutional, and other factors that influence the development, diffusion, and use of innovations. Briefly, Edquist (2005) holds that an innovation system consists of constituents that are the components and the relations between them. The main components are

organizations and institutions. Organizations are formal structures that are consciously created and have an explicit purpose. Institutions are the rules of the game, sets of common habits, norms, routines, established practices, rules, or laws that regulate the relations and interactions between individuals, groups, and organizations. An innovation system has a function – it performs or achieves something. The main function of an innovation system is to pursue the innovation process, i.e. to develop, diffuse and use innovations.

The strengths of the innovation system approach are linked to six characteristics: this approach places innovation and learning processes at the centre, adopts a holistic and interdisciplinary perspective, employs a historical and evolutionary perspective, emphasizes interdependence and non-linearity, encompasses both product and process innovations (as well as subcategories of these), and emphasizes the role of institutions (Edquist, 1997).

The shortcomings of the approach can be linked to the boundaries of the system. One way to locate the boundaries of systems of innovation is to identify the causes or determinants of innovations. The boundaries of innovation systems have been suggested to be spatial, sectoral or existing within the activities themselves. The spatial boundaries of systems of innovations need not be national: they may be global, regional, or sectoral (Edquist, 2005).

Variants of innovation systems have been formulated and applied empirically (Binz & Truffer, 2017). The focus has been national (Freeman, 1987; Lundvall, 1992; Lundvall & Dosi, 1988), regional (Cooke et al., 1997), sectoral (Malerba, 2002), and technological (Bergek et al., 2008; Carlsson & Stankiewicz, 1991). These innovation system approaches have examined the national level and boundaries in the national innovation system (NIS), regions in the regional innovation system (RIS), sectors in the sectoral innovation system (SIS), and technologies in the technology innovation system (TIS).

Simply put, the features of each approach concern the system boundaries, determining which elements contribute to the generation of innovation-related positive externalities and which do not (Bergek et al., 2015). While differing at to system boundaries, these approaches share features – mainly that the innovation and diffusion process is both a collective and an individual act (Jacobsson & Bergek, 2011). However, there are also significant differences in epistemology, research objectives, and methodological approach (Coenen & López, 2010). Because of the focus on national, regional, or sectoral and technological capabilities, the approaches have typically been most concerned with the supply side (Nelson & Rosenberg, 1993; Wieczorek & Hekkert, 2012).

In addition to NIS, RIS, SIS and TIS, Global Innovation Systems (GIS) has been proposed as a framework. The GIS looks at innovation dynamics in transnational contexts, conceptualized around knowledge creation, market formation, resource mobilization, and technology legitimation (Binz & Truffer, 2017). Recently, a Mission Innovation System (MIS) approach has been proposed, focusing on transformative innovation policy and challenge-based innovation missions (Hekkert et al., 2020). Here, innovation policy is shifting towards addressing societal challenges through the transformation of socio-economic systems.

Innovation-system approaches have helped to explain the level of innovative activity – such as new patents, products or technologies – as the quantitative output from economies, sectors or regions (Smith et al., 2010). They have also helped in explaining the success or failure of certain innovations and related economic sectors in different economies. Such approaches can also be used to explain how greener products and services might be accelerated. However, it remains unclear how these rely upon and induce broader structural changes for sustainable development

(Smith et al., 2010). Innovation-systems analysis can help to explain the emergence and success of specific cleaner technologies, but the analysis must also focus on how broader contexts put pressure on innovation systems to become greener, influencing their reconfiguration (Smith et al., 2010). Therefore, concern for sustainable development requires broad perspectives in innovation-systems approaches (Smith et al., 2010).

Innovation studies can contribute to investigations of how new products, processes and services can improve human well-being without damaging the environment. For example, they can explain how and why greener production and consumption practices emerge or do not emerge, and propose ways of accelerating without the use of environmentally harmful alternatives (Smith et al., 2010). However, with this focus on sustainable development comes an explicit emphasis on the normative direction of innovation. Therefore the challenge for innovation no longer concerns solely its economic potential but also the societal changes it induces and the consequences for environmental and social sustainability. Along with this broader problem framing, there is a need for wider analytical perspectives (Smith et al., 2010).

3.2.2 From historical transition studies to sustainability transition studies

Two waves of research contributed to an extended analytical perspective on innovation that corresponds with this broader problem framing of innovations for sustainability. First, the ‘historically informed theory for wide-scale changes to technology-in-society’ and second, the ‘problem-oriented thinking for sustainable transitions’ (Smith et al., 2010). The first wave can be thought of as encompassing *historic* transition scholars, and the second wave can be thought of as covering *sustainability* transition scholars. They both approach analytical questions of how to understand the innovation processes leading to transformations in socio-technical systems that help realize broad social functions. Drawing on Smith et al. (2010), I summarize some of this development in order to present the academic foundation of how the concepts of transitions of socio-technical systems have emerged.

The first wave, *historic* transition scholars with the ‘historically informed theory for wide-scale changes to technology-in-society’, provided a quasi-evolutionary conceptualization of historical transitions in societal functions, examining how new technologies become involved in wide-ranging processes of social change – as with the move from gas to electric lighting (Schot, 1998), from sail to steam ships (Geels, 2002), the rise of the turbo-jet in aviation (Geels, 2006a) and improvements in public sanitation (Geels, 2006b). The transition from a society with candles and gas lamps to one with electric lighting has involved the social, political and economic factors facilitating this transition and the new, wider societal opportunities made possible by these innovations (Schot, 1998). These transition studies combine the social construction of technology (Pinch & Bijker, 1984) with more structural conceptions of technological regimes and paradigms drawn from evolutionary economics (Rip, 1995). Earlier work focused on how technologies in regimes operated (Dosi et al., 1988; Nelson & Winter, 1982); later work has investigated how this relates to social institutions beyond markets and science (Dosi, 1982; Nelson, 2008).

The social construction of technology approach (SCOT) put forward by Pinch and Bijker (1984) has been criticized for lacking an adequate conception of social structures. It has been accused of neglecting the broader social context – for instance, failing to account for the changes in industrial infrastructure and the role of cultural changes. This line of social constructivism is well-suited for studying technology construction on the *micro*-level, but has difficulties in linking it with social processes on the *macro*-level (Rammert, 1997).

The evolutionary approaches put forward by Nelson and Winter (1982) from evolutionary economics explained technical changes on the *macro* level. Here, the technological paradigm concepts developed with different routines of production and organization on the firm level. These technological paradigms are selected by the market, state, and cultural environment and are adopted by the majority of firms. With this, they establish the stability of a technological trajectory (Dosi, 1982; Dosi et al., 1988). Evolutionary approaches thus serve as a tool for identifying structures of selection and stabilization which shape the direction that technical change takes in the long run. However, they tend to underrate the reflexive creation of technical alternatives and the social shaping of these selection environments (Rammert, 1997).

A more sociological interpretation can overcome these deterministic overtones. For example, selection environments can be studied further by highlighting social influences, or by examining the niches that protect a new technology from too harsh a selection process (van den Belt & Rip, 1995).

From *technological* regimes to *socio-technical* regimes

Historic transition scholars extended these concepts of technological paradigms and regimes and reinterpreted how they shape trajectories of development. The ‘regimes’ idea was reconceptualized, from dealing solely with technological regimes to a *socio-technical* perspective. This sociological approach expanded the concept to embrace institutions such as regulatory authorities and markets, heterogeneous networks including devices and people, user relations, and social expectations. Processes between and among these create structural patterns that shape innovation and inscribe trajectories of social development.

For example, the regime of automobility includes not only paradigmatic technological designs for cars but also the specialized road planning authorities, the requirements of the driving licence and vehicles insurance, the lobbying capacities of car manufacturers and oil companies, and the cultural significance of automobility. In combination, these elements form a socio-technical regime that stabilizes the way societal functions are realized and gives form to particular patterns of producing and consuming mobility (Smith et al., 2010).

These historic transition scholars are interested in the broader societal transformations from the establishment of novel technological regimes. A central question is how technology is shaped by social, economic and political forces, and how, in the same process, technologies and technology systems mould human relations and societies (Rip & Kemp, 1998b). There is also an interest in broader societal trends that contribute to the development or decline of future socio-technical regimes. However, this strand has been said to lack an understanding of the formation and installation of new regimes (von Tunzelmann et al., 2008); it has also been less interested in normative goals such as environmental or social sustainability.

The second wave – of *sustainability* transition scholars with the ‘problem-oriented thinking for sustainable transitions’ – can be seen as a further development of the research on socio-technical regimes, but one more concerned with sustainability and a broader regime approach to *sustainable* innovations (Kemp, 1994; Rip & Kemp, 1998b; Rip et al., 1995) – for example, studies of broader conditions for sustainability transitions in transport, food, energy, housing, etc. (Elzen et al., 2004). With normative goals of sustainability and concern over what the future will be like, this implies transitions over much tighter time-frames than earlier historical studies.

3.2.3 Socio-technical transitions to sustainability

These sustainability transition studies have developed into a research field in their own right, dedicated to socio-technical transitions to sustainability. Also called ‘Transition Studies’, this is an emerging area of research that includes, for example, the Sustainability Transitions Research Network (STRN) and the academic journal *Environmental Innovations and Societal Transitions* (EIST).

The literature on socio-technical sustainability transitions provides a theoretical starting point for understanding technological and social change and the emergence of sustainable practices as new alternatives to unsustainable systems. This field sees societal change towards sustainability as a process of destabilizing and reconfiguring relationships in dominant systems of provision by supporting and propagating radical innovations in alternative, protected spaces (Markard et al., 2012). Sustainability transitions research covers institutional, organizational, technical, social, and political changes in existing socio-technical systems related to more sustainable or environmentally friendly modes of production and consumption (Markard et al., 2012).

Positioning transitions studies

The socio-technical approach to transitions is broader than other approaches to sustainable development. This stylized characterization and brief overview of the focus, the problems dealt with, and the solutions/policy recommendations of the most prominent alternative approaches can accentuate these differences, and help to position transitions studies (Geels & Kemp, 2012):

- Neo-classical economists, focusing on firms, markets, governments and incentives, view environmental problems as negative externalities resulting from market failures. Their solutions and policy recommendations concern internalizing external costs by changing incentives and frame conditions (Stern et al., 2006).
- Psychologists, focusing on individuals, their attitudes, behaviour, and choice (Kaiser et al., 1999), view behavioural change as caused by changes in attitudes. Their solutions and policy recommendations concern providing information and education campaigns.
- Deep ecologists, focusing on humans’ relationship to nature, view environmental problems as a failure of modernism, capitalism, and anthropocentrism (Næss, 1973). Their solutions and policy recommendations concern green values and an ideological turn towards localism and self-sufficiency.
- Engineers and industrial ecologists, focusing on technologies and production, view environmental problems as springing from inefficient and polluting production processes. Their solutions and policy recommendations are about science and technology, with clean technologies, eco-efficiency, dematerialization, and closing material loops (Huber, 2000).
- Political scientists, focusing on the development of formal goals and targets such as the Kyoto Protocol (Böhringer, 2003) and sustainable development goals (Sachs, 2012), view these as embedded in international treaties, where solutions and policy recommendations concern translating these goals into regulations and policy programmes, environmental management standards and environmental impact assessments.

Each of these approaches focuses on a limited set of dimensions of (un)sustainability. By contrast, the socio-technical approach to transitions highlights co-evolution and multi-dimensional interactions between industry, technology, manufacturers, policy, culture, and civil society. Understanding large-scale transitions of transport, energy, agri-food, and other systems thus require analytical frameworks that encompass multiple approaches in ways that can address the interactions *between* them (Geels & Kemp, 2012).

3.2.4 MLP for studies of automobility

The MLP differs from the economic models, engineering approaches, and psychological studies that dominate transport studies. Instead of focusing on technology fixes or behavioural change, the MLP, which display the four characteristics listed below, is proposed for studying low-carbon transitions in transport (Geels, 2012, p. 474):

- i) A co-evolutionary and systemic approach. Transitions are not driven by single factors (such as prices or technological change) but involve co-evolutionary developments between multiple dimensions (technology, industry, markets, consumer behaviour, policy, infrastructure, spatial arrangements, and cultural meaning).
- ii) An actor-based approach. The MLP focuses on strategies, perceptions, actions, and interactions between car drivers, transport planners, car manufacturing firms, and public opinion.
- iii) Stability and change. The MLP encompasses stability, lock-in, and resistance to change on the one hand and (seeds for) radical (systemic) change on the other.
- iv) Complex dynamics. The MLP does not employ linear cause-and-effect relationships or simple drivers. Instead, it emphasizes mutually reinforcing developments, alignments, co-evolution, innovation cascades, knock-on effects, and hype-disappointment cycles.

The MLP has emerged as a leading framework in transition research. It is a scheme that relates various concepts and uses empirical research to identify recurring patterns and lessons. The MLP is a middle-range theory that conceptualizes overall dynamic patterns in socio-technical transitions. Middle-range theory means that it steers between the two poles of grand theories and abstracted empiricism (Merton, 1968). Grand theories are accused of being all-inclusive, unifying explanations without systematic evidence, and abstracted empiricism stands accused of focusing only on data collection and analysis evidence without the input of theory (Mills, 1959). Middle-range theories chart a middle course and display the three characteristics of emphasizing interactions between theory and empirical research, specifying relationships between concepts so that they can be made into analytical models, and studying concrete phenomena such as socio-technical transitions, rather than abstract entities like ‘society’ (Geels, 2007).

MLP suggests that transitions occur through interactions among the three levels of the niche, the regime, and the landscape, shown in Figure 6. Here, the innovation process is characterized as a coupled dynamic of selective pressures and adaptive capacity in the dominant regime in which technology is embedded (Rip, 1992; Smith et al., 2005). Concepts from other approaches – such as markets, technologies, political institutions, behaviour, and culture – are still relevant, but the MLP proposes a complex process approach that addresses the co-evolution of these elements (Geels & Schot, 2010).

Increasing structuration
of activities in local practices

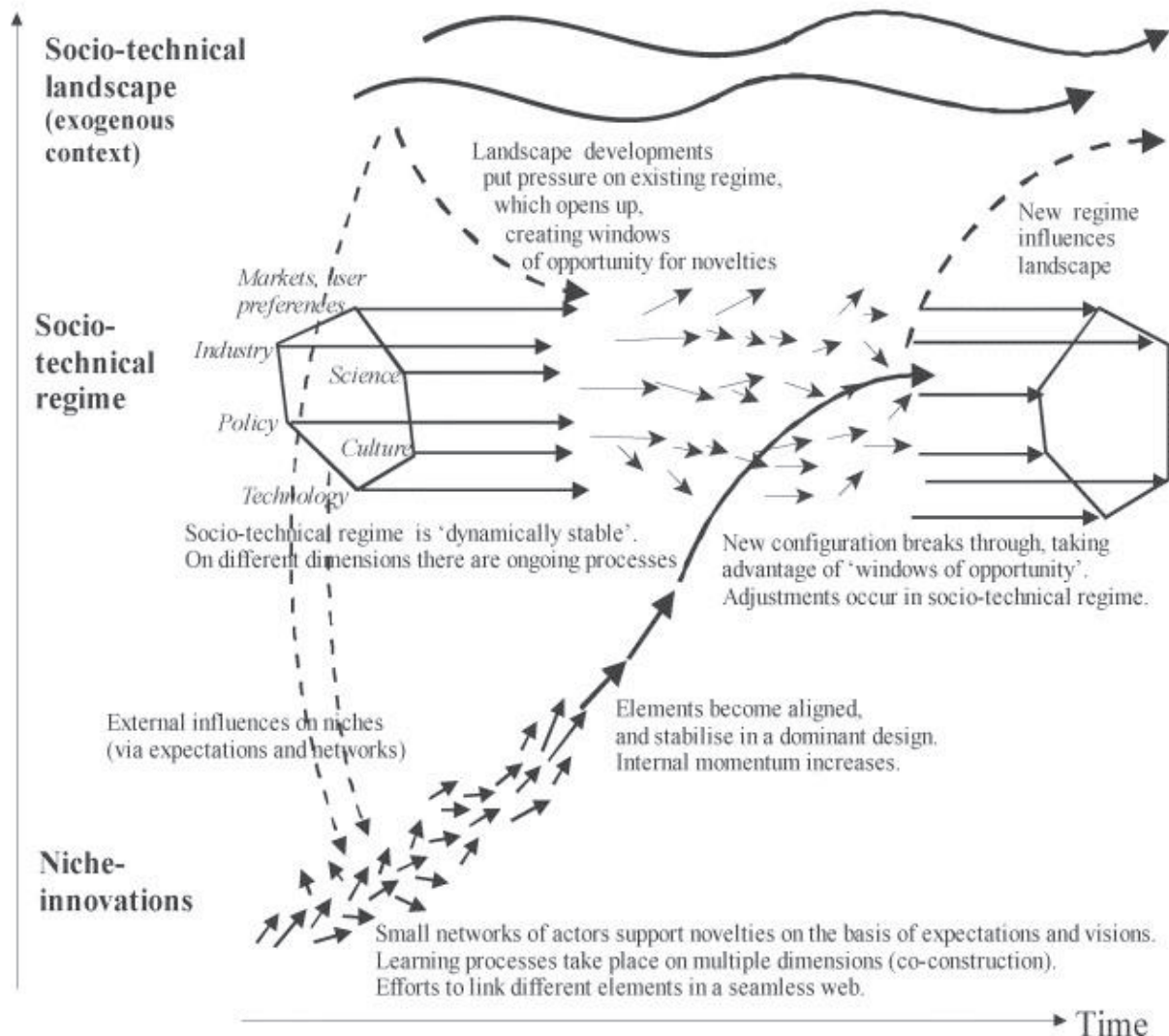


Figure 6: The multi-level perspective on transitions (adapted from Geels, 2002, p. 1263)

The MLP views transitions as non-linear processes that result from the interplay of developments at three analytical levels: niches (the locus for radical innovations), socio-technical regimes (the locus of established practices and associated rules that stabilize existing systems), and an exogenous socio-technical landscape (Geels, 2002; 2005; 2011; Rip & Kemp, 1998b). The landscape refers to exogenous developments or shocks such as economic crises, demographic changes, wars, ideological change, major environmental disruption like climate change that exert pressures on the regime. Figure 7 shows a fragmentary structure of the levels concerning the sociotechnical system of automobility, based on the MLP (Fraedrich et al., 2015). This diagram refers only to the different levels and exemplary, analytical elements without visually representing the dynamic processes that occur within the categories and between them, as shown in Figure 7.

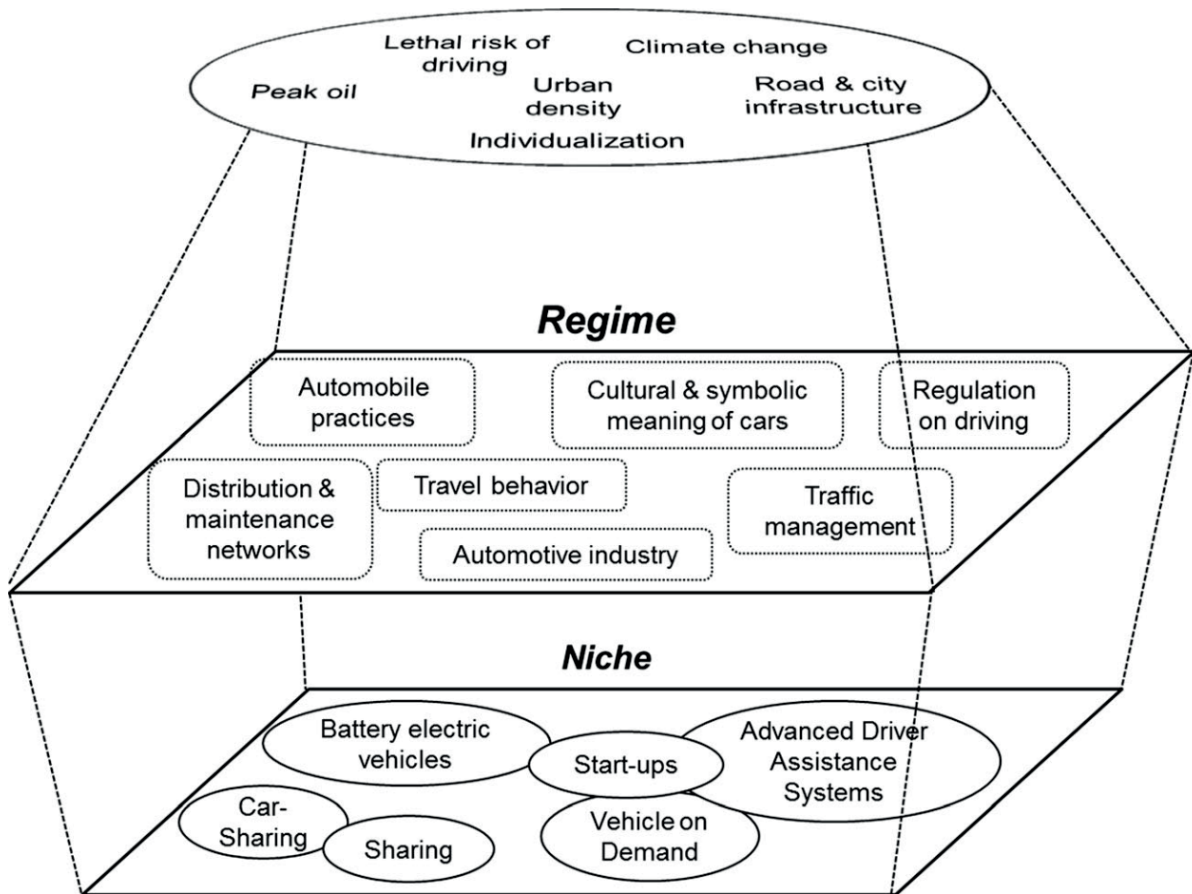


Figure 7: Multi-level perspective on automobility

The MLP borrows and combines concepts from a mix of disciplines. For example, ideas of trajectories, regimes, niches, speciation, path dependence and routines come from evolutionary economics. Sensemaking, social networks and innovation as a social process shaped by broader societal contexts come from Science and Technology Studies (STS). Rules and institutions as ‘deep structures’ on which knowledgeable actors draw for their actions, the duality of structure – i.e. that structures are both context and the outcome of actions – and the ‘rules of the game’ that structure actions, come from structuration theory and neo-institutional theory (Geels, 2004; Geels & Schot, 2007; 2010).

‘Transitions’ are defined as regime shifts and come about through interacting processes within and between levels. Existing regimes are characterized by lock-in and path dependence. Regimes are therefore adapted only to incremental innovations along predictable trajectories. This means that transitions do not come about easily – it is difficult to shift the regime. Radical innovations, therefore, emerge in niches separately from the regime. These niche innovations may break through an established regime only if something happens to the regime that leads to openings, such as external landscape developments that create pressures on the regime, producing windows of opportunities.

This will lead to struggles between niches and regimes. The regime refers to the incumbent socio-technical system that the niche is potentially affecting or replacing. For example, a struggle may be about a niche replacement happening on multiple dimensions, e.g. markets, regulations, cultural meanings or infrastructure. These struggles are waged by interpretive actors that fight, negotiate, search, learn, and build coalitions as they navigate transitions (Geels, 2010).

The MLP originates from the Twente School's quasi-evolutionary theory (Rip, 1992; Rip & Kemp, 1998b; Schot, 1992) that, as noted, aimed to make evolutionary variation–selection–retention mechanisms more sociological via crossovers with interpretivism/constructivism mainly from STS (Geels, 2010).

Variation is seen as guided by expectations (van Lente, 1995), visions and beliefs that provide cognitive substance to searching so that intentional actors guide the innovation processes.

Selection occurs in a multi-dimensional selection environment that incorporates not only markets and regulations but also social, cultural, and political requirements.

Retention occurs in technological regimes, conceptualized as 'rules' rather than routines (Rip & Kemp, 1998b). Nevertheless, the actors are not passively followers of these rules; they are knowledgeable agents (Giddens, 1984) who creatively interpret and apply the rules, albeit within constraints. Retention is, therefore, not only a process of retaining what works as in behavioural theory but is also an interpretive, negotiated and contested process of institutionalization. This means that actors both follow and sustain rules, and break and question them, thereby contributing to changing or continuing with rules.

The MLP here combines an evolutionary interest in long-term trajectories of speciation or extinction with an interpretive interest in social enactment, sense-making, and cognitive learning. This means that the trajectories *within a regime* come from social interactions within semi-coherent and temporary rule structures that interpretive actors are recursively reproducing and therefore incrementally adjusting (Geels, 2004). These trial-and-error dynamics derive from evolution theory, and sense-making and cognitive learning from interpretivism.

Evolutionary theory also guides the dynamics *between the levels of regime and niche*: various niche innovations permeate the radical alternatives that interact with these broader selection environments in the regime level. The creation of 'fit' between variations (niches) and selection environments (regimes) is also seen as an enacted and multi-dimensional process that involves not only markets but social, political and cultural dimensions as well.

Regime: From routines to rule-sets

Building on Nelson and Winter's (1982) concept of the technological regime as a domain where the cognitive *routines* of different actors are coordinated, Rip and Kemp (1998b) widened this idea to include not merely *routines* but the wider cognitive *rule-set*. These are embedded in a complex set of engineering practices, production process technologies, product characteristics, skills and procedures, ways of handling relevant artefacts and people, and ways of defining problems. All are embedded in institutions and infrastructures.

Following Giddens (1984), transition theory views these rule-sets as existing primarily in practices, where actors are rule-followers and rule-makers at the same time (Geels, 2011). These regime rules are both the medium and the outcome of action: the 'duality of structure'. Seeing rule structures as gradually rigidifying when moving from individual to community and then to the wider organizational field, rule-sets become constraining institutional habits and routines which are effectively reproduced in practice by narrowing the search space for new ideas, practices and visions (Geels, 2011; Graugaard, 2014).

A transition is a system-wide transformation of the rules encompassing formal regulations, normative assumptions and cognitive heuristics (Scott, 1995). This is why transition theory sees innovation within socio-technical regimes as incremental and looks to niches, conceived as

protected spaces where rule structures are less rigid, for path-breaking innovations (Smith & Raven, 2012).

3.2.5 Typology of transition pathways

Here I elaborate on different typologies of transition pathways to explain the development of the reconfiguration concept. Concepts of transition pathways were developed based on an analytical claim that different kinds of interactions among niche, regime, and landscape result in different kinds of alignments. Geels and Schot (2007) developed a typology of four transition pathways: transformation, de-alignment and re-alignment, technological substitution and reconfiguration. These transition pathways were developed based on combinations of the two dimensions of the timing and the nature of the interactions between levels (Geels & Schot, 2007). Because the understanding of transitions had a putatively bottom-up and niche-driven bias, Geels and Schot developed a typology of transition pathways based on different multi-level interactions in order to counter this bias.

The timing of interaction is the first relevant dimension. Previous MLP studies had emphasized simultaneous alignments of developments between different levels – for example, that a niche innovation develops at the same time as a landscape pressure. However, this is not always the case. Such interactions do not necessarily happen simultaneously. For example, a niche innovation may occur at several different development stages, and the order of the interactions may vary at different times. One must consider at what stage and state of development characterize the niche when openings in the regime arise from landscape pressure, because different timings of multi-level interactions have different outcomes. Particularly important for the progress of niche-development is the timing of landscape pressure on regimes. If landscape pressure occurs at a time when niche innovations are *not yet* fully developed, the transition path will be different from when they *are* fully developed (Geels & Schot, 2007).

Geels and Schot (2007) propose four proxies as realistic indicators to testify that niches are sufficiently developed to have chances of interacting with the regime: (i) that the learning processes have stabilized in a dominant design, (ii) that powerful actors have joined the support network, (iii) that price/performance improvements have risen with expectations of further improvement in, for example, prospected learning curves, and (iv) that the innovation is used in market niches, which cumulatively amount to more than 5% market share. The first three indicators stem from the literature on niche development, which emphasizes main learning processes, network building and articulation of expectations (Hoogma et al., 2002; Kemp et al., 1998). The fourth indicator comes from diffusion research, according to which the diffusion curve may become self-sustaining and take off at between 5 and 20% of cumulative adoption (Rogers, 1996).

The nature of the interaction is the second relevant dimension. Here, it must be considered whether the niche innovation and landscape interaction can lead to a continuation of the regime, or change. A disruptive or competitive interaction will entail pressure to replace the existing regime. A symbiotic interaction will be a reinforcing relationship where niches can be adopted as a competence-enhancing add-on in the existing regime (Geels & Schot, 2007).

Using combinations of these two criteria, Geels and Schot (2007) develop propositions about the four transition pathways: P1) transformation, P2) de-alignment and re-alignment, P3) technological substitution, and P4) reconfigurations. In addition, they propose a zero path (P0) involving reproduction with stability, and a fifth proposition (P5) on a possible sequence of transition paths, detailing how transitions may start with one path and later shift to others (Geels & Schot, 2007):

P0 Reproduction path: If the landscape has reinforcing pressure that helps to stabilize the regime, radical niche innovations may be present but will have few chances of breaking through as long as the regime is stable. There may be some internal regime problems, but the regime will have sufficient problem-solving potential to deal with them.

P1) Transformation path: If there is moderate landscape pressure when niche innovations have not yet been sufficiently developed, then regime actors will respond by modifying the direction of development paths and innovation activities. Niche innovations cannot take advantage of landscape pressure on the regime because they are not sufficiently developed. In this pathway, moderate landscape changes exert pressure on the regime, leading to re-orientations by regime actors. New regimes grow out of old regimes through cumulative adjustments and re-orientations. Niche innovations may *add to* the regime, but they do not disrupt the basic architecture.

Timing of interaction: A niche innovation is not ready when ‘some’ landscape pressure arises.

Nature of interaction: A symbiotic niche adds to the regime and enables its continuation.

An example is the Dutch hygienic transition from cesspools to sewer systems (Geels, 2006a).

P2) De-alignment and re-alignment path: If landscape pressure is new, large, and sudden, then increasing regime problems may cause regime actors to lose faith, resulting in de-alignment and erosion of the regime. If niche innovations are *not* sufficiently developed, then there is no straightforward substitute, no stable niche innovation that can ‘fill the gap’. This creates space for the emergence of *multiple* niche innovations that co-exist and compete for attention and resources. Eventually, one niche innovation will become dominant, forming the core of a re-alignment of a new regime.

Timing of interaction: one particular niche innovation is not ready when landscape pressure arises, and therefore several niche innovations enter the regime.

Nature of interaction: Disruptive innovations change the regime.

An example here is the US transition from horse-drawn carriages to automobiles (Geels, 2005)

P3) Technological substitution path: If there is substantial landscape pressure at the time when niche innovations *have* developed sufficiently, the niche will break through and replace the existing regime. Without landscape pressure, this remains a reproduction process. It becomes a technological substitution path when a ‘specific shock’ exerts considerable landscape pressure on the regime. This pressure leads to major regime tensions, with windows of opportunity for niche-innovations. Niche innovations can use these windows because they have stabilized and gathered internal momentum (this is another difference with the de-alignment and re-alignment path).

Timing of interaction: one particular niche innovation is ready when landscape pressure comes to the boil.

Nature of interaction: Disruption changes the regime.

An example is the British transition from sailing ships to steamships (Geels, 2002).

P4) Reconfiguration path: Symbiotic innovations, developed in niches, are initially adopted in the regime to solve local problems. They subsequently trigger further adjustments in the basic architecture of the regime. If radical innovations initially developed in niches have symbiotic relations with the regime, they can be easily adopted as an add-on or component replacement. These adoptions are driven by economic considerations such as improving performance or solving minor problems. Thus they leave most foundational regime rules unchanged but lead to certain adjustments. When the basic architecture remains the same, this is a transformation pathway (P1). But when the adopted novelties lead to further adjustments, such as when regime actors explore new combinations between the old and new, they learn more about the novelties.

This may lead to technical changes or changes in user practices, perceptions, and search heuristics. This may then again create space for new adoptions of niche innovations. *Sequences of component* innovations can thus, over time, and under the influence of landscape pressures, add up to major reconfigurations and regime changes. The new regime grows out of the old regime (similar to transformation path P1). The difference with P1 is that the reconfiguration path involves substantial changes in the regime's basic architecture. Transitions here are not caused by the breakthrough of *one* technology but by sequences of *multiple* component-innovations. Already developed niche innovations enter the regime, and several external landscape developments influence this transition. While these landscape developments create opportunities and pressure, the main characteristic of this transition path is the interaction between *multiple component* innovations and the regime.

Timing of interaction: *sequences* of multiple component innovations.

Nature of interaction: sequences of *multiple* component innovations, landscape less important. An example is the US transition from traditional factories to mass production (Geels, 2006b).

P5) Sequences of transition paths: If landscape pressure takes the form of 'disruptive change' (changes that occur infrequently, develop gradually, but have a high-intensity effect in one dimension), a sequence of transition pathways is likely, beginning with transformation, then leading to reconfiguration, and possibly followed by substitution or de-alignment and re-alignment. This sequential pattern indicates that crossovers may occur between transition pathways. In future decades, climate change may become such a disruptive landscape change, triggering a sequence of transition paths in transport and energy regimes.

3.3 Social practice theories (SPT)

SPT have also been proposed as applicable theories for explaining socio-technical change. SPT are relational type of theories coming from sociology, stating that everyday practices and routines are conditioned by change, habits, socialization, and normalization (Sovacool & Hess, 2017). There is no such thing as one unified practice theory. SPT are a set of cultural and philosophical accounts that focus on the conditions surrounding the practical carrying out of social life. SPT have spread to include environment and sustainability research, cultural studies, design studies, management studies, social and cultural anthropology, geography, consumer behaviour and social policy research. In the context of the continuing debate about the structure-agency problem in social theory and philosophy, SPT scholars have used SPT to (re)turn to this theoretical complexity (Halkier et al., 2011).

SPT are cultural theories, treating societal aspects as practices (Reckwitz, 2002b). SPT sees the procedures of actions as a practice, understood as a commonly shared routinized way of performing something (Reckwitz, 2002b; Shove & Walker, 2010; Watson, 2012). This implies that social structures and technologies are reproduced through routines enacted by 'carriers' or 'practitioners' of social practices, and therefore do not exist outside or above individuals (Reckwitz, 2002b; Shove et al., 2012; Strengers & Maller, 2014, p. 3). This means that SPT turn away from focusing on individual interests and instead analyse a practice by examining performances in the actual context of a systemic change. This lies beyond individual attitudes, behaviour, or choice (Shove, 2010).

These theories investigate how daily practices are shaped by established services and technologies, by shared norms, conventions and capabilities, as well as by organizational, institutional and political rules (Geels et al., 2015; Shove & Walker, 2014). Social practice theories conceptualize the practices performed by users and enable, for instance, the repetitive procedure of car-sharing to be made the unit of analysis. SPT see the procedures for enacting an action as a practice: a commonly shared and routinized way of performing something

(Reckwitz, 2002b; Shove & Walker, 2010; Watson, 2012). For example, eating breakfast is performed daily by countless individuals around the globe, making it easily recognizable as a social practice (Maller, 2015). SPT have been applied in sustainability and consumption research to describe and explain the trajectories of practices such as driving (Shove et al., 2012; Spurling et al., 2013), keeping cool (Strengers, 2010; Strengers & Maller, 2011), or warm (Brown & Walker, 2008), doing the laundry (Shove, 2003; Strengers, 2009), bathing (Browne et al., 2013), gardening (Pullinger et al., 2013), Nordic walking (Pantzar & Shove, 2010) and storing food (Hand & Shove, 2007).

3.3.1 Four phases

The theoretical use of the concept of ‘practice’ within social theory and philosophy of the social sciences is said to be as diverse as the kinds of examples employed (Rouse, 2007). Let me clarify the background for the core concepts I use in the studies. Here I follow three phases in contemporary practice theory as described by Postill (2010). In the first phase, the inspiration was primarily European, social theoretical, Post-Marxist, and macro-sociological, and was especially concerned with reconciling the opposition between agency and structure. The second phase was more concerned with the philosophy of action. It was inspired by Science and Technology Studies (STS) and the Sociology of Scientific Knowledge (SSK); taking agency for granted, it concentrated on performances. Divisions between and within the first two phases create dilemmas for scholars of the third and fourth, current phase, who seek to apply SPT to enable substantive explanation in diverse empirical settings (Warde, 2014).

The four phases tell the story of the development of SPT relevant for this thesis. First, SPT has social scientific roots in the work of early Bourdieu, early Giddens, late Foucault – and, with this background, is rooted in the philosophy of early Heidegger and late Wittgenstein. Second, their insights were used together in a philosophical ontology of practices (Knorr-Cetina et al., 2001; Schatzki, 1996; 2002). Third, these were further developed into newer interpretations and analytical frameworks applicable for empirical studies (Reckwitz, 2002b; Röpke, 2009; Shove, 2003; Spaargaren, 2011; Warde, 2005). These insights have been further developed in several research fields.

First phase: Overcoming structural constraints

Practice theories were initially developed to overcome structural constraints in ongoing theoretical discussions. Ortner (2006), a cultural anthropologist, explains this by outlining some of the theoretical backgrounds to help describe the early development of SPT: When practice theory entered the scene in the late 1970s, three major paradigms dominated the theoretical landscape: interpretative/symbolic anthropology (Geertz, 1973), Marxist political economy (Wolf, 1982), and French structuralism/ poststructuralism (Lévi-Strauss, 1978). All represented important moves away from the dominance of functionalism. Whereas the functionalist had focused narrowly on how things ‘hang together’ and the practical functions of institutions, interpretative/symbolic anthropology focused on what they mean. Marxist political economy, meanwhile, focused on social formations such as capitalism; and French structuralism and post-structuralism focused on institutions like kinship and myth that operated according to an underlying logic or structure.

These paradigms were naturally different and opposed to one another. What they all had in common was that they were theories of constraint – they saw human behaviour as being shaped, moulded, ordered, and defined by external social and cultural forces and formations such as culture, mental structures, or capitalism. They all focused on structural constraints. However, although these structural constraints are important, a purely constraint-based theory, devoid of

attention to human agency or the processes that produce and reproduce these constraints, became increasingly problematic.

Therefore, social practices can be understood as having developed as a result of the need for theories on what produces and reproduces these constraints: social practices.

In sociology, interactionism became an early alternative to these constraint perspectives (Goffman, 1959; 1967). However, it was seen as being too extreme because it focused on the micro-sociology of interpersonal interaction, ignoring all structural constraints. Although this theory was narrowly applied, it still became established as a version of the structure–agency opposition.

With this ‘interpretative turn’ represented by the interactionism and intersubjective approaches in the 1970s, a complex landscape of contemporary social theories developed. Several social theorists of diverse backgrounds set the foundation for the earlier work of SPT from the 1970s. The most prominent here were Bourdieu, Giddens and Foucault.

Pierre Bourdieu (1977) made contributions to earlier versions of practice theories in his *Outline of a Theory of Practice* that was influenced by structuralism and started his work on ‘praxeology’. He proposed the concept of *habitus* to explain how actions are produced by social structures and changed by individuals. Habitus explains why we do not have to remember a set of rules every time we act: these rules are based on practical know-how and skills internalized in our bodies. The body then becomes the device from which socially and culturally determined predispositions are acted out.

Anthony Giddens (1979, 1984) contributed with his work on the framework of a ‘theory of structuration’. This was heavily influenced by the later philosophy of Wittgenstein, and explored the concepts of shared understanding and rule-following. Giddens held that social structures are reproduced because subjects with the same understanding of the world act out these understandings. Formal and informal rules are found in procedures implicated in the practical activities of day-to-day life.

Michel Foucault (1984a, 1984b) made contributions to practice theory in his works on ancient ethics. His framework for analysing the relations between bodies, agency, understandings and knowledge can be understood as a ‘praxeological’ perspective on society. With his work on practices of the self, Foucault argued that we constitute ourselves as subjects; we are enabled by way of various ‘practices of the self’, which include activities like writing, diet, exercise, and truth-telling. However, we are also constrained in how we undertake these practices, shaped by institutions such as schools, courts of law, hospitals, and the state security apparatus, as well as by the prevailing norms and values of the society in which we live (Taylor, 2010).

These early works all, in some way, focus on practices because they have an interest in the everyday and the life-world and were influenced by the interpretative turn in social theory. With roots in the philosophy of late Wittgenstein and early Heidegger and social scientific foundations in the work of early Bourdieu, early Giddens, and late Foucault, practice theories became a set of cultural and philosophical accounts focusing on the conditions surrounding the practical conduct of social life. Bourdieu (1977) and Giddens (1979) conceptualized, in different ways, the articulations between the practices of social actors on the ground and the larger structures and systems that constrain those practices but are also open to being transformed by them. Both scholars drifted away from the oppositional relationship. Instead, they argued, in different ways, for dialectical relationships between structural constraints on society and culture on the one hand and the ‘practices’ of social actors on the other. The term

'practice' was new and important. Practice theory approached problems that dated to functionalism. It restored the actor to the social process, without losing sight of the larger structures that constrain *and* enable social action. It grounded cultural processes – of discourses and representations that used to be called 'symbol systems' – in the actual, real-life social relations of people (Ortner, 2006).

Second phase: Schatzki's ontology of practices with four components

Theodore Schatzki (1996) later outlined a social philosophy that focused explicitly on the practice concept. His basic line of thought came from the contention of Heidegger and Wittgenstein that people do what makes sense for them to do. Schatzki developed a scheme of practice components and argued that human action is performed when interlinking elements form a practice and that these practices are linked to form wider constellations of practices or fields of practices.

He saw practices as being made up of four types of components: i) 'practical understandings' that is the 'know how' and understanding 'how to go on' with an activity; ii) 'rules' that are explicit directions, instructions, admonishments; iii) 'teleoaffective structures' that are normatively ordered arrays of ends, orientations, and associated affective engagements; and iv) 'general understandings' that are common to multiple practices and condition the manner in which practices are carried out (Schatzki, 2002):

i) 'Practical understandings', which are specific to knowing how 'to go on' with a particular practice, are close in meaning to Giddens (1984) concept of 'practical consciousness' and to Bourdieu's (1990) concept of 'practical sense'. They consist of embodied knowledge on how to act in a specific context. With this knowledge, the actor knows how to identify and react to something in the social world and perform the action required. It is not the action itself, but the ability to perform the action that is important – and this ability belongs to a specific practice (Heidenstrøm, 2020).

ii) 'Rules' are explicit rules on how to act – laws, regulations, written statements, instructions, and so on – made to create a specific order to a practice and to correct action.

iii) 'Teleoaffective structures' manifest in the ways that actions matter to people (Schatzki, 1996). We act because we want to express a certain purpose, desire, belief, or expectation. Importantly, these are not the characteristics of an individual subject but represent the appropriate purpose of a particular *action* that governs what it makes sense to do when performing a practice (Heidenstrøm, 2020). Unlike rules, teleoaffective structures are not made explicit: they represent all possible hierarchies of ends and projects within a practice. As such, they are normative because they indicate a certain way of performing (Schatzki, 1996).

iv) 'General understandings' are common to multiple practices. They may be articulated in the 'sayings' of various practices in a broad sense. General understandings sit across the discursive/non-discursive divide and may display intimately connected, tacit, affective, and discursive elements. They may be relatively specific to sets of practices, but they also denote fundamental concepts, values and categories, and diffuse but culturally significant understandings, such as notions of convenience (Welch et al., 2020; Welch & Warde, 2017).

One key feature of the reformulation of Schatzki (1996) was to proclaim practices to be at the core of the social scientific analysis of social order and personal conduct. Practices are seen here as the primary entities of the social world, and society itself is 'a field of practices' (Warde, 2014).

Schatzki (1996) makes a crucial distinction between practices-as-entities and practices-as-performances. His practice-as-entity notion refers to a temporally unfolding and spatially dispersed nexus of doings and sayings linked together through understandings, explicit rules and teleoaffective structures. His practice-as-performance concept refers to specific moments of integration between elements that occur when practices are enacted in particular local situations.

This implies that practices as entities can be recognized as existing across time and space, even if they are not currently being enacted. However, during situated and specific performances, the practice ‘lives’ (Higginson et al., 2015). Thus, practices are never singular or fixed across time or space. A dialectic relationship exists between entities and performances because, while practices as entities may guide performances, it is through these performances that entities are (re)produced and either stabilized or changed (Warde, 2005).

In this ontology of practices, Schatzki sidelined objects as the outcomes of practices, treating them as external to the components of the practices. Other practice scholars have since discussed this move, developing to include material objects differently. For example, it posed a problem for those interested in the social and cultural manifestations of consumption in which the use and enjoyment of objects, services, and resources are central (Warde, 2014). This leads to discussions about materiality in the third and fourth phases of SPT.

Third phase: Reckwitz, cultural theories, entities, and performance elements

Reckwitz (2002b) made it clear that objects and their use were integral to the performance and thus the reproduction of practices in mundane everyday life. Reckwitz acknowledged the centrality of ‘things and their use’ in this definition (Warde, 2014). His well-known definition of practice thus includes *things*: ‘A ‘practice’ (Praktik) is a routinized type of behaviour which consists of several elements, interconnected to one other: forms of bodily activities, forms of mental activities, ‘things’ and their use, background knowledge in the form of understanding, know-how, emotional states and motivational knowledge’ (Reckwitz, 2002b).

Thus, in a similar way to Schatzki, his definition also consists of interconnected components. Separating this definition into four components can clarify his concepts: i) Forms of bodily activities are the way the body learns and performs a practice, how it handles objects, as well as talks and moves. ii) Forms of mental activities are the social and symbolic significance of participating in a practice, such as motivations to participate, beliefs, engagements and emotions. iii) Things and their use are all objects that are applied in a practice, such as technologies, tools, products, the body, infrastructures and materials. iv) Background knowledge is a type of socially and culturally shared understanding encompassing the skills needed to perform a practice appropriately and the practical understandings to perform it competently (Heidenstrøm, 2020).

Unlike Schatzki, this definition includes things, and captures the aspects of (a) what constitutes a coordinated entity and (b) how it is performed.

Reckwitz (2002b) explains the distinctiveness of SPT by contrasting them to theoretical narratives in the broader domain of social theories, shown in Figure 8. He argues that all practice theories explain action and are examples of social theory. Practice theories highlight the significance of shared symbolic structures of knowledge in order to grasp both action and social order.

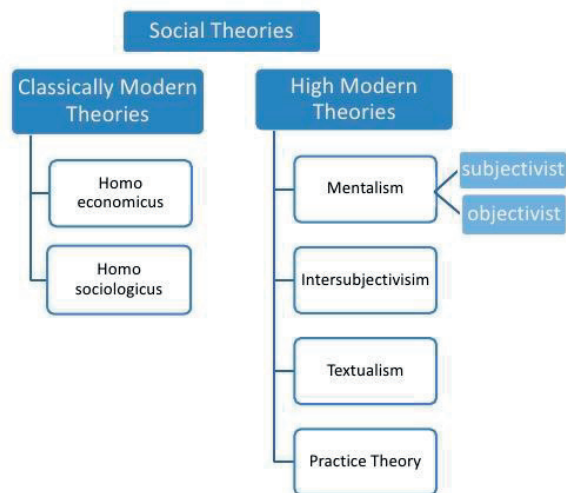


Figure 8: Toward a theory of social practice (Reckwitz, 2002b)

First, they form a conceptual alternative to the ‘classically modern social theories’ because they are different from these models of explaining action, such as with a purpose-oriented approach (*‘homo economicus’*) and a norm-oriented approach (*‘homo sociologicus’*). What distinguishes diverse cultural theorists from the two classical figures of *‘homo economicus’* and *‘homo sociologicus’* is their way of grasping the conditions of human action and social order. The model of the *homo economicus* explains action guided by individual purposes, intentions and interests, and social order is then a product of the combination of single interests. The model of *homo sociologicus* explains action by pointing to collective norms and values, as in rules which express a social understanding of what one should do, and that social order is then guaranteed by a normative consensus. In contrast, the newness of cultural theories lies in explaining and understanding actions by reconstructing the symbolic structures of knowledge that enable and constrain the agents to interpret the world according to certain forms (Reckwitz, 2002b).

Second, the broader alternatives to these ‘classically modern social theories’ are the ‘high-modern types of social theories’, where practice theories are presented as conceptual alternatives to other forms of social and cultural theory; culturalist mentalism, textualism, and intersubjectivism. SPT are distinguished from the three other cultural-theoretical vocabularies because they differ in their localization of the social and in their conceptualization of the body, mind, things, knowledge, discourse, structure/process, and the agent.

SPT are held to be appealing to, e.g. consumption studies, because they differ – in two important ways – from earlier work using social and cultural theories. First, by providing an alternative framing to models of individual choice, and second, by uncovering and exploring phenomena usually concealed in cultural analysis. This can be explained by looking at how emphasis is put on different aspects of conduct. For example, compared to the model of the independent consumer, practice theories emphasize routine over actions, flow and sequence over discrete acts, dispositions over decisions, and practical consciousness over deliberation. In reaction to the cultural turn, emphasis is placed upon doing instead of thinking, the material instead of the symbolic, and embodied practical competence instead of expressive skill (Warde, 2014).

Fourth phase?

The development of SPT after this is diverse. As related by Warde (2014), scholars from different disciplines and sub-disciplines discovered, identified, and pursued the use of practice-theoretic tools. The approach has become well-known in several ways – in terms of a ‘new paradigm’ for media studies (Couldry, 2004), ‘Practice Lens’ or ‘Practice-Based Studies’ in management learning and organizational behaviour (Gherardi, 2009; Nicolini et al., 2003), a ‘practice-oriented shift’ in economic geography (Jones & Murphy, 2011), practice-oriented design (Scott et al., 2012), and ‘practice theory’ in consumption studies (Warde, 2005) and ecological economics (Røpke, 2009).

Of particular interest for this thesis is how themes of environmental degradation, climate change, and sustainability have led to the steady increased use of SPT in empirical studies of consumption. For example, studies of the role of household consumption in a climate change setting have argued that the use of natural resources to obtain objects and operate machines is relevant, also politically, because of the problems it creates (Shove et al., 2012; Spaargaren, 2011; Warde & Southerton, 2012; Wilhite, 2012). Therefore, considerable attention has been paid to the mundane activities of everyday life, like the use of water and electricity found in practices of cleaning, washing, and keeping warm or cool (Warde, 2014). Central work here was done by Warde (2005) in his ‘Consumption and Theories of Practice’. Further theoretical development concerned connections between technologies, utilities, resource consumption, and the problems of sustainability (Hand et al., 2007; Shove et al., 2007), for example, by exploring questions of change and continuity in practices and their associated objects and resources (Pantzar & Shove, 2010; Shove, 2004) and by focusing on environmental sustainability (Bartiaux, 2008; Gram-Hanssen, 2010; Røpke, 2009; Spaargaren, 2000).

With this work, there came a greater focus on the role of materiality in practices. Things were treated as elements of the practice theories rather than outcomes, as in Schatzki’s formulation. Bringing the material and functional properties of things back into the account was clearly signalled by Reckwitz (2002a) and was later exploited extensively, with the best-known example being the three-element approach (meanings, competencies and materials) in practice theory of Shove and colleagues (2012). By paying attention to materials, consumption research deals with activities like the washing of bodies and clothes (Shove, 2003), gardening (Hitchings, 2007), heating and cooling (Shove et al., 2014) using electronic devices (Christensen & Røpke, 2010) and waste disposal (Evans, 2011). These are practices that are dependent on the use of energy, water, and scarce raw materials –where changing patterns of consumption might mitigate negative environmental effects (Warde, 2014).

3.3.2 Elemental approach to changes in practices

I follow Shove et al.’s three-element approach (see above) and the concepts of ‘practice-as-entity’ and ‘practice-as-performance’. The process of developing these short and precise descriptions of the terms involves a simplification and merging of several earlier concepts and discussions, as elaborated earlier. As Shove herself writes, ‘In constructing this scheme, we have made a number of breathtaking simplifications. One of the most striking is the contention that practices are composed of just three generic elements’ (2012, p. 120).

This scheme considers *material* as things, technologies, tangible physical entities, and the stuff from which objects are made. Shove (2012) explains that the material plays a role in practice theory. Objects, infrastructures, tools, hardware, and the body itself are considered materials (Shove et al., 2007). This is based on science and technology studies (Callon, 1984; Latour, 1992) which reveal that material artefacts (stuff) are crucial for practices. Although there was some earlier dismissal of the role of things in the theory of practice (Bourdieu, 1984; Giddens,

1984), and later acceptance on how objects are related to practices (Reckwitz, 2002b), Shove and others include things as elements of practice (Røpke, 2009; Shove et al., 2012).

This scheme considers *meaning* as inhering in symbolic meaning, ideas, and aspirations (Shove et al., 2012). Meaning with regards to emotion and motivation has been a somewhat debated element in SPT because of a lack of agreement about what meaning means. Shove et al. (2012) includes meaning as an element in this scheme and explains why. Meanings are based on the past, the setting, and the future, because what people do has a history and a setting, and meaning is, therefore, more like an exogenous motivation (Schatzki, 1996; 2002). Reckwitz (2002b), on the other hand, describes meaning as a collective term for mental activities, emotion, motivational knowledge. Shove et al. (2012) confirms and continues this sort of collection of terms by including the social and symbolic significance of participation in the term of meaning.

This scheme considers *competence* as skill, know-how, and technique (Shove et al., 2012). To bring together knowledge, understanding, experience, and how enactments are judged, Shove (2012) uses the term ‘competence’. What people do has a history and a setting. Practical consciousness (Giddens, 1984) and deliberately cultivated skills are examples of different varieties of know-how within social practice.

The simplification continues when explaining the relations between the elements because the relationships can only be described by focusing on the variation in combinations between the elements. These dynamics enable an analysis of the changes; practices change when new elements are introduced or when existing elements are combined in new ways (Shove et al., 2012, p. 120). Change in practices can be described through the terms of ‘proto-practice’, ‘practice’, and ‘ex-practice’: It is important to recognize that elements have histories and futures of their own and are routinely transformed by and through specific integrations in practice. That said, there is still value in taking seriously the view that practices depend upon the interconnection of elements. With this idea in place, we can – at least in theory – identify three possible formulations. One in which the constituent elements of practice meaning, materials and competence exist but have yet to be integrated – called proto-practice; a second, called practice, in which they are indeed actively interconnected, and a third, termed ex-practice, in which those sustaining links are no longer made (Pantzar & Shove, 2010).

In studying practices-as-entities with the elemental approach, emphasis is placed on how the elements are interconnected and how these connections are reproduced or changed. Furthermore, a practice is always connected to other practices, forming bundles or elements from other practices and the rhythm of everyday life (Shove, 2009; Southerton, 2013; Walker, 2014). When we study practice-as-performance, we study the understandings and meanings of practices that are unfolded by the *individual carriers* performing them. Watson (2012) suggested that three mechanisms are involved when a practice changes: how the elements change, how the carriers of the practice change, and how elements and carriers relate to changes in other practices. His study indicated that system change in transitions could be explained from a practice-based perspective.

Policy and interventions

For some, the concept of practices-as-entities is seen as most important when seeking to intervene in practices because it helps to avoid the methodological individualism of more behaviourist approaches to social change (Spurling et al., 2013). However, others argue that the variety of practices-as-performances is more relevant as this diversity is likely to be significant in shaping future practice change (Higginson et al., 2015). By observing and schematizing the variety of multiple performances – on the surface the same as in practice-as-entity – it may be

possible to discern particular variants of the same practice as more or less dominant or important in particular times and places and, in so doing, to gather insights about the potential future trajectories of specific practices and how this impacts across wider systems of practice. In other words, by looking at different performances of a practice and how these vary, we can learn about the variants and map which have the greatest potential to be flexible or dominant in the future (Higginson et al., 2015).

4 Research design and methodology

This chapter presents the research design, data collection, analytical process, research ethics, the positioning within the philosophy of sciences, and limitations. These elaborations are relevant to reduce the bias and overcome the limitations of the research. This chapter elaborates on what I did in my research, and why. This thesis results from an iterative research process, where steps of reviewing the literature, developing research questions, collecting data, analysing data, interpreting results, and writing papers were done in iterations.

Three episodes during this research can illustrate the importance of these explanations. Later in this chapter, I detail how I sought to deal with such issues when collecting and analysing the data and considering research ethics.

Data collection may face biases due to the self-selection in the sample and self-reported data in the interviews. Although all interviewees were informed about the confidentiality and purpose of the research, there is always the risk that interviewees will not share everything and will choose what they will talk about and what they will not. For example, one informant in a household interview mentioned travelling without a child's car seat for their child. The other household participant said he/she did not remember this and was clearly uncomfortable with the topic, and did not want to dwell on it during the interview. It was evident that this person/this couple did not want to talk about breaking the rules and chose not to elaborate.

Moreover, ethical considerations are crucial because of possible differing interests in the research results. I encountered two concrete instances that showed the importance of this. Once, a car-sharing company asked me to share my research results at a seminar they were arranging. Eventually, I realized that they had a hidden agenda when they explicitly asked me to present specific results showing that old IT systems were the main bottleneck preventing car-sharing from taking off. They wanted to use results like this to present to their board of directors to support their proposal for major new investments in IT systems.

I encountered similar challenges when a car-sharing company contacted me after the publication of a newspaper article showing growth in car-sharing services and questioning the environmental effects (Kjernli, 2019). My supervisor, Tom Erik Julsrud, was interviewed, and in the article, he was quoted as saying 'I'm not so sure the number of cars will be reduced'; further, that he believed that easy access to a vehicle could make car-sharing replace public transport: 'If you come by train to Oslo central station and there is a range of cars available, you might choose car-sharing instead of the underground for the next part of the trip.' The car-sharing company contacted me and asked if I could refute that in the media by presenting findings that proved that car-sharing was environmentally friendly.

4.1 Research design

To achieve my research objectives, I have used qualitative methods and followed Maxwell's interactive research design model (Maxwell, 2012). Figure 9 shows how the research questions are guided by the goals, conceptual frameworks, methods, and validity of the research, and vice-versa; the two-sided arrows illustrate that the research questions lay down guidelines for which methods and frameworks are chosen, how validity is secured, and goals are researched.

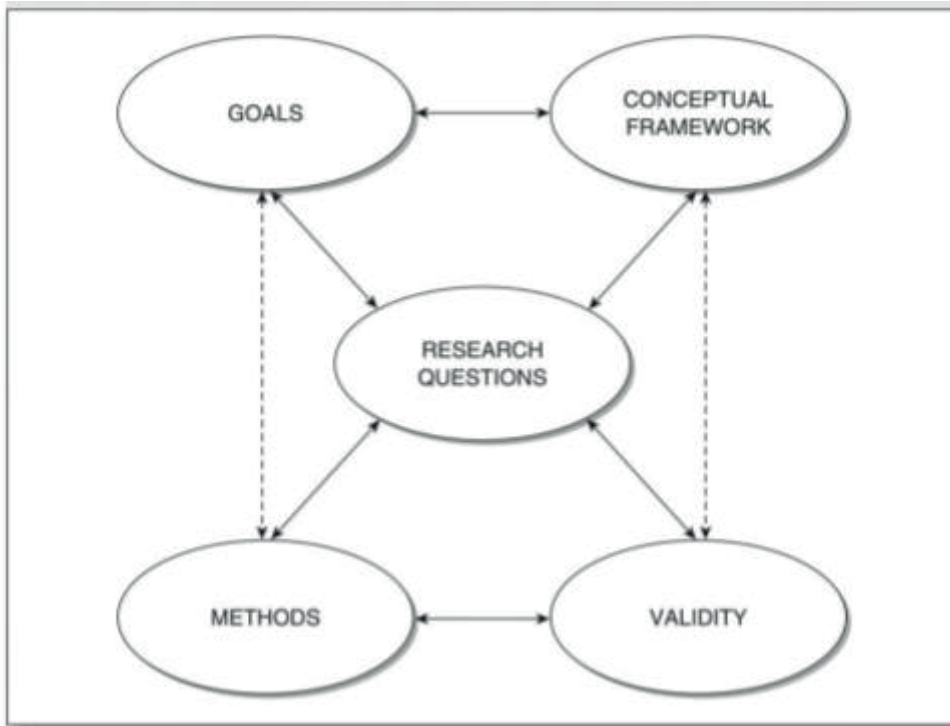


Figure 9: Interactive model of research design

This model is helpful to describe how the design of the research was planned, implemented, and modified and how the different components of the design (including the goals, conceptual framework, research questions, and methods) were conceptualized and developed, and how validity and ethical issues were addressed (Maxwell, 2012).

In this thesis, I have used this interactive process and three strategies to ensure validity. First, several researchers participated in the interviews and workshops. Second, combinations of data sources have been used, achieving methodological triangulation. Third, several researchers have been part of the data analysis processes. In sum, I argue that these strategies contribute to ensuring a rigorous review of the data material.

My research started in 2016 with a research proposal for my PhD as part of the TEMPEST research project. I started with a tentative plan and working title for my own research, framing the components of research objectives of studies of car sharing in Oslo, qualitative methods, the multi-level perspective and social practice theories as conceptual frameworks, and research questions asking how car-sharing was used. I then made a plan to ensure validity.

Parallel with reading research and following a pilot study, I started to plan the data collection with project partners, and we developed interview guides, applied for approval of the data collection, and recruited informants. Then I started collecting data from household interviews in Oslo, followed by data analysis and any necessary modifications, for instance, in the research questions.

Three events in particular contributed to the modification and further development of this work, and these modifications affected the development of the five papers presented here.

In 2018 I modified the conceptual frameworks and research questions. The initial conceptual framework was based on MLP and SPT. Analysing the data from the household interviews and synthesizing the findings proved to be too massive an undertaking for one study, so the project was developed into two studies, Paper 1 and Paper 2. Paper 2 was developed with my supervisor and one of the project partners; these co-authors were involved in the data collection, coding, analysis, and article writing.

Early in 2019, I embarked on a research stay at Maastricht University to work with Marc Dijk. Initially, I had planned to do additional data collection with interviews there and had started the process. However, I was rejected by local car-sharing enterprises, and I faced language barriers in recruiting and interviewing informants. Instead of trying to obtain additional data, I focused on using data from the TEMPEST project partners and developing a theoretical framework with Dijk. This led to Paper 3, where we applied data from project partners in Sweden and the Netherlands.

Then, in spring 2020, I had to modify the design again because of the Covid-19 pandemic. The planned data collection of observation to study experimentation had to be cancelled, so I decided to use data from another work package in the TEMPEST project – interviews with providers – and to undertake a literature review. This led to Paper 4 and Paper 5.

Consequently, for this thesis, I have drawn on existing data from a larger research project instead of collecting more data. This has also shifted the focus from purely empirical studies to more attention on the theory contribution in Paper 5.

4.1.1 Research project TEMPEST

The components in the research design were affected by developments in the overall research project TEMPEST. My research is part of the international research project ‘Transforming household mobility practices through shared consumption: Low-carbon transport and sustainable energy solutions in urban areas’ (TEMPEST).

Shared mobility is in focus throughout the joint project. The project was organized into six work packages (WP1–6). These included data collections and studies of car-sharing business development, in-depth studies of households, household surveys, stakeholder workshops, assessment of future uptake with estimations of the consequences of car-sharing, and development of policy recommendations. Figure 10 shows an overview of the six WPs. My research is positioned mainly within WP2, the in-depth studies of households. But it also connects to and uses data from the other studies in WP1 – the case description and comparison – and WP4 Stakeholder workshops. The red circle illustrates the positioning of my research in the overall project, and the red arrows the connections to the other work packages. My own role in the overall project is relevant for the methodology and the philosophy of social science I employ for my research. An overview of project partners is shown in the appendix of this thesis.

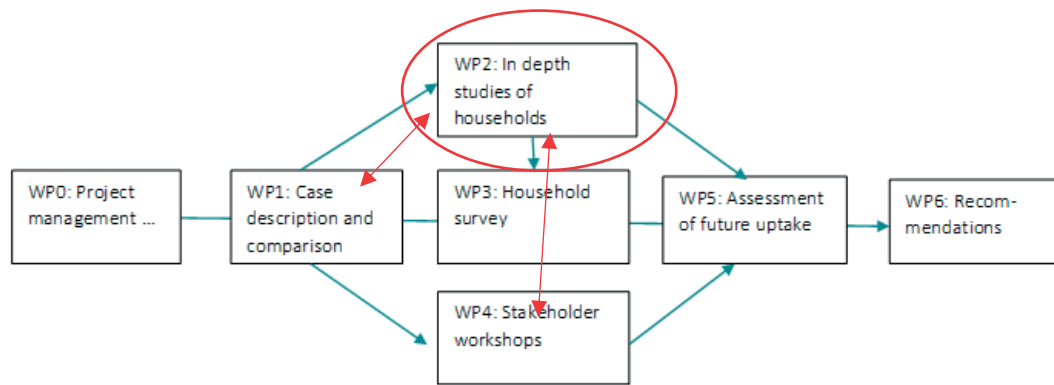


Figure 10: Overview of work packages in the TEMPEST project

Project partners contributed to preliminary steps, data collection and the related research. A master’s thesis (George, 2017) worked as a pilot study for data collection for my research. Parallel studies using some of the same data evolved during the project, contributing to (re)shaping the research questions, objectives, and analysis in my studies. For example, a study combining the interviews with survey data to study transformations in household travel patterns (Julsrud & Farstad, 2020) links to all the empirical papers and studies of car-sharing schemes (Langeland & Nielsen, 2017; Sarasini & Langeland, 2021) link to Paper 4.

I contributed to a study that examines how processes of entering, continuing or exiting car-sharing schemes unfold in Norway, the Netherlands, Sweden and the UK (Doody et al., 2021). Research that relates to my studies are studies of the role of life events in car-share uptake (Uteng et al., 2019), exploring car-sharing pathways of young urban households (Julsrud & George, 2020), car-sharing for older adults in Oslo (Uteng, 2021), a quantitative study of trust and sharing (Julsrud & Uteng, 2021), the development of organized car-sharing in Norway from 1995 to 2018 (George & Julsrud, 2018), a review of shared automobility in the urban environment (George & Julsrud, 2019), and an analysis of transport innovations (Langeland et al., 2018).

4.2 Data collection

I chose qualitative methods of interviews with households and representatives from car-sharing services and stakeholder workshops for this study because people can talk readily about practices (Browne, 2016; Hitchings, 2012). I chose qualitative data that focus on naturally occurring, ordinary events in natural settings. With an emphasis on people’s lived experiences, this is well suited for locating meanings, people, places, processes, and lived structures and for connecting this to the surrounding social world (Miles et al., 2013, p. 11). Qualitative data have strong potential to reveal complexity, and the data provide thick descriptions (Geertz, 1973) that are vivid and nested in a real context (Miles et al., idem).

I contributed to collecting data through interviews with households in their own homes in Oslo, stakeholder workshops with representatives from car-sharing services, public transport companies, and members of the city councils and neighbouring counties and municipalities. Other project partners collected data from interviews with representatives from providers of car-sharing services in Oslo and household interviews and stakeholder workshops in Malmö and Rotterdam. Table 3 shows how I use the data in the five papers. The dark blue indicates that I was responsible for data collection; and the light blue shows that others were.

Article	Household interviews Oslo	Household interviews Malmö and Rotterdam	Stakeholder workshop Oslo	Stakeholder workshop Malmö and Rotterdam	Interviews with industry	Literature review
1 Emerging and existing						
2 From novelty to normality						
3 Emerging mobility practices						
4 Providers and Practices						
5 Practices in transitions						

Table 3: Overview of data used in the papers

We chose to do the data collection this way because interviews can provide relevant data for analysing practices, as respondents may talk about their practices, often in quite revealing ways in terms of actions they otherwise take for granted (Hitchings, 2012). Interviews with households are beneficial for studying mobility practices because people can often explain in detail how the use of services occurs and how infrastructure and technology are involved. Besides, they can reflect on their emotions and skills around the use of these services. In Oslo and Malmö, the semi-structured interviews were conducted in people’s homes. This often encourages them to mention issues they otherwise regard as unremarkable, even irrelevant parts of their daily lives— because respondents are closer to the venue of actual performance, and this proximity enables the inclusion of the materiality of daily life as part of the practice.

The interview guide for the household interviews in Oslo is appended in Paper 1. In Malmö, they followed a similar guide, and in Rotterdam, they had fewer questions. The interview guide for the industry interviews in Oslo is appended in this thesis.

4.2.1 Household interviews

For the Oslo household interviews, the recruitment of respondents began by announcing the need for interviewees on the Facebook pages of three car-sharing suppliers. We registered all who showed an interest and made an overview of possible interviewees, and then booked interviews with a selection of the households. We received assistance to book interviews with

households with variations in location, age, and family make-up. The sample of respondents consisted of households who were registered members of one of three car-sharing services: Nabobil (a P2P service), Hertz Bilpool (a B2C corporate service), and Bilkollektivet (a B2C cooperative). Thirty-three households used vehicles from the car-sharing services in various ways, two were members who provided cars, and four were members but non-users. Ten households mainly used P2P; 11, B2C Corporate; and 18, B2C Cooperative.

We conducted the interviews in the respondents' homes during three periods: May–July 2017, October–November 2017, and January–March 2018. We interviewed 39 households, and I was involved in 34 of these. Interviews lasted from 45 minutes to two hours and were mainly in the afternoon or evening, sometime between 5 and 8 pm. Participants were compensated by a gift card of 500 NOK. Based on a pilot study (George, 2017), we developed two guides for semi-structured interviews: for users and non-users. The guides included an outline of topics and questions about the informants' life situations, daily journeys, leisure journeys, car-sharing use, motivation, and implications (Kvale, 2007).

Interviews were conducted in the families' own home environments because we wanted the interviewees to share information about the situation for their whole household. Conducting the semi-structured interviews at home enhanced the possibilities of getting personal and thorough descriptions. Some respondents showed us around the buildings, telling us about the neighbourhood, such as the distance to car-sharing, parking, bus station, schools, grocery store, and so forth. Conducting the interviews at their homes enabled us to acquire an understanding of arrangements such as parking, gardens, common areas, lifts, and playgrounds. We did not take pictures or make recordings, but took notes, to get a more extensive understanding of what the participants were talking about during the interviews. Table 4 gives an overview of the household interviews in Oslo with information if there are children or not in the household.

Number and location	Car-sharing service	Children
# 01 Etterstad	B2C Cooperative	No children
# 02 Carl Berner	P2P	Children
# 03 Bøler	P2P	No children
# 04 Smedstad	B2C Corporate	Children
# 05 Torshov	B2C Corporate	No children
# 06 Barcode	B2C Corporate	No children
# 07 Vika	B2C Corporate	Children
# 08 Storo	B2C Cooperative	Children
# 09 Sinsen	B2C Cooperative	Children
# 10 Manglerud	P2P	Children
# 11 Veitvet	P2P	No children
# 12 Pilestredet	P2P	No children
# 13 Keyserløkka	B2C Cooperative	Children
# 14 Ulven	B2C Corporate	No children
# 15 Ekeberg	B2C Cooperative	Children
# 16 Tøyen	B2C Cooperative	Children
# 17 Fornebu	B2C Corporate	No children
# 18 Nesodden	P2P	Children
# 19 Grünerløkka, lower	P2P	No children
# 20 Bygdøy Allé	B2C Cooperative	No children
# 21 Rosenhoff	B2C Corporate	Children
# 22 Sagene	B2C Cooperative	No children
# 23 Schouterrassen	B2C Cooperative	No children
# 24 Høybråten	P2P	No children
# 25 Tøyen, near prison	B2C Cooperative	No children
# 26 Ensjø	B2C Cooperative	No children
# 27 Sinsen west	B2C Cooperative	No children
# 28 Årvoll	P2P	Children
# 29 Vålerenga	B2C Cooperative	Children
# 30 Bislett	B2C Cooperative	No children
# 31 Torshovparken	B2C Corporate	No children
# 32 Kampen	B2C Corporate	Children
# 33 Adamstuen	B2C Corporate	No children
# 34 Kvadraturen	B2C Corporate	No children
# 35 St Hanshaugen	B2C Corporate	Children
# 36 Bogstadveien	B2C Cooperative	No children
# 37 Solli plass	B2C Cooperative	No children
# 38 Hovseter	B2C Cooperative	Children
# 39 Ruseløkka	B2C Cooperative	Children

Table 4: Household interviews in Oslo

In October 2017, master's students interviewed 12 households in the urban area of Malmö, Sweden: six users of Lund's Bilpool, four users of Sunfleet, and two non-users. In the urban area of Rotterdam (the Netherlands) in March and April 2018, seven telephone interviews with

households currently using three different car-sharing providers were conducted: two using Greenwheels, one Snappcar, and four Buurauto.

Table 5 gives an overview of the car-sharing companies and business models in the three areas, and we distinguish between P2P, B2C Cooperative, and B2C Corporate.

	Oslo	Malmö	Rotterdam
P2P	Nabobil		Snappcar
B2C Corporate	Hertz Bilpool	Sunfleet	Greenwheels
B2C Cooperative	Bilkollektivet	Lund bilpool	Buurauto ⁷

Table 5: Overview of car-sharing providers in Oslo, Malmö and Rotterdam

4.2.2 Stakeholder workshops

Project partners arranged half-day stakeholder workshops in the three areas as part of the TEMPEST project – in Oslo on 31 October 2018; Malmö on 28 January 2019; and Rotterdam on 31 October 2018 – and followed similar formats. Participants were representatives from car-sharing operators, public authorities, and mobility organizations. Workshops involved group work, followed by plenary discussions. Questions focused on three aspects of how car-sharing relates to the existing mobility system and participants' views on a) what needs to be developed (new), b) what needs to be changed (adapted), c) what should be stopped (phased out), for car-sharing to enter the current mobility system. In other words, their opinions on what a mobility system with car-sharing would look like, with the focus on what these stakeholders could do to a) build the new, b) customize, and c) phase out the old.

In Oslo, for example, three groups, as shown in Table 6, first reflected on these questions and then presented their views in a plenary session. Then the groups continued separately by discussing all ideas and considering how car-sharing enters the mobility system. In the end, a summary of the key outcomes was presented and discussed in a general session. Participants in the Oslo workshop were representatives from car-sharing operators (Bilkollektivet, Herz Bilpool, NSB Bybil), public transportation (Ruter), the public authorities (Oslo City Council, Akershus County, Bærum Municipality), mobility companies (Møller Mobility Group) and research representatives (CICERO). Table 6 shows the participants and the three groups (SWG1, SWG2, and SWG3). Conversations in the groupwork were recorded and transcribed.

⁷ Not organized strictly as B2C cooperative or corporate company, but with neighbourhood arrangements.

Stakeholder Participant	Stakeholder description	Stakeholder Workshop Group SWG ID
Bilkollektivet	Car-sharing Cooperative	SWG1
Bilkollektivet	Car-sharing Cooperative	SWG2
Hertz Bilpool	Car-sharing Service Corporate	SWG1
Møller Mobility	Car company	SWG2
NSB Bybil	Car-sharing NSB/ The Vy Group owned by the Norwegian government	SWG3
Ruter	Public transport operator	SWG2
CICERO	Research institute	SWG3
Oslo City Council	Section for the urban environment	SWG1
Akershus county	Neighbouring county to Oslo	SWG2
Bærum municipality	Neighbouring municipality to Oslo	SWG3

Table 6: Participants in the stakeholder workshop in Oslo

4.2.3 Interviews with industry

Provider interviews were conducted with employers in six car-sharing associated companies in January 2017. The providers varied from a car-sharing cooperative (Bilkollektivet), a firm providing car-sharing services (AVIS NOW) in collaboration with housing companies (OBOS), a platform providing peer-to-peer car-sharing services (Nabobil) and two companies providing station-based car-sharing hubs (Move About and Herz Bilpool).

Other project partners did the interviews, and I was not present. They followed a semi-structured interview guide, with initial questions concerning the company's establishment, services provided, and further plans. Follow-up questions concerned customer relations, channels for customer communication, sales of the services with revenue streams, ownership structures, and the companies' core competencies. Ultimately, questions considered connections with other car-sharing companies, policymakers, public transport providers, and their views on the prospects of car-sharing as part of urban mobility alternatives. Table 7 gives an overview of the interviews with providers.

Interview ID	Provider	Description	Date
IAN	AVIS Now	CS with housing companies	06.01.2017
INB	Nabobil	Peer to peer CS, P2P	11.01.2017
IOB	OBOS	Housing company	16.01.2017
IMA	Move About	CS	19.01.2017
IBK	Bilkollektivet	CS Cooperative	25.01.2017
IHB	Herz Bilpool	CS Corporate company	27.01.2017

Table 7: Interviews with respondents from the car-share enterprises

4.2.4 Systematic literature review

The systematic review covers articles indexed in the Scopus database.⁸ The articles were found through a search string, identifying articles where the title, abstract, or keywords contained: (('social practice theor*' OR "social practice" OR "practice theory") AND ("innovation system" OR "multi level perspective" OR "energy transition" OR "sustainability transition*" OR "socio-technical transition*" OR "sociotechnical transition*" OR "socio-technical innovation" OR "socio-technical system" OR "socio-technical change")) limited to journal articles in English.

A preliminary study started with a search on 8 April 2020, with a similar search string where a total of 70 articles were found. Following a review of the articles in this selection, 59 articles were selected for further work. The study presented in the paper is based on a search conducted on 8 February 2021, where 121 articles were found. I sorted through the studies retrieved, deciding which appeared to meet the inclusion criteria and merited a more detailed examination. Content analysis of the abstracts, headings, and introductions revealed, unsurprisingly, that some items concerned practice in other senses, e.g. 'research practice'. Such articles were omitted, leaving out 38 articles, so that the analysis was based on the sample of the remaining 83 articles.

4.3 Data analysis

For the four empirical papers, different research designs with data analysis and coding strategies were followed. Paper 1 and 2 use household interviews in Oslo; initially, they followed the same coding and analytical process before developing into separate studies. The studies in these two papers started as a larger joint analysis and later developed into two separate papers. Paper 3 is a comparative study that uses data from household interviews and stakeholder workshops in the two other areas; Paper 4 includes data from workshops and industry with the initial household interviews.

The analysis in Paper 1 involved three main steps. First, a research assistant transcribed all interviews, and then I organized memos, audios, and transcriptions in Nvivo, a software program for managing and analysing qualitative materials. Second, I coded these (Maxwell, 2012; Miles et al., 2013) and wrote memos of preliminary findings and research questions. I did this several times, and earlier versions focused on the dynamics of experimentation and multiplicity due to urban change and the new use of several transportation options. The study then concentrated on car-sharing and car-owning when the analysis had to become more focused. Dynamics between the use of the services and the existing system of privately-owned cars were then identified and organized. This part of the analysis was exploratory, mapping out the various uses of the services found in the sample without following concepts from the literature. Memos on these processes were made, sorting out recurrent patterns and social mechanisms. Third, these processes were further analysed and systematized following forms of reconfigurations suggested by Hodson et al. (2017); complementary, competing, or co-existing. This step of the analysis was more explanatory, using the concepts to explain the dynamics between car-owning and car-sharing found in the sample. The qualitative study was designed for confirmability and transparency (Creswell & Miller, 2000; Yilmaz, 2013) and to safeguard ethical concerns and respondent anonymity (Yin, 2010).

⁸ Scopus is the largest abstract and citation database of peer-reviewed literature. It contains publications by Elsevier, Springer, Wiley-Blackwell, Taylor & Francis, Sage, Emerald, Oxford University Press and several other publishers.

Paper 2 was written with TEMPEST project leaders Tom Erik Julsrud and Eivind Farstad. The data collection was the same as in Paper 1, and we organized the coding and preliminary findings in Nvivo (Miles et al., 2013). We followed an iterative analytical process, guided by SPT and allowing for further discoveries in the data along the way. Figure 11 shows a screenshot of the coding in Nvivo. We started by coding all of the interviews and organizing the findings of practice elements, the coevolution between the elements, and relationships to other practices. We then analysed the reproduction of the practice by searching for and identifying patterns of what was involved when the practice reoccurred in these households. During this process, we developed insights into how the performance of the practice varied and did additional coding based on these findings, ultimately discovering three ways of doing car-sharing and mapping out interactions between provider and user contexts.

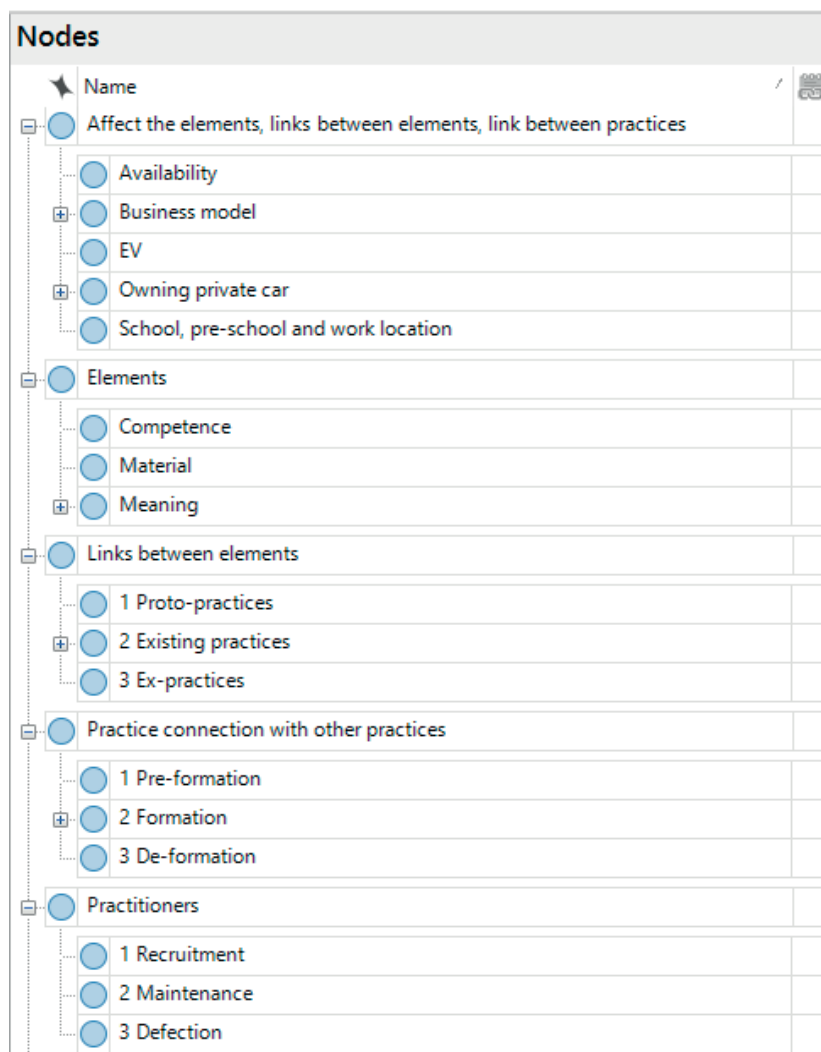


Figure 11: NVivo Nodes for coding Paper 2

Paper 3 is a comparative study using data from household interviews and stakeholder workshops in Oslo, Malmö, and the Netherlands. This analysis was conducted as part of my research stay at Maastricht University, and the study was done with Marc Dijk of Maastricht University, and Peter Arnfalk of Lund University (Sweden). We used NVivo and Excel to organize the analysis, and the coding was guided by an analytical framework developed by Dijk inspired by SPT (Dijk et al., 2019; Stanković et al., 2019). The analytical work was conducted in four main steps. The transcribing, coding, mapping, and comparisons were discussed among the three researchers in several sequences, leading to adjustments and annotations. First,

recordings from the household interviews and stakeholder workshops were transcribed, or notes were written, and then these were organized in the computer software NVIVO. Second, I coded the interviews and workshop transcriptions and notes with the seven categories of the conceptual framework. In this step, we labelled what was said about mobility practices as referring to shared elements of ‘infrastructures’, ‘business models’, ‘social norms and meanings’, ‘policy incentives or actor-specific elements of ‘financial capabilities’, ‘knowledge and skills’, and ‘values and feelings’. We discussed the initial coding in face-to-face and online meetings. This led to a new round of additional coding with some adjustments. Third, we mapped how the elements changed because of the introduction of car-sharing. Estimating the changes in each separate element was done to gain insights into what changes were happening and where. The change in each element was scored from zero to two, with 0 for ‘no/little change’, 1 for ‘some change’, and 2 for ‘big change’, shown in Table 8. This could not be a precise measure, but these steps offered important insights, obliging evaluations of changes that served as a basis for further analyses and discussion. For each element, we asked a question of change. For instance, for the shared element of infrastructures and artefacts, we asked: ‘To what extent does car-sharing entail new infrastructures and artefacts’. The final step involved comparative discussion, where we elaborated on the discoveries behind scoring the change, investigated similarities and differences, and also discussed what was place- and time-specific in the three areas. Initially, we focused on disruption from car-sharing but later removed this focus. We ultimately synthesized the findings in Excel, and the following table shows the scoring scheme for Rotterdam.

Framework elements (see Figure 1)	Rotterdam, Netherlands	
	Score (0=no change; 1= some change; 2= big change)	Comments (shortly explain score; possibly quotes)
<i>Collective contextual elements</i>		
Infrastructures		
Regulatory incentives		
business models		
Social norms & meanings		
<i>Individual actor elements (1): traveler</i>		
Knowledge & skills		
Financial capabilities		
Values & emotions		

Table 8: Codes, scoring, comments, and quotes from Rotterdam for Paper 3

I developed Paper 4 due to preliminary findings in the pilot literature review for Paper 5, which found that SPT in transition studies had an insufficient focus on providers. The paper was developed as part of this thesis to enable the elaboration of the role of providers in SPT, showing their role in steering and shaping practices. Also, due to the cancellation of a planned and approved data collection of observation for a study on experimentation, I used other existing data from the TEMPEST project. The data analysis in this paper builds on the previous studies and uses industry interviews as additional data. The paper also builds on an unpublished working paper report from the project (Langeland & Nielsen, 2017). The data analysis involved three steps: data were first synthesized; then, the coding was guided by concepts from SPT and transition studies; ultimately, the results from the coding were combined, evaluated, and cross-checked and compared against the related studies.

Paper 5 uses a systematic literature review to identify and synthesize research findings by following a seven-step process (Petticrew & Roberts, 2008). The steps were 1) Defining the questions that the review is set out to answer 2) Determining the types of studies that need to be located in order to answer the questions 3) Carrying out a comprehensive literature search to locate those studies 4) Screening the results of that search 5) Critically appraising the included studies 6) Synthesizing the studies and assessing heterogeneity among the study findings 7) Disseminating the findings of the review. As part of step 4, I sorted through the retrieved studies, deciding which ones looked as if they fully met the inclusion criteria and thus needed more detailed examination. This content analysis of the abstracts, headings, and introductions revealed, as expected, that some of the articles were about practice in other fields such as e.g. 'research practice', etc. Articles not using SPT for transition studies were left out. As part of steps 5 to 7, I did a content review of the articles to clarify their input, research process, and output. This was useful for mapping the empirical and theoretical positioning. I also noted bibliographical data such as research disciplines, research institutes, location, year, and publication journal. I sought to map relations and tendencies, such as how particular articles built on each other or debated with each other within a particular research tradition, such as consumption research. I investigated how the articles revealed controversies and how the research journal articles made theoretical contributions to SPT and transition studies regarding those controversies. I also looked at how the articles both handled earlier criticisms and provided their own criticisms. Ultimately, I mapped research directions and possibilities for further research.

4.4 Research ethics

In this work, I have followed the research ethics guidelines and norms from NESH, The (Norwegian) National Committee for Research Ethics in the Social Sciences and the Humanities (NESH, 2016) – concerning the research project and myself as a researcher, the research objects, research institutions, and the public. The ethical issues are embedded in the research from the start until communicated to the broader public outside the research community.

As a researcher, I was responsible for shaping the research questions, collecting the data and interpreting the data, and communicating and discussing the findings. This means that I have had an essential role throughout the project: involvement and interpretation are integral parts of the research process (NESH, 2016, p. 10). Thus, I had to reflect on and account for my own values and attitudes that affect the choice of topic, data sources, and interpretations (NESH, 2016, p. 10). To ensure openness in the research process and to maintain this role throughout the whole research process, it was essential for me to retain integrity in the documentation, consistency in argumentation, impartiality in assessment, and openness regarding uncertainty (NESH, 2016, p. 10).

Any research project that processes personal data must have a researcher responsible for ensuring that the project upholds privacy requirements. All research projects at the University of Oslo that process personal data must apply to the Norwegian Centre for Research Data (NSD) for an assessment of privacy. I applied to the NSD for approval of the data collection for the household interviews and stakeholder workshop in Oslo, which was granted. My research has followed this approval and routines for processing personal data.

As a researcher, I must respect the participants' autonomy, integrity, freedom, and right to co-determination (NESH, 2016, p. 13). My research seeks to respect individuals, family life, the protection of children, and third parties. We handled the data following the NSD approval and

basic considerations for data protection. Due caution and responsibility were exercised in collecting and using data from informants. In the data collection and data analysis, I de-identified the personal data from the interviews, and in the publication of the research material, I anonymized the data (NESH, 2016, p. 17). When recruiting and booking the interviews, and at the beginning of every interview, we informed the participants about the research field, purpose, funding, the intended use, and who would have access to the data (NESH, 2016, p. 13). In this process, I sought to inform thoroughly about how privacy would be handled throughout the research so that the participants would share as much correct information as possible. Thus, I sought to avoid or minimize the possibility that relevant information was left out or untrue information was given. All the same, there is already a risk that interviewees will not share everything but choose what they will talk about and what they will not.

Because this research has implications for the wider society, my research and dissemination must exhibit social responsibility. Car-sharing for sustainable mobility is a debated topic. Research can be used as an instrumental foundation for societal decisions, a critical source of correctives and alternative choices of action, or deliberately as a source of research-based knowledge to the public discourse (NESH, 2016, p. 11). Because this research may have to deal with disagreements in other segments of society, I sought to fulfil the NESH methodological requirements regarding argumentation, reasoning, and documentation (NESH, 2016, p. 11). I followed methodological considerations for semi-structured interviews and data analysis (Miles et al., 2013). Also, throughout the research, I kept a PhD diary with notes on essential decisions.

4.5 Philosophy of science

My research has a critical realist approach to social science. Claiming that social science is more than an empirical discipline, critical realism is a meta-theoretical position, a reflexive philosophical stance. It is concerned with providing a philosophically informed account of science and social science to inform empirical investigations (Archer et al., 2016). The critical realist approach is situated midway between the hard science of positivism and the soft emphasis on language and culture in interpretivism/ social constructivism. A typical critical realist position is to accept that much of reality exists although it operates independently of our awareness or knowledge of it. The critical realist approach thus involves positioning ontology, epistemology, methodology and methods.

I follow a critical realist positioning for the research because of the efforts in the empirical studies using MLP and SPT to overcome the polarity of structure and agency and the studies' explanatory ambitions. This links up with elaborations of the practice paradigm in transition studies in section 3.1. Critical realism makes it possible to show *why* and *how* practice matters. The study of practices can be profitably dealt with within a critical realist philosophical frame. The critical realist variant of realism emphasizes the possibility of understanding something like social structure and has a more radical understanding of the transformative relationship between structures, practices, and agents (Joseph & Kurki, 2018).

A critical realist positioning also contributes to explaining socio-technical transitions (Sorrell, 2018). This relates to how the ontological foundations of the MLP largely inhibit explanatory capacity. The argument is fourfold. Since structure and agency are understood as inseparable, (i) the causal influence of material properties is undervalued, and (ii) different degrees of structural constraint and freedom among actors are ignored. As a consequence (iii), transitions are reduced to shifts in the maturity and spread of socio-cognitive rules without an analysis of systemic change. Moreover, (iv) mechanisms are reduced to recurring patterns of events which cannot explain why some transitions fail while others succeed. A critical realist approach to transitions theory is suggested to remedy these limitations (Svensson & Nikoleris, 2018).

Social science, which has historically endeavoured to ground itself in empirical investigations, has paid more attention to epistemology at the expense of ontology. This has led to a focus on how we know what we know, whereas questions of the nature of *what* is known are treated mainly as an afterthought. The consequence has been an emphasis on methods and forms of explanation, with insufficient attention to questions about the kinds of entities that actually exist in the social world and what they are like (Archer et al., 2016).

The ontology of critical realism concerns the nature of things and the world. Ontological realism states that much of reality exists and operates independently of our awareness or knowledge of it; reality, therefore, does not wholly answer to empirical examination or measuring. The world exists largely independently of our knowledge of it, but our descriptions of it do not, for they clearly depend on available knowledge. The ontological assumption of critical realism is that the world exists independently of human perception and knowledge of it. Critical realism thus rejects the ontological constructivist position that the world is a product of our knowledge (Archer et al., 2016).

The strengths of critical realism are how it highlights the importance of ontology and the consequences that derive from ontological positions. It clarifies that debates over a ‘third way’ between interpretivism and positivism should not be restricted to the level of mixed methods versus quantitative/qualitative divisions but should focus more widely on the ontology of critical realism versus objectivism/constructionism. The weaknesses of critical realism are that it is considered a meta-theory that lacks concrete procedures for the conduct of social research, although examples exist (Yeung, 1997). Also, theoretical work which seeks to bridge structure and agency has been conducted without the help of critical realist theory, or under the looser banner of post-positivism (Brant & Panjwani, 2015; Scott, 2005).

4.6 Methodological limitations

Despite these advantages and the strategies for achieving validity and overcoming the research biases, the methods nevertheless have their limitations. Although I followed methodological strategies for handling validity by allowing for an iterative process following Maxwell’s interactive research design model (Maxwell, 2012), there remain possible sources of bias in this research. These include the sampling of times, places, events, people, issues, and questions (Norris, 1997). Through the research design, I have sought to minimize the impact of such possible bias. Also, other types of data collection might have been useful – observation, for example. I agree that this can reveal different or more aspects of practices, perhaps more tacit and mundane features. However, in my view, the interviews in this research produced sufficient content.

Depending on the individual skill of the researcher, the results can be influenced by personal biases and idiosyncrasies. To achieve validity, I examined the data and preliminary findings together with my co-authors, seeking to overcome some of the limitations of using qualitative methods. As mentioned, I have tried to account for possible selection bias and self-reported data bias in the data collection and analysis processes. Selection bias is also relevant for qualitative research (Collier et al. 2004), particularly with interviewing (Seidman, 2006). I also recognize that there might have been some one-sidedness, for example, regarding the range of providers and policymakers in the stakeholder workshops.

5 Paper presentations and research findings

This chapter gives an overview of the findings and implications presented in the five papers. Paper 1 shows how car-sharing relates to car-owning. In order to know more about how car-sharing relates to, and changes, the existing mobility system, further research is needed about car-sharing practices – how it emerges and relates to mobility practices (Paper 3), how car-sharing is repeated in the existing mobility system (Paper 2), and how business models and providers of the services are part of the practice (Paper 4). In Paper 1, I apply the MLP, and this serves as an introductory paper positioning the research within transition studies and system change, and Papers 2–4 build on its implications. The overall research question guiding this thesis is: ‘How do car-sharing practices influence the dynamics of change and continuity towards environmental sustainability in established mobility systems characterized by the dominance of car ownership?’. Here I elaborate on the separate research questions in the papers, and in chapter 6, I discuss how these relate to the overall question.

5.1 Paper 1: Existing and emerging

RQ: How does the current use of car sharing in Oslo relate to and influence the established use of privately owned cars? Are these relations elements in a transition towards sustainable mobility?

This paper studies how the use of car-sharing contributes to altering the car system in urban areas. The study employs data from semi-structured interviews with 39 households in Oslo who are members of car-sharing arrangements. While other research on sustainability transitions of automobility has focused on substitution pathways, such as how EVs can replace fossil fuel cars, this study applies different transition pathways applicable to examining changes beyond technological substitution. The analysis applies parts of a proposed preliminary framework on forms of reconfiguration (Hodson et al., 2017) to investigate how the niche of car-sharing interacts with the regime of privately-owned cars. This conceptualization posits three approaches to analysing these relationships: competing, complementary and co-existing (Hodson et al., 2017). The analysis offers examples of the household use of car-sharing in Oslo and shows how three forms of reconfiguration – competing, co-existing or complementary – can explain the relationship between the new and the established. The study finds that car-sharing helps to promote reduced car-ownership, changing and reducing the overall use of cars. However, there are limits to car-sharing’s contribution to environmental sustainability because of the continued use of fossil fuel cars and the continued dependence on privately-used cars.

5.1.1 Summary of findings

The paper shows relationships between the new and the established. The reconfiguration concepts can help explain some of the dynamics in relations between the emerging use of car-sharing and the existing dominance of privately-owned cars. In this article, I assume that the regime comprises private car ownership. This simplification is for analytical purposes; one could also see the regime as defined by passenger transport beyond cars.

The *competing* form of reconfiguration involves the use of B2C cooperatives and B2C corporations, where the households are so satisfied with using car-sharing that they do not want or need to own a car. These households have constant access to a range of cars located near where they live. They use a range of different car types for longer trips out of town and for shorter errands in the neighbourhood.

This *competing* form of reconfiguration provides a potential for car-sharing to *replace* the regime of privately owned cars because car-sharing covers what is needed by giving access to diverse types of vehicles close to home. Some households cannot or do not need or want to own a car. As one respondent put it:

It is the reassurance of knowing that there is always a car that we can use. It is the security aspect. We had cars for a long time; before the car collective, we both had a car for 10 years, my wife had a car, and I had one. I did not want to lose the feeling of being able to drive where I want, whenever I want. The car collective became a substitute. It gives me the chance to be impulsive and just drive off. (#16)

The *co-existing* form of reconfiguration can define the relationship when car-sharing is used as a supplement to privately-owned cars. Some households use car-sharing in addition to a privately-owned, smaller EV. They use EVs for daily journeys and car-sharing for longer trips or if a larger vehicle is needed. Because the smaller EVs cannot solve family transport needs for all activities throughout the year, car-sharing is used on those occasions when another type of vehicle is needed. Car-sharing makes it possible to own an EV in the household instead of owning a larger fossil fuel car. This reduces the use of fossil fuel cars and means fewer emissions from using unnecessarily large vehicles for daily transport.

This *co-existing* form of reconfiguration provides a potential for car-sharing to *recombine* the regime of privately-owned cars, making it possible to own smaller cars for everyday use and then opting for specific other types of cars through occasional car-sharing. The current regime of private ownership can shift towards greater use of EVs or other smaller vehicles for daily journeys and car-sharing for occasional trips. The regime of privately-owned cars remains stable, given the continued need to use a private vehicle for everyday trips. The changes involve a continued occasional need for larger cars, creating a demand for different types of vehicles from car-sharing services.

The *complementary* form of reconfiguration can explain how P2P car-sharing needs the established system of private car ownership in order to exist. P2P car-sharing can exist only in combination with private car ownership. P2P car-sharing involves using cars that already exist, and these vehicles are used more frequently and by more people when used in P2P car-sharing services.

This *complementary* form of reconfiguration provides a potential for car-sharing to *reduce* the regime of privately-owned cars because users of the P2P car-sharing use cars that already exist in the privately-owned car regime. This type of car-sharing requires other private car owners who can provide vehicles, and the change lies in mobility practices and business models for providing the cars, reducing the need for private car ownership.

Table 9 summarizes how these three forms of reconfiguration describe the relationship between the emerging use of car-sharing and the existing privately-owned car regime, linking it to results from the household interviews.

<i>Form of reconfiguration</i>	<i>Relationship</i>	<i>Empirical findings</i>	<i>Provides potential</i>	<i>Data household #</i>
Complementary	Productively fused relationships of new and new/old socio-technical arrangements	P2P Cars are the same, and rely on privately owned cars	Potential for reduction	3, 10, 12, 28, 11, 18, 24, 32
Competing	Struggles between new vs. new or new vs. old socio-technical arrangements	B2C Car sharing located near housing, w/range of cars	Potential for replacing	06, 07, 13, 16, 23, 26, 38
Co-existing	Parallel and largely independent socio-technical arrangements	B2C Car sharing in addition to privately owned car, such as EV	Potential for recombining	02, 04, 08, 14

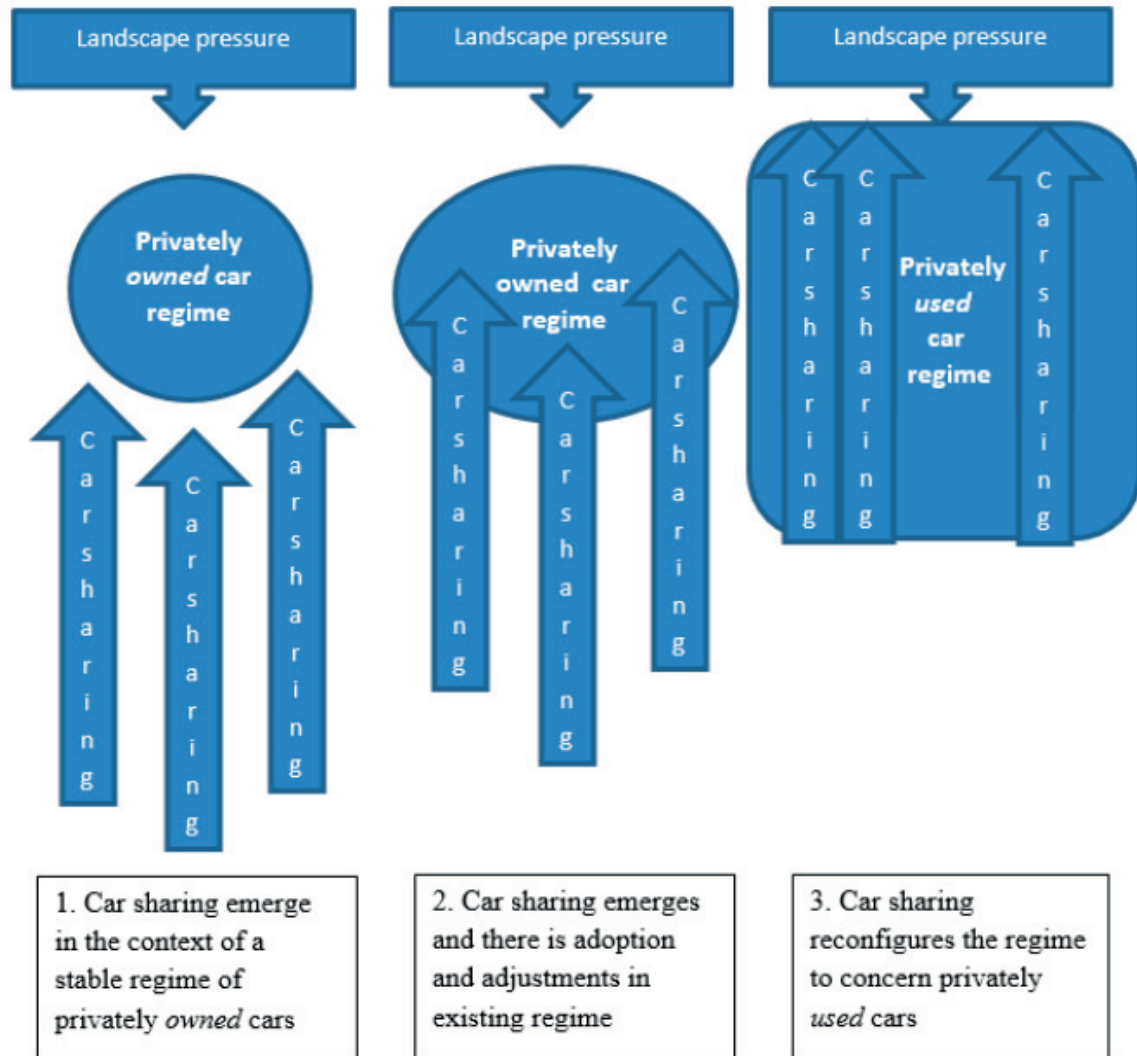
Table 9: Complementary, competing, and co-existing forms of reconfiguration

5.1.2 Implications

This paper serves as a starting point for the other articles, positioning the research within sustainability transition research using the MLP and showing the need to investigate more about practices. It starts to tell the story about how car-sharing can change the mobility system by looking at how it relates to car ownership. Further, it suggests that how car-sharing relates to and can affect the mobility system is broader than just interfering with car-owning because it also interferes with other mobility practices and business models.

The findings suggest that niches of car-sharing, in addition to causing changes in the regime of privately owned cars, also contribute to stabilizing the regime. Accessing cars instead of owning them causes changes in user practices and business models – but because households still want to use cars privately, the regime is stabilized. The occasional use of private cars instead of ownership reconfigures the regime of privately-owned cars, making it a matter of the *use* of cars rather than *owning* them. Figure 12 shows how the regime changes from privately *owned* to privately *used* cars.

The paper shows that the availability of other means of transport for daily trips (public transport, bicycles, walking) and urban housing (shorter distances) may create a demand for private cars on an occasional rather than a daily basis, and car-sharing may cover this need. This also implies a vice-versa situation; when car-sharing is available, this creates an important reason for not having to own a car. Car-sharing provides vehicles for occasional use, and this is what some households need. What many urban households require is not a car for everyday use but access to a car. When everyday journeys can be managed without owning a car, and car-sharing is available, the privately-owned car is simply not necessary. In this way, car-sharing, together with the reduction in cars for everyday travel, affects the regime of privately-owned cars.



Source: Based on Geels and Schot (2007)

Figure 12: Reconfiguring the private car regime

The paper further discusses how car-sharing does not automatically imply environmentally sustainable mobility. From the use of car-sharing reported by the households sampled, two contradictions emerge. First, car-sharing involved almost no use of EVs for these households using the services at the time of the data collection. This may be partly because the car-share services had few EVs at the time of the study; nevertheless, it meant that car-sharing involved using fossil fuel cars. Second, when car-sharing services were available in their areas, households that normally would not have used private cars now got the possibility to use them – and that may result in greater use of cars instead of other, more environmentally sustainable options, such as cycling or public transport, or not travelling at all.

5.2 Paper 2: Novelty to normality

RQ: Under which conditions are car-sharing practices reproduced, and what are the implications of this reproduction for a transition to sustainable mobility?

This paper analyses the reproduction of car-sharing practices and discusses its role in transitions to sustainable mobility. The study uses the same data as Paper 1 – interviews with 39 households using car-sharing in Oslo, Norway. The study employs a social practices approach and show three specific ways of reproducing car-sharing practices: (a) FUSS: Frequent, Unplanned, Short-term, and Small-car use, (b) POLL: Planned, Occasional, Longer-term, and Larger-car use; and (c) PERC: Purpose Elected from Range of Cars. These performances are essential for understanding the conditions under which the practices are reproduced. The paper elaborates on how these reproductions involve the co-evolution of the elements of meanings, materials, and competencies from social practice theory. It then examines contributing factors, such as the role of the provider and user contexts. It highlights how car-dependent activities and substitutes for daily car use contribute to the reproduction of car-sharing.

5.2.1 Summary of findings

‘Performances in the same practice are not always the same,’ says Warde (2005, p. 140). Practice-as-performance is the observable action that happens when practices are enacted in specific situations at certain times.

FUSS characterizes household use of smaller cars, often for quick errands. The co-evolution here concerns mainly the meaning of predictable, fast, and easy access; the skills of rapid booking and picking up; and the materialistic element of a close vehicle-hub with smaller cars constantly available. One respondent referred to how using car-sharing spontaneously involves feelings of freedom when she said, *‘It gives a feeling of freedom, just driving – but that can be done in other people’s cars, too’* (# 15).

POLL involves bigger, specially equipped cars for scheduled trips and certain leisure activities. The co-evolution here involves the material of safe, high-quality cars, the meanings of security, and the functionality of well-outfitted vehicles relative to cost. In addition, experience with cost- and time-planning, which includes calculating total costs with fuel and kilometre prices and comparing it with, for example, train tickets, brings this performance together. Car-sharing is included when planning activities occur when, say, organizing a weekend trip. *‘Typically, we drive to our cabin on Friday evening and return Sunday evening. We’ll be going back and forth for a weekend, so we rent until Monday. On the way from work, I pick up a car, drive home, we pack it, have something to eat, and leave. On Sunday, we get back at 10 pm. I remove the children’s seats and take them inside, and then return the car’* (# 32).

PERC concerns car-sharing with several types of specific vehicles for certain commitments. Important here is that the performance of the car-sharing practice exists and is reproduced precisely by involving diverse use of a selection of models, compared to private ownership and dependence on one particular vehicle. As explained by one household member, *‘If you buy a car, then you have that one car, for all kinds of purposes. In principle, it must work for everything. While here [with car-sharing] we have it all, and I enjoy having the freedom of choice when I need a small car or a large one’* (# 21).

Table 10 identifies the various ways the elements co-evolve in the three distinct performances of car-sharing.

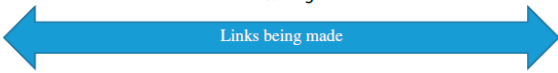
Material	Meaning	Competence
		
FUSS Small car Electric vehicles (EV) Closeness Immediate parking Housing location	Short distance Easy access Predictable Fast and available Freedom Spontaneity is important Environmental concerns, do not want to own car Faster to use car sharing sometimes instead of public transport	Booking experience Efficient reservation and pick-up routines Knowledge on location and availability of cars General knowledge on approximate costs and time use from previous use, detailed time and cost calculations are not necessary
POLL Large cars Special equipment SUV, station wagon, not EV	Longer distances Safety Comfort Predictability Planned, non-impulsive use Price concerns, value high-quality car	Cost calculations Alternative travels Have previous experience with using this type of car, also know-how on family planning for whole trip including reserving car and picking up
PERC Variety of cars Ranging from small EV to large SUV and moving vans	The variety is valued Need or want to use different types of cars for different occasions Cost or environmental concerns	Calculations of price, time, and what can be transported Have learned how to use different cars Skills with price planning and experience with purpose-selected cars

Table 10: Co-evolution of elements *FUSS*, *POLL* and *PERC*

In addition to demonstrating these three ways of doing car sharing, the analysis indicates how modes of access and provision are part of the reproduction of car-sharing practices. Six dynamics are found to be important when repeating the practice. From the provider's perspective, the reproduction of the practice is about maintenance, insurance, and customer service. From the vantage point of the users, the practice is more about transportation cost calculations, quality valuations, and saving. Figure 13 highlights that these drift between the provider context and the user context, and this is different than with traditional car-owning. For instance, regarding maintenance; in car-owning, this is situated in the user context, while in car-sharing practice, this has 'drifted' towards the provider context.

Provider context

Insurance: The providers offer insurance, and this plays a role in reproducing the practice. Insurance is in the car-sharing practice situated in the provider context. It has moved away from the user context in car-owning because the providers of car-sharing need to be involved in offering insurance.

Maintenance: The change of repair responsibilities from car owner to car-sharing provider affects reproduction. The car-sharing companies are responsible for maintenance. Households can use a car without having to keep up with the maintenance. As stated by this respondent, 'I trust the cooperative to take care of the cars. I feel that I've got technical backing, mechanics and such when needed. No need to think about maintenance, changing tires, and all that' (#08).

Customer service: The providers' booking services, keyless technologies, and customer service affect the reproduction. Users can communicate with the providers and get help with problems such as unlocking the cars, notifying about dents and lack of fuel, and getting technical support.

User context

Transportation cost: Price perceptions and cost planning for using car-sharing affect reproduction. The cost aspect is always involved, but cost perceptions vary from household to

household. Some include car-sharing in the family budget as transportation or holiday costs; others do not calculate the specific cost but instead are of the mind that car sharing is cheaper than ownership. They highlight that the costs are predictable because they do not have to pay for unexpected repairs or maintenance as they would with car ownership. Some make plans for their car-sharing expenses, setting aside a certain amount each month, as in this household:

We have a budget of 40,000 to 50,000 NOK [US\$4,200 to US\$5,300] each year for car use. It is still cheaper than owning. We pay a fixed amount to an account we have for car use; we both pay 1,500 NOK each month. We drive a lot during Easter and for several cabin trips, and we rent over a longer period in the summer (# 09).

Safe, good-quality cars: The type of cars affects reproduction, as some informants emphasized the importance of the value of using car-sharing because of the type of car they get for the price. In particular, some families with small children said that they could never afford a car of such high quality if they had to own their own vehicle. They did not want to use an older, unsafe car when driving the children, so they used car-sharing to get access to newer cars.

The cars are always new, and the fact that you know that when you drive long distances with two children makes me feel safe. You have a safe car with winter tires that professionals have installed. I think that is the great thing about the car collective. They have proper cars, and if anything is wrong, it is fixed straight away (# 13).

Less effort: Ease affects reproduction, as an absence of obligations is part of the practice. This excerpt describes how accessing instead of owning requires less effort from the household. The family appreciates the time freed up by not having to deal with ownership and maintenance, thus the distribution of responsibility is part of the practice.

Personally, I really like the idea of sharing instead of owning. It's like so many other things. I don't own CDs anymore, I have Spotify. No ownership, but I have music anyway. I like not owning a car. I don't have to worry about how much value is lost or about maintenance (# 21)

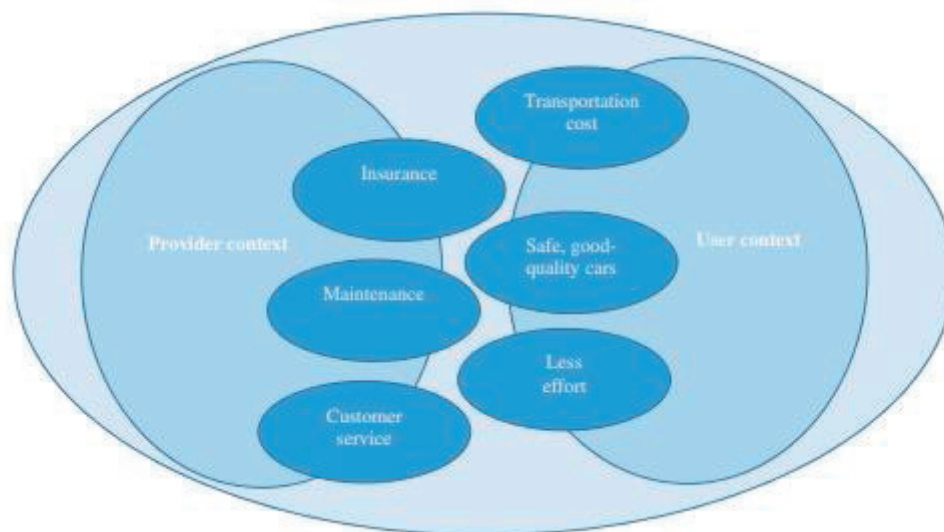


Figure 13: Provider and user context

5.2.2 Implications

Three ways to stabilize a practice

The paper contributes to the SPT discussion on what a practice is *for* and thus how it unfolds and normalizes (Hui et al., 2016; Shove and Walker, 2014). The study offers input to debates on the role of practices in sustainability transitions by showing that neighbouring practices contribute to reproduction. This relates to the three distinct ‘circuits of reproduction’ through which practices are maintained and stabilized (Hargreaves et al., 2013, p. 406; Pantzar and Shove 2010, p. 458). These three ways to stabilize a practice are through *combinations of complementary practices*, *certain connections between particular elements*, and *content in current practices* coming from previous practices and later serving as a foundation for future practices.

Combinations of complementary practices: The reproduction of the practice of car-sharing relates to the continuity of other practices such as leisure-time activities, weekends at cabins in the mountains, or out-of-town celebrations with family and friends. Practice theory holds that repetition of practices is interlinked with other practices, and the study has found support for this view. Car-sharing practices are reproduced because other practices that require cars are reproduced. For example, transport to skiing activities requires car use. The study found that skiing practices were stable and thus supported the need for occasional and special-purpose car use. Whether a practice is reproduced relates to what the practice is *for*.

Certain connections between particular elements: Car-sharing involves the *meanings* of occasional instead of daily car use, and this is strongly linked to the *material* aspect of platform technologies for accessing cars. This particular linkage between elements is affected by increased biking, and public transportation options reduce the need for daily car use. In addition, new regulations limiting parking and norms about less driving and environmental concerns serve to reduce daily car use.

Content in current practices coming from previous practices: Car-sharing practices address the need for occasional, rather than daily, use of private cars – changing the role of private car use. Car-sharing thus represents a continuation of private car use; the content in this practice comes directly from the previous practices of car use. The practice is new, with new elements and new co-evolutions of the elements, and some of this comes from earlier practices concerning cars and mobility and communication, such as using smartphones for travel.

How is car-sharing changing the mobility regime marked by the dominance of privately owned cars?

The paper finds that car-sharing is part of maintaining the established mobility system with its dominance of the private use of cars. From the standpoint of the broader debate around platform services and their sustainability implications, this research contributes to supporting the view that car-sharing maintains and serves to perpetuate private car use. Car-sharing still involves cars used in private settings, as opposed to carpooling, public transportation, or cycling. Car-demanding activities are solved with car-sharing; private car use is still required, supporting a continuation of a car-demanding mobility system. Using shared cars instead of car-owning is more about a shift from owning to accessing; the rise of car-sharing services is linked with the stable practices that require personal car use. Thus, the study supports a cautious view of how car-sharing contributes to environmental sustainability. Easier, cheaper, and faster access might also mean increased use of cars.

The practices in the established regime of daily use of privately-owned cars are changing. There is not yet a fundamental shift from one dominant regime to its successor, but we see that car-

sharing has a role in changing the dominance of privately owned daily car use. This might be part of a step towards a new regime with a new mix of, for example, connected, autonomous, shared, and electric vehicles. There is not yet a ‘new’ regime. Car-sharing has not replaced car ownership – but car-sharing plays a role in changing the established regime and is being stabilized through connections between elements. The stabilization of car-sharing with new links between particular elements is part of reconfiguring the existing culture, market, user preferences, policies, and technologies in the current regime.

The paper shows that by understanding the reproduction of practices as several different performances, a social practices approach can contribute to understanding the normalization of new mobility practices in sustainability transitions. The three ways of doing car sharing and the six dynamics of tying the practices together highlight how performances are not always constant for the same practice. We show how different ways of doing car-sharing are relevant for understanding how new practices emerge. By highlighting the three different forms of car-sharing practices – FUSS, POLL, and PERC – we show how these practices can demonstrate how niche practices can contribute to a transition by playing a role in a new regime. By empirically showing what is involved when a practice is reproduced, the paper sheds light on how a practice evolves from novelty to normality.

5.3 Paper 3: Emerging mobility practices

RQ: How does car-sharing emerge differently in different places, amid particular local, established mobility practices?

This study investigates how car-sharing is emerging and unfolding amid established urban mobility practices. We apply a conceptual framework with seven elements based on SPT and transition literature to deconstruct practices in order to reveal how such (relatively) new mobility practices emerge. The comparative study uses qualitative methods with data from household interviews and workshops with stakeholders in three areas: Oslo, Norway; Malmö, Sweden; and Rotterdam, the Netherlands. The household interviews in Oslo are the same as used in Paper 1 and Paper 2.

The framework deviates from the three-element model in social practice theories by including shared elements and actors’ actions with actor-specific elements. We see practices as an entanglement of the use, operation, and urban planning and regulation of services. Some elements – travelling, operating and regulating – are specific to these actors (i.e., knowledge and skills, financial capabilities, and values and feelings), while others are not and are instead seen as shared elements (i.e., infrastructures and artefacts, policy incentives, social norms and meanings, and business models). The elements are not separate but collectively shape each other (see Figure 14). The three small blue-coloured circles represent the actor-specific elements in the three dotted-lined circles (travelling, operating, and regulating), and the four outer circles in the other blue colours show the shared elements. The dotted circles surrounding the elements illustrate that the elements are interrelated, constituting the practices.

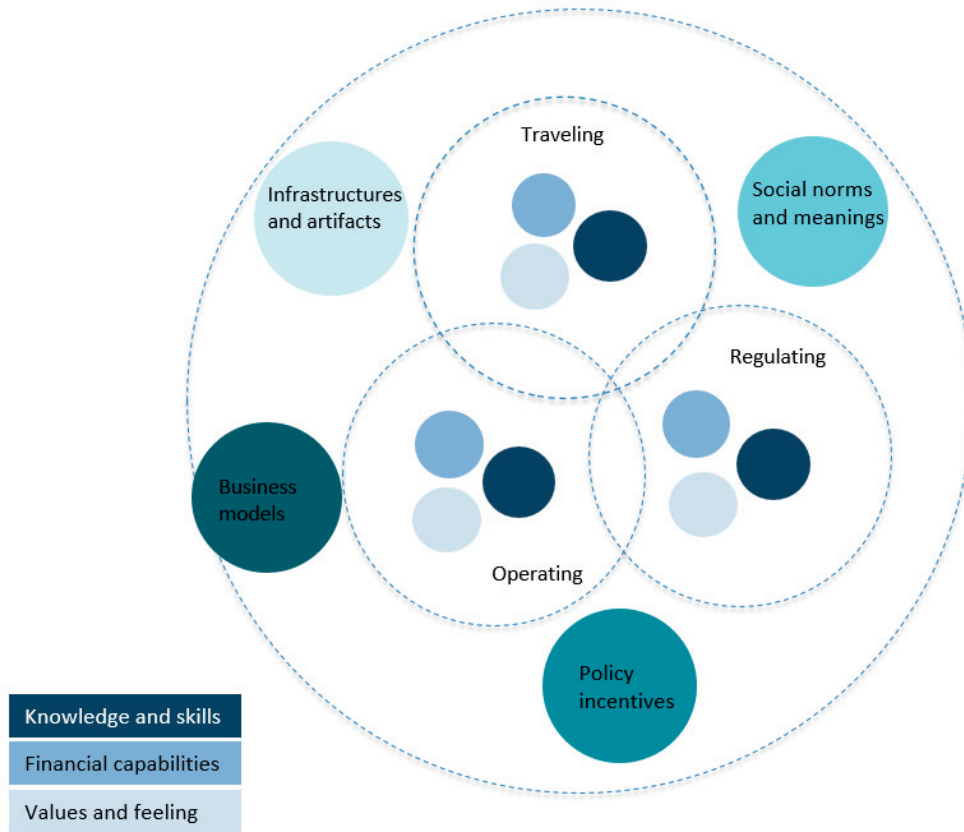


Figure 14: Conceptual framework of seven elements

The framework includes the social context in a different way from the three-element approach because it highlights actors' interrelatedness in shaping practices. Dijk et al. (2019) has used this seven-element framework to address factors that hinder resource-efficient practices of mobility.

5.3.1 Summary of findings

The results indicate how these elements of practices change from the situation *before* the introduction hence *without* car-sharing, to *after* and *with* car-sharing. We compare the practices in the three areas by examining changes in the elements. In line with our conceptual framework of social practices, we score the level of changes in the four shared elements and the three actor-specific elements. For the actor-specific elements, we score the changes for travellers, operators, and planners separately.

The data from the stakeholder workshops inspired this way of mapping changes. The participants were asked questions about a) what needs to be developed (new), b) what needs to be changed (adapted), and c) what should be stopped (phased out) for car-sharing to enter the current mobility system. In this way, it was possible to capture and compare changes in elements, not focusing on time but rather on how elements putatively change before and after car-sharing is introduced.

The analysis reveals different changes in the three areas, with greater change in Malmö because of public procurement of car-sharing and less in Rotterdam, where there was interest in urban experiments directed at phasing out car use and supporting car-free city zones. The framework highlights that new digital technologies and regulations are important, influencing business

models and the social meaning of mobility towards a broader acceptance of access-based transportation. For car-sharing to contribute to environmental sustainability, the three areas need to reduce the daily use of cars so car-sharing can become a viable option for occasional use of cars. Further, policies should combine Electric Vehicles (EVs) and car-sharing, e.g. in Oslo, the focus of promoting EVs should include shared EVs, and in Rotterdam, improved charging infrastructure would be effective.

Here I highlight and compare the changes in each element in the three areas. Table 11 shows the summary of scores in the shared elements, and Table 12 shows the actor-specific elements.

Shared elements

Infrastructure and artefacts

To what extent does car-sharing entail new infrastructures and artefacts?

Oslo and Rotterdam scored 1, ‘some change,’ due to the new role of EVs, smartphones, and the internet for car-sharing without the creation of extra parking infrastructure. Malmö scored 2, ‘big changes’ because new, dedicated parking for car-sharing has been provided in garages in addition to new devices and supporting software.

Business models

To what extent does car-sharing entail new business models?

All three areas scored 2, ‘big change’, in the business model element because of the recent emergence of new services such as P2P car-sharing.

Policy incentives

To what extent does car-sharing entail new policy incentives?

Malmö scored 2, ‘big change’ because the municipality was involved in Sunfleet. Oslo and Rotterdam scored 0, ‘no change’ because policy incentives were limited to more minor suggestions and ideas, with hardly any substantial direct incentives actually implemented.

Social norms and meanings

To what extent does car-sharing entail new social norms and meanings?

Rotterdam scored 2, ‘big change’, because of how perceptions on the role of cars in the city have shifted towards the idea of phasing out cars. Malmö and Oslo scored 1 because the change in norms concerned the reduction of cars’ daily use.

	Business models	Infrastructure and artefacts	Policy incentives	Social norms and meanings
Oslo	2	1	0	1
Malmö	2	2	2	1
Rotterdam	2	1	0	2

Table 11: Summary of scores in shared elements

Actor-specific elements

Knowledge and skills

To what extent does car-sharing entail new knowledge and skills for travellers, operators, or planners?

For ‘travelling’, we found ‘some’ changes (score of 1) in all three areas, mainly with regard to planning and using smartphones in connection with transportation. These were not big changes, as users were already familiar with booking sites and applications for transportation, and these skills were applied in the use of car-sharing services.

This was similar for ‘operating’ with ‘some’ change (score of 1) in all three areas due to new combinations of existing skills and digital competencies.

On ‘regulating,’ Malmö scored ‘big’ change (2), more than Rotterdam (1) or Oslo (0). This resulted mainly from how the planners in Malmö were involved in activities that fostered learning about car-sharing and the development of regulations. In Rotterdam, some change was evident because of how planners were involved in car-sharing as part of learning from experiments in car-free cities. Oslo scored ‘no change’ here because we did not find a new use of knowledge or skills for car-sharing per se.

Financial capabilities

To what extent does car-sharing entail new financial capabilities for travellers, operators, or planners?

Concerning ‘travelling,’ we found ‘big changes’ (score 2) in Oslo and Malmö due to respondents’ perceptions of financial differences between the variable costs of using car-sharing services compared to fixed costs through loans, insurance, and taxes related to owning cars. Rotterdam scored only ‘some change’ (1) here, as our respondents focused more on comparing direct, variable costs for transportation, such as the use of trains or rental cars, to car-sharing.

There has been a growing assortment of ‘operating’ and associated business models in each of the three cities since 2015. Their expertise and concerns vary: for instance, in cooperatives, the revenues go back to the company, whereas the P2P have private providers. Overall, we saw some change (score of 1) but acknowledged that our assignment of a score of one on this has certain limitations in revealing differences for different business models.

On ‘regulating,’ Malmö scored ‘big change’ (2); Rotterdam scored ‘some change’ (1) and Oslo scored ‘no change’ (0). In Malmö, the planners were involved in both procurement and subsidized parking. In Rotterdam, some change was due to how financial support was directed at including car-sharing parking in certain areas to promote efforts towards car-free cities. In Oslo, the planners were not involved in supporting car-sharing per se but focused on EVs.

Values and feelings

To what extent does car-sharing entail new values and feelings for travellers, operators, or planners?

On ‘travelling,’ Oslo and Malmö scored 2 (big change) because of how car-sharing involved a change from the idea of using a car daily to ideals of occasional, purpose-driven car use. Rotterdam only scored 1 (some change) here because of how this perception involved little change, as cars were already accepted as being used occasionally rather than daily.

On ‘operating,’ all three locations scored 1 (some change). Services have continued the earlier ideas for access-based car use but with some changes in values concerning their role in contributing to environmental improvements, for example, through EVs.

Concerning ‘regulating,’ Malmö scored 2 (big change); Rotterdam, 1 (some change), and Oslo, 0 (no change) because of how planners valued car-sharing. In Oslo, planners generally ignored car-sharing, whereas in Malmö, some planners were keen on it, and Rotterdam was in the middle because participants were somewhat interested in car-sharing but only as a transient option towards car-free areas.

Actor-specific elements			
	Knowledge and skills	Financial capabilities	Values and feelings
Oslo: travelling	1	2	2
Oslo: operating	1	1	1
Oslo: regulating	0	0	0
Malmö: travelling	1	2	2
Malmö: operating	1	1	1
Malmö: regulating	2	2	2
Rotterdam: travelling	1	1	1
Rotterdam: operating	1	1	1
Rotterdam: regulating	1	1	1

Table 12: Summary of scores in actor-specific elements

5.3.2 Implications

Accepting access-based transportation

Albeit a clearly reductionist approach, scoring changes in the elements offer a way of structuring the comparative analysis beyond bare qualitative descriptions. This is useful for further examining the interrelations between the elements and conceptualizing connections between the actor-specific and shared elements that can inform policy interventions.

Figure 15 is an illustration that summarizes and compares the scoring of changes in the elements in the three areas (see paper 3 for larger illustrations). It highlights, for example, the differences in the shared elements: the ‘business models’ element represents a big change in all three areas. ‘Social norms and meanings’ score some change in Oslo and Malmö and a big change in Rotterdam. There is more of a difference for the ‘policy incentives’, with a big change in Malmö and a small one in the two other cities. The figure also illustrates the differences in the changes in elements for regulating, operating, and travelling regarding the actor-specific elements. For example, for ‘regulating’, there is big change in Malmö, some in Rotterdam and little in Oslo. The distinction that regulation happens both in ‘policy incentives’ in the form of shared elements and ‘regulating’ with actor-specific elements, highlights that regulators have agency that develops and varies and that the regulations and incentives are part of shaping the practice as a shared element. These results emphasize that some elements are more ‘structural’, and some are more ‘actional’.

The local peculiarities mainly refer to the policy incentives and associated involvement of urban planners. Changes vary among the three study areas, with greater involvement in Malmö with regard to public procurement of car-sharing services, dedicated parking and informing planners and policymakers about car-sharing. There was a strong municipal engagement in and support for car-sharing, while policy incentives in Oslo and Rotterdam were limited to suggestions and ideas, with hardly any substantial direct incentives actually implemented. The focus was different in Rotterdam, where there was interest in pilot projects and urban experiments directed at phasing out car use in general and supporting car-free city zones. In Rotterdam, policy incentives were instead primarily directed towards car alternatives such as walking and biking. Car-sharing was not the objective but rather seen as a temporary instrument for the bigger change of removing cars. Another key difference between the three study areas concerns the role of EVs as shaped by new technologies and different national and local policies. In Oslo,

regulatory incentives were mainly focused on EVs. In Rotterdam, some users see car-sharing as the way to access driving an EV when buying one is too expensive (or undesired).

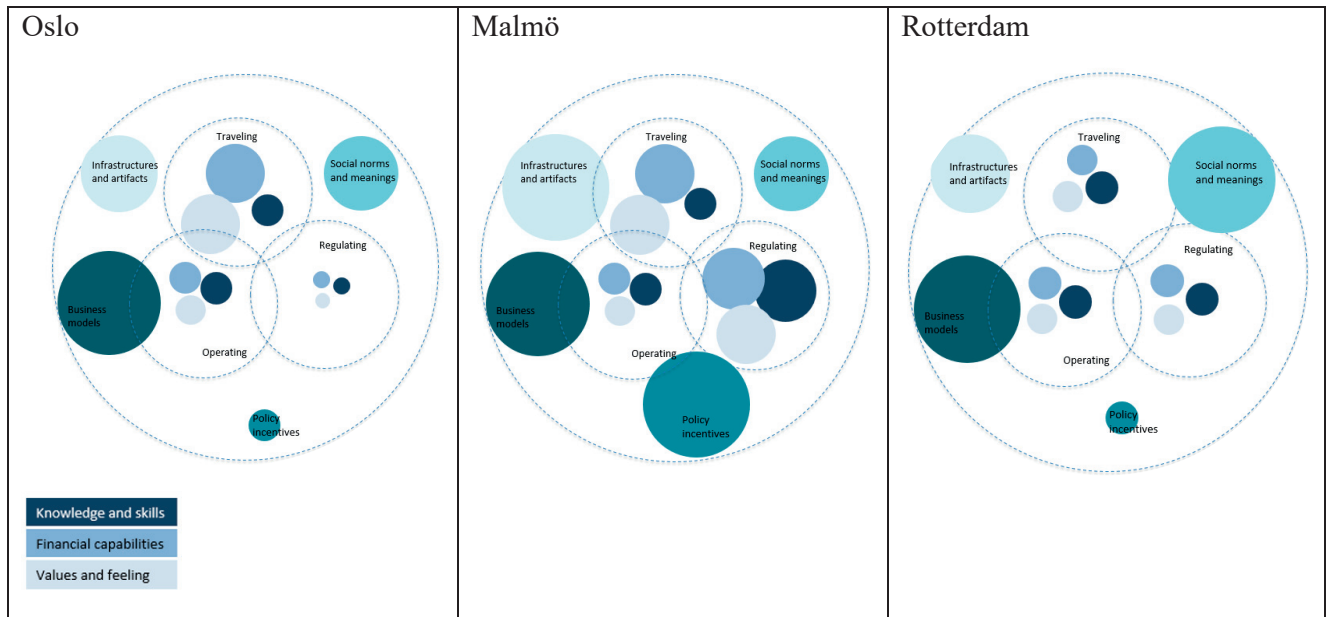


Figure 15: Comparing the changes in scores of the seven elements

We also found similarities in all three areas, such as how new ‘business models’ for sharing schemes were introduced, both as P2P and B2C (corporate and cooperative). New digital technologies, EVs, and parking, are important in the ‘infrastructure and artefact’ elements in all three areas; and they affect the other shared elements (‘business models’ and ‘social norms and meanings’) in terms of the acceptance of access-based transportation. Changes in these three shared elements, together with ‘policy incentives’ aimed at reducing daily car driving, can explain the reconfiguration in mobility practices that support the emergence of car-sharing. In the three locations, a new group of car-sharing users has emerged (albeit very limited in modal share) with digital skills to access cars and the necessary financial capabilities for car-sharing. The three cities show a trend of more internet and smartphone use for mobility and slightly reduced daily car driving independent of car-sharing. The new group of car-sharing users has been successfully recruited by a growing supply of car-sharing schemes/vehicles and is supportive of or neutral towards local regulations. These interactions can be understood as a collectively shaped enabling environment for car-sharing. In all three locations studied, the daily use of cars has changed for some travellers, and we note the emergence of new social norms of using cars, through the internet and direct payment instead of through private garages financed with car loans. The necessary ICT technologies and associated skills related to travelling and operating are in line with the general trend of more ICT use in mobility practices as well as with the tendency towards more on-demand mobility.

How car-sharing emerges in particular areas is also influenced by a range of ‘other’ non-mobility-related practices. For instance, existing housing and working arrangements in these areas shape the demand for car use, affecting the development of car-sharing. However, our analysis has focused more narrowly on established mobility and car-sharing practices as though they exist in isolation from this wider urban system. This relates to discussions in SPTs on what practices are *for* and where to direct interventions and, as others have noted, to the fact that ‘invisible energy policy’ may be more significant than actual energy policy (Royston et al.,

2018). Similarly, the demand for mobility can also be studied as a derived demand driven by apparently non-mobility related issues, such as the location of homes and workplaces and out-of-town shopping centres.

This study has implications for transition studies and social practice theories because it demonstrates how an elemental approach of shared and actor-specific elements is useful for showing how changes in emerging practices relate to existing systems. Our approach is strong in its comprehensiveness and balance between material-, socially constructed-, and more objective social elements, although the study of each of the elements should be further deepened in future research. We see that our distinction of collective and actor-specific elements is somewhat at odds with other social practice approaches. Still, we see a great advantage of this distinction as well, namely making the different stakeholder-specific parts of the ‘entanglement’ explicit. This insight can be important for policy interventions in the context of policy transformation processes. For instance, it can be useful to map how actors react to changes in regulations, business models, or social norms and values. Future research should develop the framework further, examining connections to neighbouring practices and applying them to other empirical topics, such as EVs or other areas involving relations between technology and policy and interventions dealing with interconnections between the shared and actor-specific elements.

5.4 Paper 4: Providers and practices

RQ: How do car-sharing providers shape car-sharing practices, and with what implications?

Social practice theories can be helpful for studying changes in mobility systems as regards automobility practices. However, many such studies address the demand side and the user practices without examining the supplier side. This study focuses on the role of providers in car-sharing practices, using data from household interviews with car-sharing members (as in Papers 1 and 2), stakeholder workshops (as in Paper 2), and interviews with providers of car-sharing services. The research objective is to explore how business models and platforms contribute to shaping car-sharing practices. The results show how new car-sharing service companies, in addition to established firms such as car dealers and car rental companies, affect car-sharing practices by offering several alternatives for accessing cars. The implications of this are discussed, noting how car-sharing practices are shaped by car-sharing providers in the recursive relationship between practice-as-entity and practice-as-performance.

5.4.1 Summary of findings

The results explain how car-sharing practices are shaped by both *new* actors and *established* automobility services that offer various car-sharing arrangements. The providers’ role in car-sharing practices is described as a practice-as-entity and elaborates on three elements from practice theory: the meanings of mobility, car and communication competencies, and objects and infrastructures.

Meanings of mobility: A common concern for new services and incumbents alike was whether cars would continue to be part of the mobility system. Some incumbents aimed to identify ways of continuing with cars as part of the mobility system. This also involved preventing the demand for private cars from disappearing. Some of the new companies were more focused on meanings of mobility in general and wanted to offer car-sharing as part of a broader selection of mobility services, such as explained here:

Today, car-sharing is our main task, but in the future, other solutions concerning mobility on demand are the main goal: the mobility you need, when you need it. Car-sharing is part of this picture and does not exist alone (IMA).

Objects and infrastructures: The material element of car-sharing practice includes physical and digital objects and infrastructures related to cars and platform technologies. The car is the object in use, and the various car-sharing business models and platforms provide ways of accessing these vehicles.

Car and communication competencies: Competencies related to both cars and communication matter, where car fleet management is central for the providers of station-based and free-floating schemes, and the P2P services need competence for the platform technology. Some incumbent providers stated that they drew on their experience within the automotive industry.

Table 13 shows variants of car-sharing services investigated with a label for the type of car-sharing, highlighting the different types of access to cars.

Provider	Scheme	Type of Car-Sharing
Platform	Peer-to-peer	‘Neighbour’ car-sharing
Car collective	Station-based	‘Cooperative’ car-sharing
Car rental company	Station-based	‘Self-service rental’ car-sharing
Through housing companies	Station-based	‘Community’ car-sharing
Public transport company	Free-floating	‘City-car’ car-sharing

Table 13: Variants of car-sharing services investigated

Connections between elements and connections to other practices

Three types of connections tie the elements together and affect what is understood and recognized as car-sharing. The various business models and platforms and the ways in which they offer solutions for i) booking and payment, ii) opening and accessing the vehicle, and iii) driving and parking.

i) Associated with booking and payment, the business models and platforms are relevant because of which costs are covered – for example, usage in time-periods and distances, fuel and parking, and insurance and maintenance.

ii) Take the opening of a car by means of a smartphone instead of a key. This involves the material element with the ICT devices and the competence element because of the knowledge of how to open the car this way, as well as the meaning element, in terms of the flexibility to open the car without needing a specific key.

iii) Parking is involved from the beginning to the end, depending on whether the services are station-based or free-floating. There can also be other specific encounters, e.g., charging electric vehicles (EVs). What is understood as car-sharing relates to current parking policies regarding, for instance, residential parking because of how such regulations need to deal with parking for car-sharing cars and not only being restricted to privately owned cars. This is also relevant for regulations with building norms for minimum parking spaces in housing development and discussions of how these could be reduced if they include car-sharing.

Connections to other elements and practices are also relevant and include connections to other shared mobility alternatives, such as bike-sharing schemes, as well as public transport, housing, and workplaces. As one respondent noted, car-sharing relates to other mobility practices, public transport in particular:

Good public transport is important for alternative systems such as car-sharing to work well enough and be a good alternative to private car ownership. (IMA)

5.4.2 Implications

The analysis shows how providers are involved in shaping car-sharing practices, but what are the implications?

Moving Mobility: The analysis shows how car-sharing providers contribute to changes in the mobility system, as car-sharing services provide *mobility* to users. In this Paper, I argue that the emerging alternatives to car ownership are transforming the ‘system of automobility’ into a ‘system of mobilities’. With the incumbent’s role in continuing with automobility – in addition to facilitating the generation of new meanings of accessibility to cars – existing meanings of cars for mobility are stabilized. This is in line with former research stating that car-sharing is both immersed in and distinct from the regime of automobility (Kent & Dowling, 2013). The established car retailers and car rental companies offering car-sharing services indicate changes in both the regime and niches, implying that providers play a role in changes in both regime- and niche- practices.

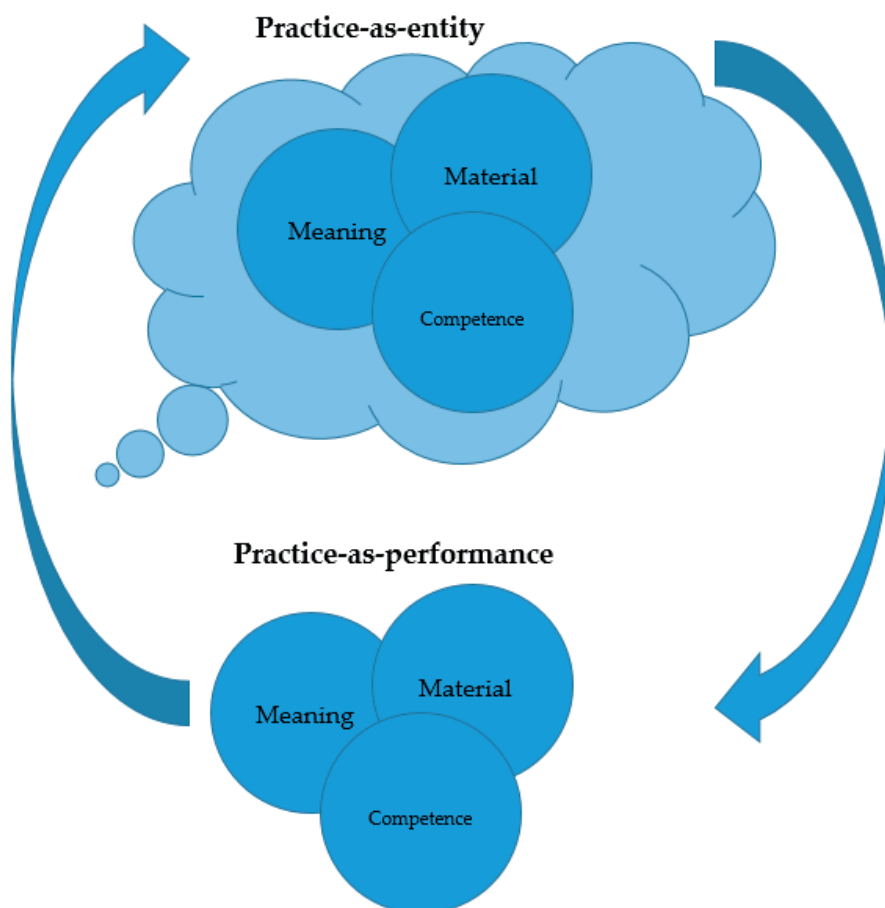


Figure 16: Recursive relationship between practice-as-entity and practice-as-performance

Shaping and Steering Practices: By investigating the recursive relationship between practice-as-entity and practice-as-performance, the study shows how car-sharing practices are shaped and steered by car-sharing providers. The provision of mobility services shapes what is understood as car-sharing, the ‘practice-as-entity’. The analysis has shown that car-sharing practices involve several business models and platform technologies. The types of services offered are evolving, leading to a larger understanding of what car-sharing involves, in turn leading to different ways of doing car-sharing. Figure 16 illustrates this by showing that practice-as-entity is what is commonly thought of and *recognized* as a ‘doing’, whereas practice-as-performance is what is involved when people actually *carry out* this ‘doing’.

This means that neither car-sharing as practice-as-performance nor as practice-as-entity is fixed or static. Car-sharing is both understood differently and done differently, and the results of this study highlight how providers contribute to different understandings, which then again shapes the different doings. The analysis throws light on how the increased provision of car-sharing services constitutes a central part of this understanding of car-sharing as ‘the entity’ – with implications for how it is manifested and executed in the ‘performance’. The analysis, thereby, throws light on the role of providers in this recursive relationship.

5.5 Paper 5: Practices in transitions

RQ: How are social practice theories applied in sustainability transition research?

Social Practice Theories (SPT) can contribute to transition studies by deepening our understanding of the key social mechanisms and dynamics underpinning transitions in everyday life and the role of agency and collective action in processes of social change (Köhler et al., 2017). Several studies have applied SPTs with concepts from transition studies, and these connections merit attention. The review presented in this paper shows how SPT are applied in studies of system change by i) considering change and continuity in practice elements, niches and regimes, ii) connecting consumption and production, iii) going beyond user practices, iv) mapping diffusions of innovations in daily life and v) examining policy implications and interventions. This is followed by a discussion of how the studies contribute to a practice paradigm for the Multi-level Perspective (MLP), proposing a ‘practice innovation system’ PIS approach for future research.

5.5.1 Summary of findings

This systematic review covers articles indexed in the Scopus database, and the search strategy is explained in chapter 4.2.1. I undertook a broader content review of the 83 articles in the sample to clarify their input with theoretical and empirical positioning, the research processes in the studies, and the output of specific contributions. I noted several ways in which SPT was used in studies of system change. I categorized the types of applications, which revealed five central tendencies. The Appendix in Paper 5 gives an overview of these key findings.

Here I present only two of the main findings that study the tension between stability and instability by investigating dynamics between practice elements, niches and regimes. Hargreaves et al. (2013) and Seyfang and Gilbert-Squires (2019) use SPT and MLP to reveal critical points or constraints blocking transitions in regimes and practices. Hargreaves et al. (2013) argue that both the MLP and SPT are ‘middle-range’ approaches that refuse to give predominance to either structure or agency in socio-technical change processes and instead focus on the dynamics of ‘structuration’ that drive both system stability and change

(Hargreaves et al., 2013, p. 407). Applying SPT and MLP, Seyfang and Gilbert-Squires (2019) acknowledge differences between MLP and SPT but propose that parallels exist in particular between the stability of regimes and practices and possible disruption by niches and proto-practices. These parallels concern how regimes and practices are seen as stable, supported by existing rules, regulations and institutions, and innovation and change need to deal with such stable elements. Figure 17 shows a continuation of this argument. Based on Gazull et al.'s (2019) study of household energy transition policies in Mali, the underlying assumption of this figure is that transitions in regimes (vertical circle) and transitions in everyday practices (horizontal circle) follow different dynamics that interplay (points of convergence or divergence) and then either reinforce or hinder each other.

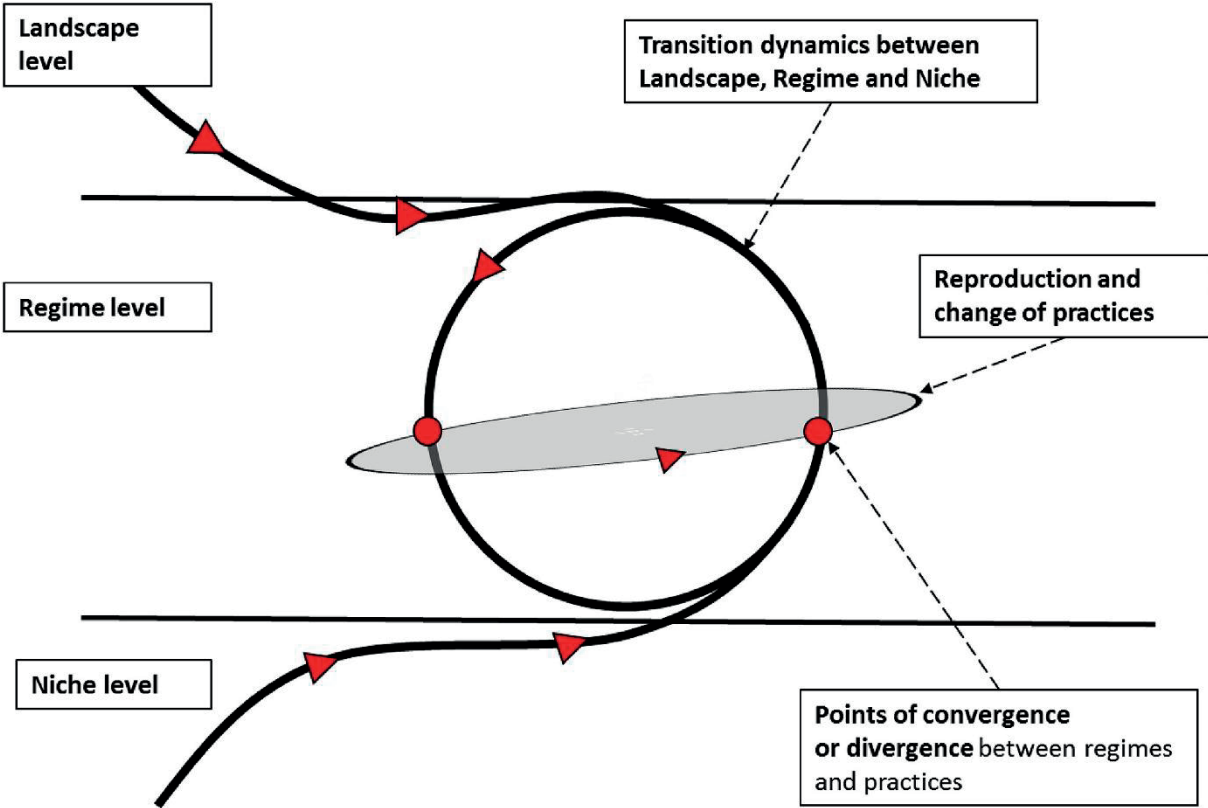


Figure 17: Combining MLP and SPT

Another key observation of SPT for studies of system change is Hölsgens et al. (2018), who takes an SPT perspective to investigate whether the MLP approach is suited for analysing and understanding the diffusion trajectories of social rather than technological innovations. A significant challenge for social innovation research is translating *social innovation* from a high-potential novelty into actual mainstream practice. They argue that elements of socio-technical systems can be portrayed as social practices, which are shown in Figure 18. Here, several different practices are shown at the levels of regimes, such as practices of management, design and producing, governance practices, inscribed practices and epistemic practices.

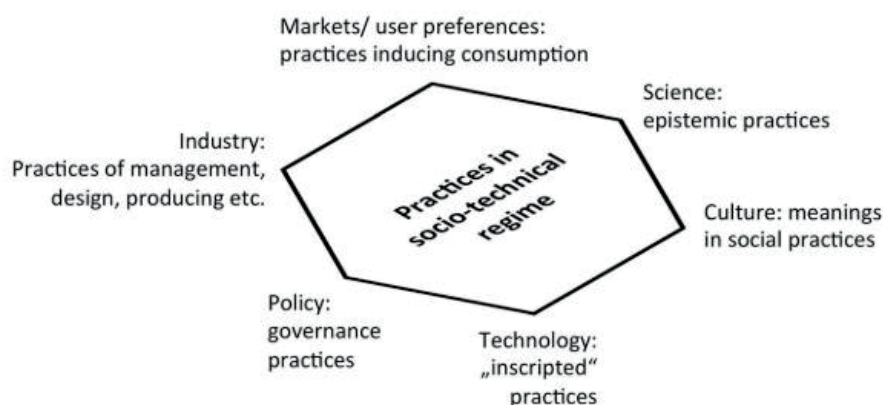


Figure 18: Elements of socio-technical systems from a practice perspective

The review shows how social practice theories are applied in sustainability transition research for more purposes than studying users and that applying SPT can contribute to additional extensions of the MLP. I elaborate on how SPT can help to account for past, present and future *local actions* not covered by the four other action paradigms under the MLP. There is a need – and a possibility – for another action paradigm in the MLP: *the practice paradigm*.

5.5.2 Implications

Despite the many fruitful studies that apply SPT in transition studies, concretization is still lacking, particularly considering innovations. Based on this review and the discussion of a practice paradigm in the MLP, I propose concretizing the connections between SPTs, MLP and innovation systems approaches to form a *Practice Innovation System* framework. This would involve a ‘3x3’ conceptual framework consisting of three elements, three levels, and three layers: elements of meaning, material, and competence, levels of niche, regime, and landscape, and layers of practice-as-performance, practice-as-connections, and practice-as-entity. This framework integrates these perspectives, showing how the concepts complement one another and providing a more comprehensive picture of the various dynamics of change and continuity. I suggest placing the PIS in the ‘innovation system’ approach ‘family’ because it can be used to consider how social practices structure the development, diffusion, and use of new technologies, products, and processes (Edquist, 2005). The PIS is helpful because, instead of studying institutions and organizations directly, the approach makes the practices the unit of analysis (which indirectly takes institutions into account) but focuses on how these are recursively shaped.

The three elements come from the elemental approach in SPT. I propose highlighting the co-evolution of elements by elaborating on Shove’s (2012) three colours – yellow ‘meaning’, red ‘competence’, and blue ‘material’ – by adding the connections between the elements with orange, green and violet blend in between the elements.

The three levels come from the MLP. I propose highlighting regime and niche practices and including other regime practices, as presented in Figure 18.

The three layers come mainly from Schatzki’s (1996) original distinctions between practice-as-entity and practice-as performance. I propose conceptualizing these as *layers* and introducing a new layer, ‘practice-as-connection’, inspired by the concept of the nexus of practices (Hui et al., 2016). Practice-as-performance refers to the actual doings, the repeated performances seen

as observable action. Practice-as-entity concerns the general understandings and sayings that make practices distinguishable concepts, as recognizable patterns of action. Practice-as-connection is the context surrounding the performances, e.g. neighbouring practices and the setting for the practices performed or understood. I distinguish the ‘practice-as-connections’ to amplify the space- and temporal-specific aspects involved in the production and reproduction of practices in daily life and to emphasize new possibilities for analytical foci of investigating what practices are *for*. The connections between the layers are crucial here. Such a distinction deviates from other SPTs that sees practices as flat and not disconnected from their surroundings. This layer acknowledges that practices are interconnected, and this distinction is suggested as a way of studying the nexus of practices. The layers also make it possible to identify shifts in the development of new practices when the understandings of practices are different or more developed than is the doing of the practice, say when the *understandings* of a vegan diet or solar energy are present, but the actual execution of it is not yet present.

Figure 19 shows the ‘3x3’ conceptual framework consisting of three elements, three levels, and three layers. The y-axis shows increased structuration for the practices, and the x-axis show time development. The arrows suggest some dynamics in the model, for example, on how the entity can develop before the performance. Also, a two-sided arrow illustrates the dynamics between the layers going both ways and in iterations (see Paper 5 for a larger illustration and further explanations of the figure).

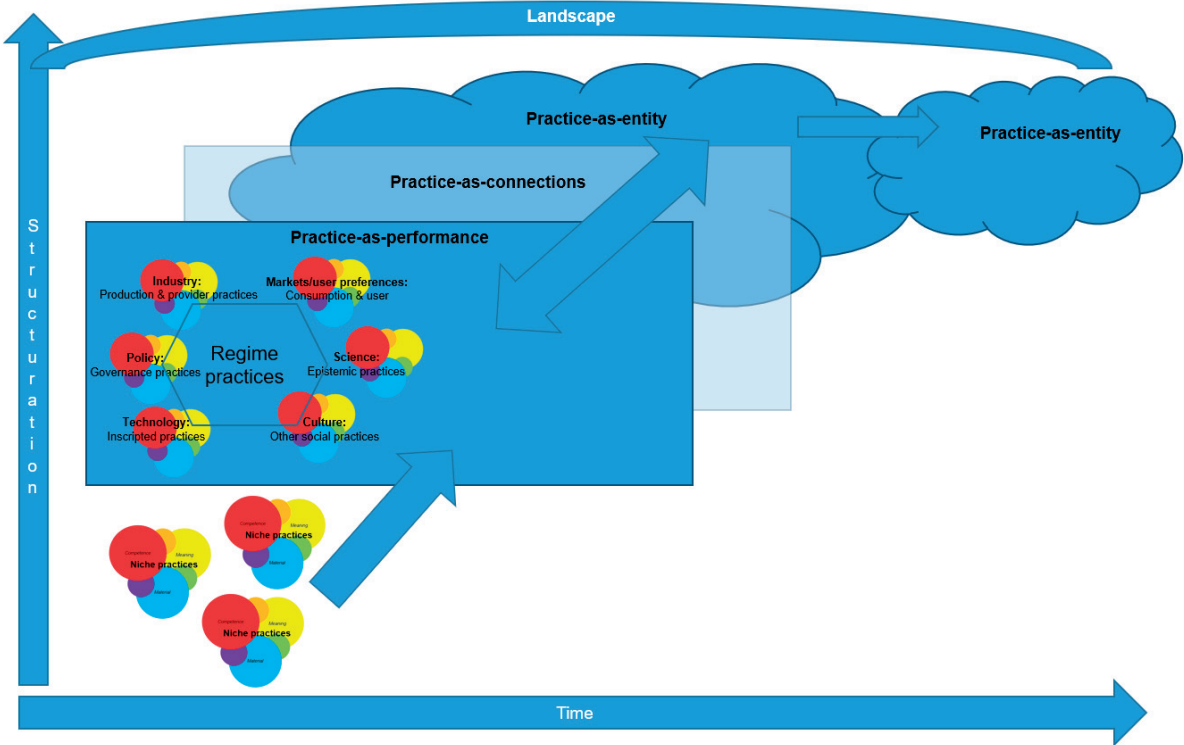


Figure 19: Conceptual framework PIS

SPT is increasingly used in transition research in contributing to overcome the structure–agency division. My literature review shows that this also concerns overcoming six related dichotomies: consumption and production, normality and novelty, stability and instability, micro- and macro-levels, social and technical change, and flat and hierarchal levels. This review reveals that SPT in transition studies are used to study local time- and space-specific changes

beyond individuals' behavioural change, connecting practices to societies by studying different 'scales' of collective practices, such as grassroots and community-based initiatives. The role of citizens and concepts of collaborative consumption and circular economy call for new understandings of the role of practices in transitions.

I hold that the PIS approach is well-suited for accounting for this and other concepts such as prosumers and intermediaries, as well as in studies of informal practices, power distribution, and social justice. I, therefore, suggest eight avenues for applying the PIS approach in transition studies: 1) disruption, 2) experimentation, 3) destabilization, 4) failures, 5) unsustainability, 6) social sustainability, 7) informal practices, and 8) interventions.

6 Discussion: Car-sharing practices in system reconfiguration from automobility to (auto)mobility

6.1 Dynamics of change and continuity towards environmental sustainability

‘How do car-sharing practices influence the dynamics of change and continuity towards environmental sustainability in established mobility systems characterized by the dominance of car ownership?’

Here I discuss how the papers contribute to answering the main research question by separately answering the research questions (see Table 14). Paper 1 examines changes in the automobility system using only the Multi-level Perspective on how car-sharing relates to car-owning. In the following three empirical papers, Papers 2, 3, and 4, I use SPT to study further aspects of the role of car-sharing practices in the system change of automobility towards environmental sustainability. The studies show how car-sharing contributes to both change and continuity by encouraging adjustments away from the daily use of cars to new ways of using cars on an access-basis in private household settings, by providing a range of means to access cars. Further, for providers, regulators and household users alike, car use becomes an occasional rather than a daily occurrence.

<p>1 Existing and emerging RQ: <i>How does the use of car sharing in Oslo today relate to and influence the established use of privately owned cars? Are these relations part of a transition towards sustainable mobility?</i> Data: Household interviews Oslo. Theory: MLP Reconfiguration pathways. Contribution to main RQ: Car-sharing relates to car-owning. Reconfigures the regime from car <i>owning</i> to car <i>use</i>. Environmental sustainability: + Cars are used less with car sharing compared to owning. + Car sharing is used occasionally in addition to a privately owned, smaller EV. + Opportunities for choosing a vehicle for specific purposes. - Continued use of fossil fuel cars. - Continued dependency on privately used cars. Paper positioning in the thesis: Introduces MLP. Lack of attention on practices leads to the need for Papers 2–4, which does this.</p>	<p>3 Emerging mobility practices RQ: <i>How does car-sharing emerge differently in different places, amid particular local, established mobility practices?</i> Data: Household interviews Oslo, Rotterdam and Malmö. Stakeholder workshops Oslo, Rotterdam and Malmö. Theory: SPT inspired, seven elements. Contribution to main RQ: Car-sharing unfolds amid established urban mobility practices, including changes in shared elements and actor-specific for travelling, operating, regulating. Environmental sustainability: Connects to the reduction of the <i>daily</i> use of cars, for car sharing to be a viable option for occasional use of cars. Car-sharing through public procurement, for accessing EVs and towards car-free cities. Paper positioning in the thesis: Controversial because of scoring the changes and separating shared and actor-specific elements. Lack of attention on the role of providers leads to the need for paper 4, which does this.</p>
<p>2 Novelty to normality RQ: <i>Under which conditions are car-sharing practices reproduced, and what are the implications of this reproduction for a transition to sustainable mobility?</i> Data: Household interviews Oslo. Theory: SPT 3 elements, MLP niche and regime. Contribution to main RQ: <u>Practice-as-performance:</u> Ways of doing car-sharing and circumstances that trigger the reproduction. User context and provider context affect reproduction. Several different (FUSS, POLL, PERC) niche practices can contribute to a transition by playing different roles in a new regime. Environmental sustainability: Supports a cautious view, a shift from owning to accessing; car-sharing is linked to other stable practices that still require personal car use. Paper positioning in the thesis: Lack of attention on other mobility beyond car-owning leads to the need for Paper 3, which does this.</p>	<p>4 Providers and practices RQ: <i>How do car-sharing providers shape car-sharing practices, and with what implications? The research objective is to explore how business models and platforms contribute to shaping car-sharing practices.</i> Data: Household interviews Oslo, Stakeholder workshops Oslo, Interviews with industry Oslo Theory: SPT 3 elements, focus on providers. Contribution to main RQ: <u>Practice-as-entity:</u> Providers play a role in changing entities, which then again change performance. Environmental sustainability: Several types of car-sharing providers entail business models outside sharing economy concepts. Moving mobility: Car-sharing is part of many changes toward a ‘System of mobility’. Paper positioning in the thesis: The types of services offered are emerging, leading to a larger understanding of what car-sharing involves (practice-as-entity), in turn leading to emerging ways of doing car-sharing (practice-as-performance). Complements the other papers with an emphasis on the role of providers.</p>
<p>5 Practices in transitions RQ: <i>How are social practice theories applied in sustainability transition research?</i> Data: Literature review of 83 articles. Contribution to main RQ: SPT are applied in studies of system change i) considering change and continuity in practice elements, niches and regimes, ii) connecting consumption and production, iii) going beyond user practices, iv) mapping diffusions of innovations in daily life and v) examining policy implications and interventions. Propose the PIS approach.</p>	

Table 14: Synthesis of the five papers

6.2 Reconfiguring automobility

Here I want to simplify the key takeaway message – that car-sharing plays a role in reconfiguring the automobility system to an (auto)mobility system through change and continuity. The () parentheses in the title of this thesis indicate the changing role of the auto; the car is still part of the mobility system but plays a less dominant role. With ‘a car-sharing reconfiguration’, the (auto) is still part of this system, both through car-sharing and through a continuation of car-ownership. This is in line with previous research stating that car-sharing is both immersed in, and distinct from, the regime of automobility (Kent & Dowling, 2013).

Terms such as ‘Peak car’, ‘After the car’, or a ‘New post-car system’ suggest the decline of personal vehicles and an increase in car alternatives (Dennis & Urry, 2009). For example, a future of cycling and living with a shift in cultural attitudes, less reliance on the automobile and increased demand for living in mixed-use, compact developments in or near city centres (Goodwin & van Dender, 2013). When talking about how the automobility system is transitioning to the (auto)mobility system, this could also be characterized as ‘Peak *daily* cars’.

In Chapter 3, I highlighted how Laakso et al. (2021a), in their literature review, show how the concept of reconfiguration is used in research on socio-technical transitions and applications of SPT. They suggest that future research on sustainability transitions could benefit from addressing the tensions between and within niche and regime *practices*. In Papers 2, 3 and 4, I discussed similar issues of practices and system change. Papers 1–4 show, in different ways, how car-sharing reconfigures the automobility regime. Therefore, in this discussion section, I synthesize to explain how Papers 1–4 can contribute to these ‘reconfiguration’ conceptualizations in SPT for transition studies.

Reconfiguring regimes

In Paper 1, I use concepts of forms of reconfiguration from pathway typologies for system change, noting how three forms of reconfigurations can describe the change from the regime of car *owning* to a regime of car *use*. Although these reconfiguration pathways were originally proposed in connection with analysing urban multiplicity (Hodson et al., 2017), I use them to describe how the emergence of car-sharing is related to the dominance of car-owning in the existing system.

In the other three papers, I find that car-sharing is part of reconfiguring the automobility regime dominated by privately-owned cars because car-sharing is part of a greater change consisting of sequences of multiple component innovations. Car-sharing as such does not reconfigure the automobility regime alone, or bring a change in the *daily* use of cars. As Papers 2, 3 and 4 show, the change includes digital infrastructure and smartphones, and other mobility innovations such as electric bikes and other bike-related matters such as biking lanes and cargo bikes. Also, the increased availability of public transport and limitations for car use, such as new limited (free)parking spaces for housing, workplaces, and shopping/leisure, contributes to reducing *daily* car driving. The practice perspective in the studies also highlights the meanings and social norms of car-sharing. When access-based mobility is accepted, several adjustments occur in the automobility regime.

When *daily* driving is changed, car-sharing emerges as an essential innovation that enables people not to own a car for those few, occasional times when they need one. This means that car-sharing is part of *sequences* of *multiple* component innovations that lead to adjustments in the automobility regime. The auto becomes less dominant – and I signal this change by putting the ‘auto’ in parentheses. The auto is still part of the mobility system – but its role has changed, from owning to sharing, and from daily car use to occasional car use.

This is partly in line with how Geels and Schot (2007) explain the reconfiguration pathway, as presented in Chapter 3. In the reconfiguration pathway, the new regime grows out of the old regime, precipitating substantial changes in the regime's basic architecture. Transitions are caused, not by the breakthrough of *one* technology, but by sequences of *multiple* component-innovations. This transition is influenced by other niche innovations that enter the regime, such as smartphones and electric bikes, and multi-faceted external landscape pressure from the climate crisis. As stated in the pathway terminology: While these landscape developments create opportunities and pressure, the main characteristic of this transition path is the interaction between multiple component innovations and the regime. Symbiotic innovations, which develop in niches, are initially adopted in the regime to solve local problems. They subsequently trigger further adjustments in the basic architecture of the regime, causing changes in culture, the market, user preferences, policies, and technologies in the automobility regime (Geels & Schot 2007).

Reconfiguring practice elements

In Chapter 3, I further presented how Laakso et al.'s (2021a) review shows that 'Reconfiguration' in studies with a theoretical background in SPT is used to illustrate the dynamic process through which elements of practices are re-organized, replaced or re-arranged to a different form, figure or combination, in order to change the prevailing practices (Laakso et al., 2021a). Paper 2, 3 and 4 elaborate on changes within elements and connections between elements. Paper 3, with its seven-element approach, offers one way to study such a reconfiguration of elements in practice. The highlighting of shared and actor-specific elements may be controversial because it goes against the flat ontology of SPT, and against the non-division between structure and agency. However, some scholars, among them Roysen and Merten (2019), indicate that certain elements are more shared. They refer to social norms as 'structural' elements influencing the emergence, maintenance and development of (more sustainable) social practices. Similarly, Green et al. (2018) show how 'structural differences' intersect with 'local contingencies.'

6.3 Beyond behavioural change and beyond user practices

SPT are known for going beyond behavioural change. At the beginning of Chapter 3, I drew similarities between SPT and sustainability transition approaches and argued that SPT might avoid the pitfalls of the individualist and systemic paradigms dominating sustainable consumption research. This means, *inter alia*, that policy interventions informed by SPT would recommend that it is the *practices* per se that need to be (de)-incentivized – not the individual consumers themselves. Throughout the empirical studies, I have emphasized the role of households in such studies. As explained in 3.1.5, I chose households for the studies because of the opportunities to go between the levels of individuals and community.

Instead of taking the need for cars as a 'fixed' demand and examining how to meet it, the studies show how car-sharing can instead contribute to changing this 'set in stone' demand. This connects with Shove's (2003) proposal of using SPT to go beyond individual interests and intentions, and instead look at the consensus of normality, at what is considered normality, and what contributes to this. In her seminal work, Shove (2003) elaborated on normality, arguing that, instead of increased efficiency or changing consumption to continue to meet the same demands, we should examine what constitutes the normality of this demand. Through examples of indoor temperatures and daily showering, she finds that, instead of increasing energy efficiency to achieve these 'set' goals, one might change the ideas of indoor dressing and cleanliness. Similarly, the studies in this thesis emphasize that having access to cars without ownership plays a role in changing the demand for cars. Instead of taking the demand for cars as fixed and striving to meet that demand through EVs, this thesis can serve as an alternative

approach to studying what can change the expected ‘normality’ of car demand. I show that car-sharing is not about adding more cars to solve the same needs: rather, it contributes to changing the perception of ‘normality’ or expectations of the taken for granted demand for cars. This can be understood as a way of reconfiguring the regime of automobility.

In addition to demonstrating the role of households as analytical foci and as sources for data, I have highlighted how car-sharing practices, and change/ continuity for automobility, are not solely about the users. In the studies, I have employed concepts from the elemental approach in SPT to highlight the role of providers and policymakers for practices. Paper 2 makes it clear that car-sharing involves certain elements in the practices within the user and provider contexts. In Paper 3, I used the seven-element approach with actor-specific elements to show how changes in practices have involved changes not only for travelling but also for operating and regulating. In Paper 4, I elaborated on the role of providers in shaping practices; and in the literature review (Paper 5), I highlight how SPT can be used to study variants of ‘provider practices’ or practices in firms, organizations or networks.

Environmental sustainability

Paper 1 finds that car sharing acts help to promote reduced car-ownership, and changing and reducing the overall use of cars. However, there are limits to its contribution to environmental sustainability because of the continued use of fossil fuel cars in car-sharing services and the continued dependence on privately used cars. Paper 2 supports a cautious view, in the shift from owning to accessing, car-sharing is linked to other stable practices that still require personal car use. Paper 3 further shows that car sharing connects to the reduction of the daily use of cars. Car sharing is a viable option for the occasional use of cars. Meaning that the reduction in *daily* car use is reliant on changes beyond the introduction of car sharing. Interventions should thus not only be directed at car-sharing per se: rather, it should be on urban mobility in general. Further, in some places, car sharing is a solution for accessing EVs and a step towards car-free cities. Paper 4 further supports this, showing that car-sharing is part of ‘moving mobility’ with many ongoing changes, including access-based mobility, towards a ‘system of mobility’.

6.4 PIS approach conceptualizing the practice paradigm in transition studies

In Paper 5, I proposed a *Practice Innovation System* approach to conceptualize the practice paradigm for innovation studies and sustainability transition research. The approach is aimed at not only studying practices but also studying innovations and system change through a practice-theoretical perspective. Joining the other Innovation Systems approaches in breaking with the linear model of innovation, it goes beyond the boundaries and perspectives of the other IS approaches presented in Chapter 3.2, making it possible to study cross-national -regional, -sectoral and -technological practices.

I hold that the PIS approach can provide a concrete conceptualization of the practice paradigm in transition studies. This relates to Chapter 3 and the presentation (in 3.1.3) of how agency in the rule-based model of action is the foundation for a practice paradigm. There, I elaborated on the need and possibility of the practice paradigm. According to Geels and Schot (2007), a rule-based model of action, on which the MLP is based, incorporates several ways of conceptualizing agency, with four foundational paradigms of rational, interpretative, power-based and routine types of rule-based actions. With the PIS approach, the practice-paradigm is suggested as an action paradigm, as an alternative to these other four paradigms. MLP, with the rule-based paradigms and the pathway typologies presented in section 3.2.5, was initially intended to systematize pathways of transitions that had been merely empirically observed. Thus, as the MLP with the other four rule-based action paradigms provides an overall past and ‘global’ framing, I hold SPT can help account for past, present and future *local actions*. The

PIS paradigm is very similar to the others because it also follows Giddens (1984) in understanding rules as structures that are recursively reproduced because they are used and changed by actors. But I hold that the PIS approach, with the practice paradigm, makes it possible to study actors and actions differently from, e.g. markets and institutions, when innovations occur in the social realm – for example, concerning the citizen instead of the user.

The literature review in Paper 5 is the basis for the PIS approach, and in Chapter 5.5, I highlight how it involves a ‘3x3’ conceptual framework consisting of three elements, three levels, and three layers. These layers can also be connected to my studies in Paper 1–4: Paper 2 shows observable actions performed by the practitioners, the practice-as-performance layer. Paper 3 shows connected collective elements, neighbouring practices, and pre-existing elements, the practice-as-connections layer. Paper 4 shows the understandings and sayings of practices, the practice-as-entity layer.

Throughout this research work, I have kept asking myself what a study of ‘system change’ really entails. I hold that employing the practice paradigm for transition studies can be one way to study system change. The PIS approach can account for the social, with a different (and reduced) focus on organizations than is the case with other innovation systems approaches. By directing attention to practices, it offers possibilities to study how innovations emerge, and how they contribute to continuity and change. In Table 15, I highlight the key points in this discussion chapter.

Reconfiguration	Reconfiguring automobility regime: Peak daily car use. Reconfiguring car-sharing practice elements and connections between elements.
Beyond behavioural change Beyond user practices	Households as one way to study collective practices. New normality – change ‘fixed’ demand for cars. Providers, business models and regulations are part of practices.
Practice paradigm Layers in the PIS approach	Paper 2: The practice-as-performance layer. Observable actions performed by the practitioners. Paper 3: The practice-as-connections layer. Connected collective elements, neighbouring practices, and pre-existing elements. Paper 4: The practice-as-entity layer. Understandings and sayings of practices.

Table 15: Summary of discussion

7 Conclusions

7.1 Summary of research positionings and main findings

In this thesis, I first presented the empirical setting and research context, in order to explain the potential of car-sharing to contribute to environmental sustainability. I argued that considerable attention has been paid to EVs and public transport, but that there is also a need to examine other alternatives – such as car-sharing. But, rather than looking at how this is up-scaled, emerges, or diffuses, I argued that it is also important to investigate how such innovations can contribute to change status-quo, bringing changes in today's current mobility system.

To perform such studies, I argued that transition studies with SPT are suitable. In Chapter 3, I explained the relevant background of these fields, first by elaborating on the need and possibilities for a practice paradigm for transition studies. To back up this reasoning, I further elaborated on ontological challenges and possibilities for conceptual crossovers in these fields. In particular, I wanted to shed light on specific topics of reconfiguration across regimes and practices, and the action paradigms for agency in the rule-based MLP model. This laid the foundation for the practice paradigm. Paper 5 should be seen as an additional contribution to this theory presentation by reviewing transition studies that have used SPT. At the end of Chapter 3, I explained my choice of studying practices, households and everyday life for transition studies. Households offer an appropriate empirical focus here, because they can serve as an intermediate unit between individuals and meso-level scales in the transition literature.

This links in with Chapter 4, which continues the explanation of household and stakeholder attention, with a presentation of the research design and methodology. This chapter elaborates on what I did in this research and why. This thesis is the result of an iterative research process, where the component steps – reviewing the literature, developing research questions, collecting data, analysing data, interpreting results, and writing papers – were undertaken in iterations. I noted three episodes occurring in the course of this research that illustrate the importance of these explanations, and explained how I strove to solve such issues when collecting and analysing the data and in paying due regard to research ethics. Household interviews and stakeholder workshops were helpful for achieving the research objectives, as they triggered conversations about naturally occurring, ordinary events in natural settings, and people could talk about practices, further elaborating on what might otherwise be taken for granted.

In addition to presenting the research context in the overall TEMPEST project, the data-collection, and steps of the data-analyses for the studies, I explained relevant considerations of research ethics and the positioning within the philosophy of science. The critical realist approach to social science links to the elaboration of the practice paradigm in transition studies in chapter three. I also indicated some methodological limitations, noting that although I would hold that my strategies achieved rigorousness and validity of the research conducted, I cannot rule out the possibility of biases in data-collection, analysis, and dissemination.

In Chapter 5, I presented selected parts of the five papers to summarize the main findings and implications, focusing on those parts that help to recap the main positionings and findings of the papers related to answering the overall research question of this thesis.

This selection of findings further links to the discussion in Chapter 6. Here I discussed how car-sharing practices contribute to reconfiguring the automobility system, from 'automobility' to '(auto)mobility'. Further, I discussed how car-sharing is part of other ongoing changes that contribute to reducing the daily role of the car.

7.2 Implications for theory, policy and society

The main theoretical contributions of this thesis concern the use of SPTs for transition studies. I have shown how SPT and concepts from the MLP can be used to study reconfiguration of regimes and practice elements and suggested the PIS approach as a concretization of the conceptualization of the practice paradigm for transition studies. In chapter 3, I gave a thorough overview of the background of the action paradigm for agency in the rule-based model of the MLP. I also went through the four phases of the development of SPTs to back up the reasoning behind the practice paradigm for transition studies. Chapter 6 connects this to the empirical studies and shows the implications for theory, as summarized in Tables 14 and 15. In line with the main argument in SPT for transition studies, my studies go beyond behavioural change. I contribute to theory development by showing that SPT in transitions studies can be used to study how reproduction contribute to reconfiguration (Paper 2), and how user- and provider contexts (Paper 2), actor-specific elements for travelling, operating and regulating (Paper 3) and providers (Paper 4) can be included in studies of practices. This highlight the need to investigate the nexus of practices and challenges the strict flat ontology of practice theories. My empirical studies of mobility highlight that new business models and regulations are part of practices, differing from studies of practices of daily showering and ideas of cleanliness that might be less affected by regulations and business models.

This thesis has shown that car-sharing contributes to change as well as continuity in the automobility system by providing access to cars. Here I highlight three main implications for policy and society.

First, I show how some households repeatedly use car-sharing, and these lessons can be helpful for those who want to engage more with car-sharing – for example, municipal authorities in Norway wondering what car-sharing is about and what they can do. Paper 2 is particularly useful in showing what leads to the normalization of car-sharing in a household context. This study shows how to establish car-sharing in a household, with some examples of various ways of doing car-sharing, whether for weekend trips or short errands. Further, Paper 2 provides specific examples of success, so that the practice can be established: for instance, instead of linking the cost to one trip to celebrate, say, a birthday, it can be linked to the whole family's total annual transport costs. Car-sharing costs should not be directly connected to a specific activity. For example, a car-owner would hardly worry about the transportation cost involved in attending the birthday celebration of a grandparent. Car-sharing costs could be included in the family budget as transportation or holiday costs. In addition, time use is relevant. Extra time spent on car-sharing, booking and delivery, can be counter-calculated against the time saved from maintenance and obligations that car-ownership demands. Further, with activities that require car use, it is possible to book/ plan the car-use at the same time as planning that activity, whether weekly ski-school or helping to transport the children's football team to a game.

Paper 1 is relevant for how environmental considerations can affect car-owning, showing that a B2C scheme undertaken in collaboration with housing facilities competes with car-owning and has the potential to replace car-ownership, because it is so easy to use. Further, car-sharing can co-exist with owning smaller EVs, potentially recombining the types of cars owned and driven daily, thus contributing to greater environmental sustainability. Paper 4 shows that the more types of providers there are, the more ways car sharing is used; and that several different ways of using car-sharing may emerge – relevant if planners/researchers want to look into different types of car-sharing, such as car sharing in the workplace or self-service rental in housing associations. With the growing proliferation of car-sharing services and access to these, car-sharing is becoming more and more acceptable. If car-sharing is gradually adopted as an

unwritten rule or norm, that may influence the actions of individuals as well. With this recursive two-way relationship, a broader understanding of what car-sharing is can lead to more ways of doing it. This may contribute to a reduction in car use, but we should also bear in mind that extremely cheap and easy access may contribute to increased car use – or that car-sharing is used instead of walking, cycling, or public transport.

Second, I suggest that car-sharing should be treated as Access-Based Car (ABC) use, going beyond ‘sharing-economy concepts’. As Paper 2 shows, the *doing* of car-sharing vary because car-sharing encompasses several types of travel, depending on the vehicle, trip length and time of use. Further, as shown in Paper 4, providers contribute to a range of different car-sharing *understandings*: indeed, the term ‘access-based cars’ may encompass these differences better. This links in with discussions of sharing economy and Access-Based Consumption terms (Acquier et al., 2017; Bardhi & Eckhardt, 2012; Castellanos et al., 2021). It is also relevant for the current debate on policy support for car-sharing actors,⁹ especially regarding the differences between cooperatives and other providers (Solem & Newth, 2021). In the Norwegian debate on ‘who is in, and who is out’, VY, the provider of a free-floating scheme, is upset that they are not included as a car-sharing service (Hombre, 2021). In a newspaper opinion piece, they write that ‘Oslo does not need a bloodbath for car sharing. Oslo needs good car-sharing schemes that make it attractive to manage without having a car of your own. Politicians should avoid market alterations through skewed support measures, and instead allow climate-friendly car-sharing solutions’. This example illustrates the pitfalls involved in defining car-sharing schemes and why the term ‘access-based cars’ can usefully encompass the full range of the activity.

Third, using social practices and household level as the unit of analysis can shed light on how car-sharing practices are linked to the broader social context, and this can be helpful as regards where to steer interventions. I recommend that policy interventions follow this approach. Interventions should go beyond behavioural change, using a systemic practice approach. In the comparative analysis in Paper 3, I highlight how interventions could be directed. In the three locations, *specific* actions targeted *indirectly* at car-sharing would be valuable to promote car-sharing practices further. Changing existing mobility practices – such as increased walking, cycling, public transport, home deliveries, or working-from-home solutions – to encourage the occasional use of cars would pave the way for acceptance of access-based models, among travellers, operators and planners alike. This implies that interventions should be directed not only at car-sharing *per se*. Rather they focus on urban mobility in general, with the associated infrastructure, business models, and social norms towards changing the daily use of cars. For car-sharing to contribute to environmental sustainability in personal urban mobility, it is essential to work on different ways of reducing the daily use of cars, so that car-sharing can become a viable option. In all areas, measures to reduce the daily use of cars involve support for public transportation and cycling as means of daily transport. This could include new or increased support for bikes for transporting people and goods, possibly with (electrical) cargo bikes, and opportunities to combine cycling and public transport, and bike parking in transport stations, housing, workplaces, and shopping areas. Papers 3 and 4 are particularly relevant here, highlighting that providers and policymakers are part of shaping practice.

⁹ The findings in Paper 3 on policy incentives are based on data from 2017. This has now changed with new policies (2021) for parking support for car-sharing vehicles in Oslo.

7.3 Research boundaries, limitations, and suggestions for further research

This thesis has methodological and theoretical limitations, and my choices have affected the research.

In Chapter 4.6, I mentioned some methodological limitations. I have used semi-structured household interviews, a point that relates to the still-ongoing debate on suitable methodologies for practice-oriented studies (Halkier, 2017; Martens, 2012). I now realize I could have chosen a research strategy more in line with ethnographic interviews, and included photos. In an interview setting, taking photos can be used to slow down the conversation and focus on one single object, and photo stories and images provide more data material on interactions items (Heidenstrøm & Hebrok, 2021). There are also limitations in the way I have studied households as units. Further studies could look more into the dynamics of (internal) negotiations (see Raven et al., 2021).

The empirical scope, with a focus on Oslo, together with Rotterdam and Malmö, set limitations to these areas. I have only, and in a limited qualitative way, studied the implications for environmental sustainability. For example, I have not looked into implications in the forms of a quantitative change in vehicle holding or VKT (vehicle kms travelled). Also, the limited focus on environmental sustainability means that I did not look into economic or social sustainability – for example, linking car-sharing to transport poverty and car dependence (Mattioli, 2021).

The research could connect more to other emerging forms of mobility, such as micromobility (Fitt & Curl, 2020) and MAAS (Hensher et al., 2021). In addition, I did not look into non-mobility practices in depth. By investigating more what the practice is *for*, I could have collected more data on this topic and focused my questions on this – for example, a multi-sector approach to handling cross-sector synergies in how non-transport sectors influence various aspects of travel behaviour (Jones, 2012). The focus in this thesis has been on *mobility*. A more comprehensive system study, such as through a PIS approach, might reveal more about what the practice in question is *for*.

Similarly, I did not investigate connected regimes or multi-regime dynamics. Mine was a narrow theoretical focus on the MLP and SPT, without engaging, for example, more with Strategic Niche Management (SNM). SNM may be used for all innovations but is especially suited for sustainable technologies and mobility systems that offer environmental and social benefits undervalued in the marketplace (Kemp et al., 2000). I could also have discussed connections to other disciplines and intervention points, such as design for sustainability transitions, practice theory and transitions theories (Öztekin & Gaziulusoy, 2020).

The Covid-19 Pandemic

Another possible shortcoming is that the research has not included possible effects from the Covid-19 pandemic that started in 2020. At first, I did not know how to include the Covid-19 pandemic in my research, as the pandemic erupted when I had already finished much of the data collection and analysis, and was working on writing and revising papers. Of course, I could have done desk research on the topic, but also this was challenging because of the ongoing uncertainty. Although some research on the pandemic and mobility has now been published and is available, I felt it was too late to include it in this research in a way that would do it justice.

I was also struggling with separating my own experiences from research. For example, I know from my own experience that people have been working from home, attending online

conferences, shopping online etc. I have also followed discussions on the decline in demand for car-sharing services, with trips being cancelled – but also on the perceived increase in car-sharing because of the need for individual cars instead of (often crowded) public transport. However, including such issues would have required further desk research with a thorough literature review, or additional data collection instead of simply referring to my own experiences. I, therefore, chose to limit the research presented in this thesis to the existing data collection obtained before the pandemic hit. On that basis, I decided against including Covid-19 issues and their effects on the study findings.

Here, let me briefly mention some possible effects of the pandemic on this research. The Covid-19 pandemic has had an immediate and significant impact on mobility (Sovacool et al., 2020). One of the most critical ways in which countries around the globe tried to slow the spread of the pandemic was by restricting the movement of people, which has had a considerable effect on transport systems (Bucsky, 2020). The pandemic, together with lockdowns, has resulted in changes in transport due to social distancing, with people remaining at home and avoiding gatherings (in Norway, also enforced by official local regulations) (Leidner, 2020). This led to increased cycling (Buehler & Pucher, 2021) and decreased use of public transport worldwide (Tirachini & Cats, 2020). Both local and longer trips have been limited, with more and more people working and socializing from home (Schwarz et al., 2020). In areas with complete lockdown, people have been unable to get to the grocery store or shopping centres. Home delivery, home-schooling and home office have reversed the flow for work, education, health, purchasing and consumption. Home delivery of everything, including streaming services, broke the old habits of travelling physically outside the home (Sheth, 2020).

If I were to do this PhD again, I might have included more on the effects of the pandemic. This crisis has demonstrated how rapidly mobility can change, which is a subject for further investigation. There have emerged relevant examples of rapid changes, as well as certain constellations of practices that can be solved online, ranging from academic seminars, yoga classes and choir rehearsals to birthday celebrations or baby showers. If they cannot be conducted in the traditional way, with many people physically present, they are not cancelled: instead, they take place online. This illustrates how practices are interconnected where stability and instability interact.

Future research

More research is needed on social practices in sustainability transitions. In this thesis, I have indicated the PIS approach as suitable for studying practices and system change. Continuing the focus on everyday social practices beyond behavioural or technological change, I suggest eight avenues for applying the PIS approach in transition studies: disruption, experimentation, destabilization, failures, unsustainability, social sustainability, informal practices and interventions.¹⁰ Paper 5 elaborates on these possibilities.

As a final remark, I want to highlight that car sharing must be seen together with other mobility solutions for sustainable mobility, such as EVs, walking, cycling, public transport, and travel reduction. This thesis has shown how a practice- and transition perspective can approach environmental sustainability problems associated with car mobility. The contribution of this study is in line with how Kemp et al. (2012, p. 5) argue for the value of a transition perspective:

¹⁰ Here let me note that I had originally started on, but had to cancel, studies focusing on experimentation and disruption.

'The transition perspective has developed as a specific way of looking at dynamics that recognizes recurring patterns, for example, of regime resisting change, the role of special (local) niches for the exploration of transformative change and conditions under which these changes can spread to regimes and societal landscapes. The perspective thus helps to understand what is currently happening in the transport system, as well as to anticipate possible outcomes of new development, and to identify useful strategies for working towards more sustainable systems of mobility'.

Appendix

Interview guide industry

- 1. Can you give a brief overview of the business and your position?**
- 2. How did you manage to establish the company? Did you get any support along the way? Did you meet resistance?**
 - Financing, organization, regulation, attitudes, etc.
- 3. What is the most important product/service for the company?**
 - What is the central selling point (accessibility, flexibility, green alternative, etc.)?
 - Do you have plans to expand in the near future? Why / why not?
 - What technologies are you investing in (electric cars, hybrid, different models, booking systems, etc.)?
 - Do you have plans to upgrade the car fleet to hybrid, electric cars, etc., which can help reduce CO2 emissions? Why / why not?
 - What do you see as the biggest opportunity or challenge associated with the use of new technology in the car fleet? What is the biggest advantage/disadvantage?
- 4. What is the most important customer group for the company?**
 - Individuals, households, companies, public organizations (P2P, B2C, B2B)?
 - Do you have information about the customer groups (age, education, income, etc.)?
 - Do you have plans to expand the customer segment? Why / why not?
 - What opportunities/challenges do you see for attracting new customers?
- 5. How do you get in touch with customers?**
 - Which channels? Online booking system, smartphone, app.?
 - Do you have plans for new ways to reach customers in the future? Why / why not?
- 6. What relations do you have with customers?**
 - Have you involved the customers in the development of the services?
 - Do you have plans to develop new types of customer relationships in the near future? Why / why not?
- 7. How do you sell the product/service to the customers/users (turnover/revenue stream)**
 - Payment per trip, monthly/annual subscription, mileage (km fee), other ways, what does it cost?
 - Is profitability the main goal for the company, or other things (market share, etc.), in the phase you are in now / in the future?
 - Do you have plans to develop new ways to sell the product/service in the near future? Why / why not?
 - What are the most important costs and revenues in the company (cost structure)?
- 8. Who owns the cars, finances them (key resources)?**
 - Do you have plans to change the ownership structure in the future (new investors)?
 - Do you have plans for new forms of financing/sources?
 - What is the core competence of the company? Do you have plans to develop other skills in the future?
 - How is the company organized? What are you specialized in?

- 9. Who are the company's most important partners/subcontractors?**
- Who does what regarding the delivery of the product/service?
 - Do you have plans to develop new partnership schemes? Why / why not?
 - Do you have plans for new business models/concepts? Why / why not?
- 10. In which geographical areas do you mainly operate now (urban areas - inner city, outer city, suburbs, countryside)? Why?**
- Do you think it is possible to expand the area (more in urban areas, less urban areas)? Why / why not?
- 11. Are you interested in participating as a partner with other car-sharing companies or public transport companies in so-called integrated mobility schemes (Mobility as a Service)? Why / why not?**
- 12. Do you think car sharing / the car-sharing scheme you have can contribute to a more sustainable urban development? Why / why not?**
- 13. In your opinion, what are the main drivers and barriers to car sharing?**
- Financing, organization, regulation, attitudes, others?
- 14. What can / should politicians do to facilitate increased car sharing as part of urban transport / urban mobility solutions?**
- 15. To what extent do you collaborate with authorities (national, regional, local), and what do you collaborate on?**
- 16. Will driverless cars have any special significance for your car-sharing company?**

TEMPEST project partners

The project had partners in Norway, Sweden, the UK, and the Netherlands. The table shows the project partners and their affiliations.

Affiliation	Partner
The University of Oslo, Centre for Technology, Innovation & Culture, Norway	Elisabeth M.C. Svennevik
Institute of Transport Economics (TØI), Norway	Cyriac George Eivind Farstad Tanu Priya Uteng Tom Julsrud
Lund University, Sweden	Peter Arnfalk
Erasmus Universiteit Rotterdam, Dutch Research Institute for Transitions (DRIFT), The Netherlands	Derk Loorbach Sem Oxenaar
School of Geography and the Environment, Transport Studies Unit (TSU), University of Oxford, UK	Brendan Doody Tim Schwanen

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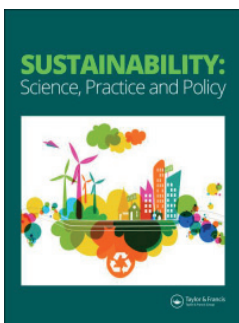
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PART II
Papers



From novelty to normality: reproducing car-sharing practices in transitions to sustainable mobility

Elisabeth M. C. Svennevik, Tom Erik Julsrud & Eivind Farstad

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From novelty to normality: reproducing car-sharing practices in transitions to sustainable mobility

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ABSTRACT

This article investigates the role of practices in sustainability transitions. Employing a social practices approach, we analyze the reproduction of car-sharing practices and discuss its role in transitions to sustainable mobility. We assemble data from interviews with 39 households using car sharing in Oslo, Norway, and show three specific ways of reproducing car-sharing practices: (a) FUSS: Frequent, Unplanned, Short-term, and Small-car use, (b) POLL: Planned, Occasional, Longer-term, and Larger-car use; and (c) PERC: Purpose Elected from Range of Cars. After examining contributing factors, especially the role of provider and user contexts, we turn to how car sharing relates to other household practices. We highlight how car-dependent activities and substitutes for daily car use contribute to the reproduction of car-sharing. We then discuss how the reproduction of a new practice can help to explain the process through which a niche-based practice becomes a regime-based practice in the transition from one mobility regime to a new one. The article shows that by understanding the reproduction of practices as several different performances, a social practices approach can contribute to understanding the normalization of new mobility practices in sustainability transitions.

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Introduction

The role of cars in cities is changing. New technologies, policies, urbanization processes, and shifts in consumption patterns are altering the path dependency of automobiles (Sheller and Urry 2000, 2006; Urry 2004), and car-sharing services are emerging worldwide (Shaheen and Cohen 2013). Some recent studies have indicated that car sharing can promote environmentally sustainable mobility (Rabbitt and Ghosh 2016; Sovacool and Axsen 2018). Socio-technical innovations of shared mobility with new practices can contribute to changing personal transportation, reducing the need for private cars (Boyer 2016; Hasselqvist and Hesselgren 2019; Schwanen, Banister, and Anable 2012; Svennevik 2019). However, the fossil-fueled, privately-owned car remains dominant, causing local environmental problems like congestion and air pollution, and contributing to climate change. This is not a question of an unsustainable *transportation sector*, but of an unsustainable *mobility system* (Banister 2005). There

is a need to study new alternatives such as car sharing from a mobility-system perspective.

Transition studies have now become established as a research field (Köhler et al. 2017), employing various approaches and theories, with the most prominent alternative being the multi-level perspective (MLP) (Geels 2012). Sustainability transitions refer to how established socio-technical systems shift to more sustainable modes of production and consumption, through long-term and multi-dimensional processes (Markard, Raven, and Truffer 2012). Research on sustainability transitions in mobility has involved historical, contemporary, and future studies, with a heterogeneous system approach that includes industry, science, policy, culture, technology, and markets with user preferences (Cohen 2012; Dijk 2014; Geels et al. 2011; Köhler, Turnheim, and Hodson 2020). Cultural and societal aspects come into focus, adding a much-needed dimension to the techno-centrism of transport studies (Cass and Faulconbridge 2017). Transition studies and the MLP have proven useful for studying automobility and system change, but have been

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criticized for devoting an overly large amount of attention to industry and provider prerogatives and lacking bottom-up perspectives that include user practices. Greater understanding is needed of how practices relate to system change (Geels 2010; Köhler et al. 2017, 5, 29–30).

Seeking to meet the call for a deeper understanding of practices in transition studies, some scholars sought to integrate social practice theories (SPT) and to suggest fruitful ways of combining these approaches for empirical studies (Hargreaves, Longhurst, and Seyfang 2013; Huber 2017; Jalas et al. 2017; McMeekin and Southerton 2012; Temenos et al. 2017; Watson 2012; Welch and Yates 2018). Recent work on car sharing shows how SPTs can be useful for studying sustainable mobility, for example, in combination with mobility biographies to show people's decision to car share (Kent, Dowling, and Maalsen 2017) or by conceptualizing sharing as a socio-material practice (Dowling, Maalsen, and Kent 2018). A study of how car sharing endures as a routinely performed social practice has indicated that practice theories can be useful for studying the emergence of car sharing (Kent and Dowling 2013).

In Europe, the sharing economy, with platform services and associated infrastructures for car sharing, has been expanding and enabling changes in how cars are used (Münzel et al. 2019, 2020). Car sharing through platform-business models has been held to contribute to sustainable mobility (Vaskelainen and Münzel 2018). However, recent studies question the environmental sustainability of platform-based accesses, investigating the intentions and impacts of the use, and finding both positive and negative effects (Dill, McNeil, and Howland 2019). In particular, free-floating services with (overly) easy access is questioned, as it might lead to more car use (Becker, Ciari, and Axhausen 2017). Other studies find that the motivation for using peer-to-peer car sharing vary from social, to economic or environmental motives (Böcker and Meelen 2017). In Norway, for example, recent studies have found that reduced automobile ownership and environmental concerns, and the continuing need for a vehicle to go shopping and on weekend trips, are relevant to the emergence of car sharing as a social practice (Julsrud and Farstad 2020; Julsrud, Farstad, and George 2020; Svennevik 2019). Following up on these recent car-sharing studies, and seeking to respond to the call for a deeper understanding of practices in transition studies, this article applies a practice theoretical understanding and data from interviews to investigate what happens when the practice of car sharing is reproduced.

We then discuss how this relates to system change in transition studies.

The next section reviews literature on SPTs and how they have been used within transition studies, indicating the theoretical insights for our empirical study. The next section presents the context of car sharing in Oslo, the procedures for our data collection, the methodology used to conduct household interviews, and the data-analysis process. We then describe our findings and discuss three different ways of doing car sharing. The conclusion summarizes the findings and offers some points on implications for policy, practitioners, and further research.

Literature review

Social practice theories

Theories of social practice conceptualize the practices performed by users and enable, for instance, the repetitive procedure of car sharing to be made the unit of analysis. SPTs see the procedures for enacting an action as a practice: a commonly shared and routinized way of performing something (Reckwitz 2002; Shove and Walker 2010; Watson 2012). SPTs are cultural theories, where the societal aspect is practice (Reckwitz 2002). Furthermore, social structures and technologies do not exist outside or above individuals, but are reproduced through routines enacted by “carriers” or “practitioners” of social practices (Reckwitz 2002; Shove, Pantzar, and Watson 2012; Strengers and Maller 2014, 3). We can understand and analyze a given practice by examining performances in the actual context involved.

The distinction between practice-as-performance and practice-as-entity originates from Schatzki (1996) and has proven useful in empirical studies (Maller 2015; Speck and Hasselkuss 2015). Practice-as-performance is the actual “doing” and constitutes observable actions. This draws attention to micro-level production and reproduction of the “doings” of daily life and refers to specific moments of integration between elements that occur when practices are enacted in particular local situations at certain times. By contrast, practices-as-entities reveal that rather than being the result of individual choice, actions are social. The entities are recognizable, understandable, and describable by the elements that comprise the conditions of existence of a practice. The entity can identify a range of relatively stable elements that configure at the macro-level as blocks and patterns of action (Higginson et al. 2015; McMeekin and Southerton 2012; Spurling et al. 2013; Strengers and Maller 2014).

The “elemental” approach takes into account that, at the moment of “doing,” practitioners (the doers) simultaneously reproduce practices in which they are engaged and elements of which these practices are made. Shove, Pantzar, and Watson (2012, 22) suggest it is possible to describe and analyze change and stability by paying attention to the trajectories of elements and to the making and breaking of links between them. They propose a scheme of the coevolution of the three elements: material, competence, and meaning. The elements may exist separately, not yet as a practice, but a “proto-practice.” If they are connected and coevolve by links being made, a practice is established. Later, the elements may lose the connection, dissolving the practice and becoming an ex-practice (Schatzki 2011; Shove, Pantzar, and Watson 2012).

The process of developing these fairly short and precise descriptions of the elements includes a simplification and merging of several earlier concepts and discussions (Gram-Hanssen, 2010; Reckwitz 2002; Schatzki 1996; Warde 2005). First, “meaning” includes symbolic meanings, ideas, and aspirations (Shove, Pantzar, and Watson 2012). Meaning is based on past, present, and future because what people do has a history and a setting (Schatzki 1996, 2002). Reckwitz (2002) describes meaning as a collective term for mental activities, emotions, and motivational knowledge. Second, “competence” includes skill, know-how, and technique (Shove, Pantzar, and Watson 2012). Finally, “material” includes things, technologies, tangible physical entities, and the stuff of which objects are made. Despite some earlier dismissal of the role of things in practices (Bourdieu 1984; Giddens 1984), and later acceptance on how objects are related to practices (Reckwitz 2002; Schatzki 2002), things are now commonly treated as elements of practice (Røpke 2009; Shove, Pantzar, and Watson 2012).

Social practice theories and transition studies

Several scholars have called for combining SPTs with other conceptual perspectives and this integration has in particular been pursued by researchers working in the field of sustainable consumption (Spaargaren 2003; Spaargaren, Martens, and Beckers 2006; Warde 2005). Recent research along these lines suggests viewing SPTs as a heuristic tool (Frezza et al. 2019; Gram-Hanssen 2011; Lamers, van der Duim, and Spaargaren 2017; Perera, Auger, and Klein 2018). This has led to fruitful discussions on the usefulness of applying SPTs with other fields of research (Kennedy, Cohen, and Krogman 2015; Welch and Southerton 2019). For example, also management scholars have noted opportunities for

using SPTs (La Rocca, Hoholm, and Mørk 2017; Nicolini 2012). By this, they mean that combinations with SPTs can prove useful because of how these approaches direct our attention toward actions: why we do what we do and how we do it.

One study of the connections between sustainable consumption research and transition studies called for using practice theories because practice-based approaches reveal processes of reproduction and change in forms of consumption that can offer conceptual insights into sustainability transitions (McMeekin and Southerton 2012). Recent studies have indicated that to develop a practice theoretical understanding of sustainability transitions more empirical studies are needed to address the recursive relationship between collective agency and the everyday performances of practices that produce patterns of consumption (Welch and Yates 2018).

Using a “systems-of-practice approach” Watson (2012) identified three mechanisms involved when a practice changes: how the elements change, how the people change, and how elements and people relate to changes in other practices. His study indicated that system change in transitions could be explained from a practice-based perspective.

Recently, additional calls have come for applying practice theories in transitions studies (Boyer 2016; Dijk et al. 2019; Greene 2018; Köhler et al. 2017; McMeekin and Southerton 2012; Ockwell et al. 2018; Seyfang and Gilbert-Squires 2019). Given such emerging concepts as the “sharing economy,” new understandings of consumption dynamics within wider systems are needed. In addition, SPTs may contribute to transition studies by deepening our understanding of the key social mechanisms and dynamics underpinning transitions in everyday life, and of the role of agency and collective action in processes of social change (Köhler et al. 2017).

The MLP proposes that transitions occur through a dynamic process with interactions involving the three levels of niches, regime, and landscape (Geels et al. 2011; Geels 2012). Niches are the locus for radical innovations, regimes are the locus of established practices and associated rules that stabilize existing systems, and the landscape is the wider context which influences niche and regime dynamics (Geels et al. 2011; Rip and Kemp 1998).

A personal urban-mobility system may, for example, involve a dominant regime of privately owned cars, niches of car-sharing services, and a landscape of climate crises. In this context, “transition” is generally understood as a change from one regime and its dominant practices to a new regime with new rules and new combinations of dominant practices. This process can come about through niches that build up and destabilize the

regime and landscape levels and put pressure on the regime (Geels et al. 2015).

Despite calls from the field of transitions research, proposals for using practice theories in transitions studies have encountered skepticism, even rejection from some quarters (Shove and Walker 2007, 2010, 2014; Watson and Southerton 2015). The different ontologies, combined with the fact that SPTs are seen by some scholars as theories rather than perspectives or lenses, underpin these attitudes. Both the MLP and SPTs are relational approaches applicable to studying socio-technical acceptance and diffusion (Sovacool and Hess 2017), but differ in how they view practices. SPTs adopt a flat ontology in which practices are the primary unit of analysis while the MLP sees practices more with graded levels of structuration, causing a discussion on incompatibilities due to alleged hierarchical views (Geels et al. 2011, 37).

Geels et al. (2011, 37) propose paying less attention to this vertical nested hierarchical view and focusing instead on how the distinction between the levels of the MLP refers only to degrees of structuration and stability. Thus, in connecting MLP-level concepts with practice theories, stable/routinized practices can be seen as “regimes,” whereas emerging fluid practices can be seen as “niches.” Similarly, it has been argued that SPTs also recognize different degrees of stability within practices (Smith, Voß, and Grin 2010). An empirical study of collaborative consumption for housing indicated two areas where MLP insights might complement SPTs in understanding practice evolutions, niche ripening, and regime resistance, shedding light on the systemic processes that affect practice configurations (Huber 2017).

In their contribution on the integration of the MLP and SPTs, Hargreaves, Longhurst, and Seyfang (2013) argue that both frameworks are “middle-range” approaches that refuse to give predominance to either structure or agency in socio-technical change processes, but instead focus on the dynamics of “structuration” that drive both system stability and change. They argue for integration because, although the MLP offers a useful framework for understanding sustainability transitions in particular systems and regimes, it needs to be extended further to account for activities that cut across existing regimes and systems. In particular, this holds for activities that engage more directly with people’s everyday life practices and concentrate on normality as much as on novelty. Shove, Pantzar, and Watson (2012) argue similarly, that the MLP is valuable for understanding novelty and how new innovations within niches break through to form dynamically stable regimes, but they say less about the dynamics

of normality. The dominant focus in the MLP on innovation and transition in specific regimes forces attention to the new and the novel, thereby overlooking the wider systems that hold things in place and maintain normality (Shove 2003).

A recent study using SPTs and MLP acknowledges differences, but proposes that parallels exist between the stability of regimes and practices, and possible disruption by niches and proto-practices (Seyfang and Gilbert-Squires 2019). The present study builds on the view that parallels exist between stability of regimes and stability of practices. These common points of reference concern how regimes and practices are seen as stable and supported by existing rules, regulations, and institutions while simultaneously drawing attention to how innovation and change need to deal with such stable elements. The stability and reproduction of practices results from the repeated integration of elements, and innovation in practices derives from the making and breaking of links between them (Pantzar and Shove 2010).

Whereas Hargreaves, Longhurst, and Seyfang (2013) and Seyfang and Gilbert-Squires (2019) focus on using an SPT approach and the MLP to reveal critical points or constraints blocking transitions in regimes and practices, we examine the conditions under which a practice is reproduced. We apply a practice-informed methodology to analyze the reproduction of a practice, and then discuss how this relates to how the MLP considers the role of establishing new practices in a transition from one regime to another.

By applying both of these approaches, our analysis allows for a study of the role of car-sharing practices in the transition of a mobility *system* instead of a transportation *sector*. Such a transition to a sustainable mobility system goes beyond a solely sectoral change in transport, and further than technological substitutions such as electric vehicles (EVs). New emerging mobility alternatives connect to other practices. The objective of transportation is not the trip per se, it is more about the destination of the trip or the goods transported. Thus, by examining households’ practices and involving more of these related aspects, this article aims to contribute to the study of *system* change rather than *sectoral* change.

Changes in consumption and production are central both in sustainability transition studies and in SPTs. A general (mis)understanding is that transitions studies focus on production and practice theories on consumption (Köhler et al. 2017). With this article, we show that both approaches take in both aspects. While sustainability transitions refer to how socio-technical *systems* shift to more sustainable

modes of production and consumption (Markard, Raven, and Truffer 2012), practice theories understand changes in *practices* as interactions between modes of provision and modes of access. These interactions are due to how social practices form historically shaped, concrete interaction points between, on one hand, modes of access, with actors and their lifestyles and routines, and on the other hand, modes of provision, with infrastructures of rules and resources, including norms and values (Verbeek and Mommaas 2008). Building on this insight, we explain how the modes of provision that constitute providers' contexts and the modes of access that comprise user contexts, are part of the practices. With these two distinctions, our analysis goes beyond the simplification of the focus on consumption-for-practice theories and production-for-transition studies, and instead elaborates on the interaction between providers and users to explain the role of practices for system change. Our analysis shows how the distinctiveness of provider and user contexts can be useful for how practice theories can contribute to transition studies.

The research question guiding this study is as follows: under which conditions are car-sharing practices reproduced, and what are the implications of this reproduction for a transition to sustainable mobility? Our study applies a social practice approach to study this phenomenon, investigating the parallels between system change and reproduction of practices. In this way, we seek to contribute to understanding of how SPTs can be applied to help explain system change.

Methods

Our data are drawn from interviews with members of the three car-sharing services *Bilkollektivet*, *Hertz Bilpool*, and *Nabobil*, respectively categorized as a business-to-consumer (B2C) cooperative, B2C corporate provider, and peer-to-peer provider (P2P). We conducted semi-structured interviews with 39 households that are registered members of these car-sharing services in the urban area of Oslo. Households were couples or singles, with and without children. We conducted the interviews in the homes of the respondents during three periods: May–July 2017, October–November 2017, and January–March 2018. The [Appendix](#) provides an overview of the interviews, categorized by the number of the households #1–39, with information on location and type of service.¹ We use this numbering scheme throughout this article, and the quotes are marked with *Respondent 1 and 2* when they involve more than one respondent in the household.

The three car-sharing services differ in their business models. First, *Bilkollektivet* is a B2C cooperative with a car fleet available for users. Second, *Hertz Bilpool* is also B2C car-sharing service but it is a corporate company rather than a cooperative, with a car fleet available for its users. Finally *Nabobil* does not have a car fleet but rather is a P2P service organized as an online platform that provides car sharing between people. As of September 2019, *Bilkollektivet* had a fleet of 400 cars and *Hertz Bilpool* had approximately 150 cars in Oslo. *Nabobil* reported over 5500 available cars throughout all counties in Norway (for more on the context of car sharing in Oslo see, for example, Uteng, Julsrud, and George 2019, 190–192).

Based on a pilot study (George 2017), we developed two guides for semi-structured interviews: for users and non-users. The guides included an outline of topics and questions about life situation, daily travels, leisure travels, car-sharing use, motivation and implications (Kvale 2007). We used an audiorecorder and conducted the interviews in the participants' homes. They showed us around the buildings, giving information about the neighborhood, such as the distance to car sharing, parking, bus station, schools, grocery store, and so forth. Conducting the interviews in the homes enabled us to acquire understanding of arrangements such as parking, gardens, common areas, elevators, and playgrounds.

Interviews can provide data suitable for analyzing practices, as respondents may talk about their practices, often in quite revealing ways in terms of actions they otherwise take for granted (Hitchings 2012). Interviews with households are particularly useful for studying mobility practices because people are often able to explain in detail how the use of the services occurs and how infrastructure and technology are involved. In addition, they can reflect on their emotions and skills around the use. Conducting the interviews at their own homes typically encourages them to mention issues that they regard as usual and mostly irrelevant parts of their daily life. This occurs because respondents are closer to the venue of actual performance and this proximity enables inclusion of the materiality and daily life being part of the practice.

Despite these advantages, this means of data collection also has limitations. Because we conducted the interviews in the homes of our respondents we did not actually observe the use of car sharing. In addition, restrictions concerning privacy issues and limited permission for data collection ruled out participant observation. The data collection – including the recorded audios, transcribed interviews, field notes and memos – was facilitated by using NVivo, a software program for managing and analyzing

qualitative materials. During both the phases of data collection and analysis, we wrote memos to organize the coding and preliminary findings (Miles, Huberman, and Saldana 2013).

We followed an iterative analytical process, guided by SPTs and allowing for further discoveries in the data along the way. We started by coding all of the interviews and organizing the findings of practice elements, coevolution between elements, and relationships to other practices. We then analyzed the reproduction of the practice by searching for and identifying patterns of what was involved when the practice reoccurred in these households. During this process, we developed insights into how the performance of the practice varied and did additional coding based on these findings, ultimately discovering three ways of doing car sharing and mapping out interactions between provider and user contexts.

Results

This section highlights how car sharing is reproduced in Oslo. First, we demonstrate the observable doing of car sharing in the city and discuss how this relates to the reproduction of the practice. We discuss three different ways of doing car sharing and then explain the practice-as-entity by giving an overview of how elements coevolve. Second, we show how modes of access and provision affect repetition. Finally, we describe how car-sharing practice relates to other mobility practices as well as household social practices more generally.

Three ways of doing car sharing

Practice-as-performance is the observable action that happens when practices are enacted in specific situations at certain times. Ways of doing practices are often questioned by newcomers who experiment, adapt, and improvise around accepted ways of doing things (McMeekin and Southerton 2012). In describing different ways of performing car sharing, we highlight how the practice is enacted differently in certain space and time surroundings. In the words of Alan Warde (2005, 140), “performances in the same practice are not always the same.” We distinguish three particular performances of the practice that we term FUSS (Frequent, Unplanned, Short-term, Small-car use), POLL (Planned, Occasional, Longer-term, Larger-car use), and PERC (Purpose Elected from Range of Cars use). These performances are essential for understanding the conditions under which the practices are reproduced.

First, FUSS characterizes household use of smaller cars, often for quick errands. The

coevolution here concerns mainly the meaning of predictable, fast, and easy access; the skills of rapid booking and picking up; and the materialistic element of a close vehicle-hub with smaller cars constantly available. One respondent referred to how using car sharing spontaneously involves feelings of freedom when she said, “It gives a feeling of freedom, just driving – but that can be done in other people’s cars, too (# 15).

In addition, they have acquired the wherewithal for using a specific type of car and recognizing cars of similar models. Predictable parking affects the performance and it is part of the frequent use that the vehicles have their own specific parking lot. As a respondent explained, “It’s good to know that when I use the car cooperative, there’s a parking lot when I come back; really nothing I need to worry about. Just drop off the car and go home” (# 08)

Time calculations are particularly important here, especially for families with young children. The time spent using car sharing versus public transportation is carefully evaluated, and car sharing is used to save travel time for certain errands and activities. Access distance is relevant for this performance, as the vehicles must be reachable within short walking distance. Thus, both the location of housing and the location of the cars play a crucial role.

Second, POLL involves bigger, specially equipped cars for scheduled trips and certain leisure activities. The coevolution here involves the material of safe, high-quality cars, the meanings of security, and the functionality of well-outfitted vehicles relative to cost. In addition, experience with cost- and time-planning, which includes calculating total costs with fuel and kilometer prices and comparing with, for example, train tickets, brings this performance together. Car sharing is included when planning activities as occurs when, say, organizing a weekend trip.

Typically, we drive to our cabin on Friday evening and return Sunday evening. We’ll be going back and forth for a weekend, so we rent until Monday. On the way from work, I pick up a car, drive home, we pack it, have something to eat, and leave. On Sunday, we get back at 10pm. I remove the children’s seats and take them inside, and then return the car (# 32).

This performance relates to other practices of the households, such as the use of cabins, family traditions, holidays, and seasonal activities.² Respondents usually reserved a car as they would book a trip, especially for peak seasons such as Easter or Christmas. Cabin trips involved car sharing, as illustrated by these two accounts:

If we are going on weekend trips or have booked a cabin, we use the car collective. Because of the remote location, the car collective is the only option to get to the cabins (# 29).

The last time we were at the cabin, we rented a car through the car collective here. It was a big station wagon (# 37).

In other words, this particular use can be challenged by other alternative trips such as flying abroad or traveling to destinations accessible by train. Thus, this reproduction of the car-sharing practice closely relates to other practices and car sharing is used to accomplish a planned trip.

Finally, PERC concerns car sharing with several types of specific vehicles for certain commitments. Important here is that the performance of the car-sharing practice exists and is reproduced precisely by involving diverse use of a selection of models, compared to private ownership and dependence on one particular vehicle. These respondents used car sharing both for transporting goods and to reach distant areas and the objectives were succinctly summed up by one respondent who told us, “It is either to pick up or bring something that is too big to take with me easily on the subway or bus. Or, it involves traveling to a place that’s difficult to reach by public transport” (# 26). Others explained how they from time to time needed different kinds of vehicles. They preferred car sharing to owning because they could opt for a vehicle that corresponded to a specific purpose and were able to avail themselves to different cars at different times. If they had to own one particular vehicle, they could not find one single model that would be suitable. As explained by one household member,

If you buy a car, then you have that one car, for all kinds of purposes. In principle, it must work for

everything. While here [with car sharing] we have it all, and I enjoy having the freedom of choice when I need a small car or a large one (# 21).

Awareness that car sharing can be used for different types of errands links the practices together and affects reproduction. This performance of car sharing is recurring under circumstances in which car-sharing services provide a diverse selection of different kinds of vehicles. The members of one household noted,

Respondent 1: We don’t always need a big car or a small one. Once we had to pick up a cabinet, so we took a van ... If we have a lot of stuff with us, we can take a station wagon, and if not, we can opt for a small car.

Respondent 2: If we go on a day trip, to an art exhibition, say, we’ll take a tiny car. If we go on Easter holidays then we take a ...

Respondent 1: ...a station wagon. Not having to own, that is very good (# 16).

This implies that this type of reproduction is the most diverse, and concerns both bringing things and traveling to places. It involves both spontaneous and planned trips, and thus spans the two other practices by involving a wide range of cars and trips.

Analyzing a practice-as-entity makes it possible to unveil what the practice consists of by identifying elements and how they relate to each other. Table 1 identifies the various elements that configure blocks and patterns in the three ways of doing car sharing. Shove, Pantzar, and Watson (2012) propose that

Table 1. Coevolution of elements.

Material	Meaning	Competence
FUSS Small car Electric vehicles (EV) Closeness Immediate parking Housing location	Short distance Easy access Predictable Fast and available Freedom Spontaneity is important Environmental concerns, do not want to own car Faster to use car sharing sometimes instead of public transport	Booking experience Efficient reservation and pick-up routines Knowledge on location and availability of cars General knowledge on approximate costs and time use from previous use, detailed time and cost calculations are not necessary
POLL Large cars Special equipment SUV, station wagon, not EV	Longer distances Safety Comfort Predictability Planned, non-impulsive use Price concerns, value high-quality car	Cost calculations Alternative travels Have previous experience with using this type of car, also know-how on family planning for whole trip including reserving car and picking up
PERC Variety of cars Ranging from small EV to large SUV and moving vans	The variety is valued Need or want to use different types of cars for different occasions Cost or environmental concerns	Calculations of price, time, and what can be transported Have learned how to use different cars Skills with price planning and experience with purpose-selected cars

elements already exist separately from the practice, becoming a practice when they are interlinked. Our findings support this view of elements as existing pre-practice: we note how pre-existing elements come together in the three ways of reproducing the practice of car sharing. The table shows that the elements are connected to the three ways of doing car sharing—FUSS, POLL and PERC. We acknowledge that they are interlinked, but distinguish these three separate categories to emphasize how each of the practices differs in its reproduction.

Modes of provision and access affecting repetition

In addition to demonstrating three ways of doing car sharing, our analysis indicates how modes of access and provision are part of the reproduction of car-sharing practices. Synthesizing the provider and user contexts, we can see that the practice of car-sharing concerns already existing elements that are tied together in a new way (especially in comparison to, say, owning a car). This shows how car-sharing practices are different from car-owning practices because certain aspects of car use are distributed differently and shifted from the user context to the provider context. As a respondent explained, “I don’t want to have to take care of car maintenance. With a cooperative, someone else takes care of the cars, so you do not have to. You feel in a way that you have a car without having it” (# 26).

To illustrate this, we present how user and provider contexts interrelate (see Figure 1). The circles illustrate the different aspects that are involved, and are placed on two sides to show how it belongs to the provider or user context. The circles are situated inside a larger circle, exemplifying the drifting interrelations inside the practice and demonstrating that

these move around and in aggregate constitute the practice.

The following section first elaborates on how from the perspective of the provider the practice is about maintenance, insurance, and customer service. Attention subsequently turns to the vantage point of the users, where the practice is more about cost calculations, quality valuations, and saving efforts.

The providers’ contexts vary on the basis of how they offer cars through services rather than ownership in accordance with various business models. On one hand, we find differences in the use of B2C cooperative and B2C corporate regarding the forms of ownership and membership. Some members of the B2C cooperative regard themselves as co-owners of several different cars, as noted in this statement.

What I think I have boasted the most about, when people at work ask, “Don’t you have your own car?” Then I say that I have hundreds. They are customized to our needs for particular days, are of a certain size, and are exactly what we need (# 08).

For these users, the co-owning aspect ties the practice together and is essential when reproducing the practice. Some respondents said that they were even willing to pay more because of their role as co-owners and their wish to support this nonprofit cooperative.

On the other hand, we note three similarities in the use of P2P, B2C cooperative, and B2C corporate. First, the providers offer insurance and this plays a role in reproducing the practice. Insurance creates understandings of security and predictability and is seen as uncomplicated and affordable for some of the car-sharing users. Second, the change of repair responsibilities from car owner to car-sharing provider effects reproduction. The car-sharing companies are responsible for maintenance. Households

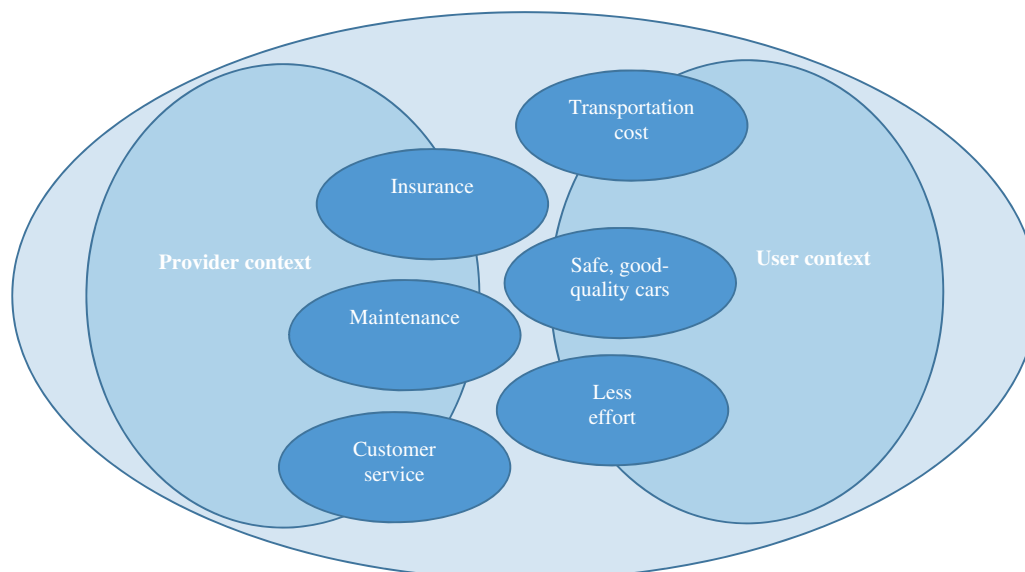


Figure 1. User and provider contexts are part of the practice.

can use a car, without having the competence, capacity, or capital to keep up with the maintenance. As stated by this respondent, “I trust the cooperative to take care of the cars. I feel that I’ve got technical backing, mechanics and such when needed. No need to think about maintenance, changing tires, and all that” (# 08). Finally, the providers’ booking services, keyless technologies, and customer service affect the reproduction. Users can communicate with the providers and get help with problems such as unlocking the cars, notifying about dents and lack of fuel, and getting technical support.

Turning now to the user contexts, we discuss how cost, quality, and ease are involved in the reproduction of the practice. First, price perceptions and cost planning for using car sharing emerge as important in tying the elements together and repeating the practice. The cost aspect is always involved, but cost perceptions vary from household to household. Some include car sharing in the family budget as transportation or holiday costs; others do not calculate the specific cost but rather are of the mind that car sharing is cheaper than ownership. They highlight that the costs are predictable because they do not have to pay for unexpected repairs or maintenance as they would with car ownership. Some make plans for their car-sharing expenses, setting aside a certain amount each month, as in this household.

We have a budget of 40,000 to 50,000 NOK [US\$4,200 to US\$5,300] each year for car use. It is still cheaper than owning. We pay a fixed amount to an account we have for car use; we both pay 1,500 NOK each month. We drive a lot during Easter, and for several cabin trips, and we rent over a longer period in the summer (# 09).

Second, some respondents emphasized the importance of the value of using car sharing because of the type of car they get for the price. In particular, families with small children said that if they had to own their own vehicle, they could never afford a car of such high quality. They did not want to use an older, unsafe car when driving the children, so they used car sharing to get access to newer cars.

The cars are always new and the fact that you know that when you drive long distances with two children, makes me feel safe. You have a safe car with winter tires that have been installed by professionals. I think that’s the great thing about the car collective. They have proper cars, and if anything is wrong, it is fixed straight away (# 13).

Finally, ease affects the reproduction, as an absence of maintenance obligations are part of the practice. This exchange describes how accessing instead of owning requires less effort from the household.

First respondent: Personally, I really like the idea of sharing instead of owning. It’s like so many other things. I don’t own CDs anymore, I have Spotify.

No ownership, but I have music anyway. I like *not* owning a car. I don’t have to worry about how much value is lost, or about maintenance

Second respondent: We don’t even have to wash the car or change the tires ...

First respondent: I can have a smooth-running new car whenever I need it (# 21)

They appreciate the time freed up by not having to deal with ownership and maintenance, thus distribution of responsibly is part of the practice.

Car-sharing practices and other practices in households

Other practices in the households related to car-sharing practices in mainly two ways: as parts of reducing daily driving and as car-dependent activities. On one hand, car-sharing practices related to reduced use of cars for daily trips. Some users lived within walking distance of schools and workplaces, whereas others relied on public transportation or bicycles. In addition, the increased use of the Internet and home-delivery services reduced the need for daily car use:

First respondent: Things have become so much easier. We can arrange everything online, to free up time ...

Second respondent ...using services. We buy services; we buy housekeeping, grocery deliveries, and other home-delivery services. (#21)

On the other hand, car sharing involved the continued use of cars for certain trips. Other practices where the households needed a vehicle, such as cabin trips, sports activities, family visits, and celebrations affected the use of car sharing. Some used car sharing for shopping or for regular activities, such as weekly winter ski practice. They planned the activity and booked a car for a certain period, such as explained by a respondent who told us, “Our daughter went to a ski school in the winter, which was the only longer trips we did. Then we booked a car for five weekends in a row, so that we had a car for going on longer trips like that” (# 13). This implies that other practices are relevant to how car-sharing practices are reproduced. Practices requiring occasional car use support the normalization of the use and play a part when car-sharing practice goes from novelty to normality.

Discussion

The theoretical framework from SPTs applied in this analysis has provided a way to explain the

reproduction of car-sharing practices. The framework looks at how performances are not always unvarying for the same practice. This is useful in responding to the call for attention to practices in studies of system change in transitions to sustainable mobility. The insight is also instructive for highlighting how a novelty such as a niche for a new practice can be reproduced and therefore normalized, becoming part of a new mobility regime. The analysis thus relates to the discussion in SPTs about what practices are *for* and to transition studies of how a niche practice becomes a regime practice.

These issues relate to the three distinct “circuits of reproduction” through which practices are maintained and stabilized (Hargreaves, Longhurst, and Seyfang 2013, 406; Pantzar and Shove 2010, 458). The three ways to stabilize a practice are through *combinations of complementary* practices, *certain connections* between particular elements, and *content in current* practices coming from previous practices and later serving as a foundation for future practices.

First, car-sharing practices are stabilized through *combinations of complementary* practices. The analysis contributes in the SPT discussion on what a practice is used *for*, and thus how it unfolds and normalizes (Hui, Schatzki, and Shove 2016; Shove and Walker 2014). The investigation outlined above has shown that the reproduction of the practice of car sharing relates to the continuity of other practices such as leisure-time activities, weekends at cabins in the mountains, or out-of-town celebrations with family and friends. Practice theories hold that repetition of practices is interlinked with other practices, and our study has found support for this view. This implies that other practices support the use of private cars, and continued *car* use, instead of, for example, public transport. When car-sharing services are available, households can continue their car-dependent practices without owning cars.

This particular feature of the service can play a role in a transition to sustainable mobility if the aim is to change the regime of private car ownership and to reduce the use of private cars in cities. For households, car-sharing practices are reproduced because other practices that require cars are reproduced. For example, transport to skiing activities requires car use. We found that skiing practices were stable, and thus supported the need for occasional and special purpose car use. If the objective is to reduce car ownership in cities, perhaps one way to achieve this may involve being able to use public transportation or car sharing to get to skiing destinations.

This observation relates to how car sharing plays a role in the transition of the mobility *system* rather

than being limited to a transport *sector* transition. Our study offers input to debates on the role of practices in sustainability transitions by showing that neighboring practices contribute to reproduction. Whether a practice is reproduced relates to what the practice is *for*, the practice of car sharing does not exist in a vacuum, but unfolds in user and provider contexts that shape the practice and interlink the elements.

Second, car-sharing practices are stabilized through *certain connections* between particular elements. Car sharing involves meanings of occasional instead of daily car use, and this is strongly linked with the material aspect of platform technologies for accessing cars. As mentioned, we found that some connected stable practices create a demand for occasional car use. At the same time, increased biking and public transportation options affect the need for daily car use. In addition, new regulations for limited parking and norms about less driving and environmental concerns, serve to reduce daily car use. In stabilizing the car-sharing practice, we found new connections between meaning elements of environmental concern with respect to using cars and skills elements of booking cars for trips. The structure, culture, and practices in the established regime of daily use of privately owned cars are changing. There is not yet a fundamental shift from one dominant regime to its successor, but we see that car sharing has a role in changing the dominance of privately owned, daily car use. This might be part of a step toward a new regime with a new mix of, for example, connected, autonomous, shared, and electric vehicles. There is not yet a “new” regime. Car sharing has not replaced car ownership—but car sharing is playing a role in changing the established regime and is being stabilized through connections between elements. The stabilization of car sharing with new links between particular elements is part of reconfiguring the existing culture, market, and user preferences, policies, and technologies in the current regime.

On the contrary, we find that car sharing is part of maintaining the established mobility system with its dominance of private use of cars. From the standpoint of the broader debate around platform services and their sustainability implications this research using SPTs and MLP contributes to supporting the view that car sharing maintains and serves to perpetuate private car use. Car sharing, nonetheless, still involves cars used in private settings, as opposed to carpooling, public transportation, or bicycling. Car-demanding activities are solved with car-sharing; private car use is still required, supporting a continuation of a car-demanding mobility system. Using shared cars

instead of car owning is more about a shift from owning to accessing; the rise of car-sharing services is linked with the stable practices that require personal car use. Thus, the study supports a cautious view on how car sharing contributes to environmental sustainability. Easier, cheaper, and faster access might also mean increased use of cars.

Third, car-sharing practices are stabilized through *content in current* practices coming from previous practices. The analysis contributes to the discussion of the normalization of new practices in transitions. We show how different ways of doing car sharing are relevant for understanding how new practices emerge. By highlighting the three different doings of car-sharing practices – FUSS, POLL and PERC – we show how these practices can support the understandings of how niche practices can contribute to a transition by playing a role in a new regime. As a new niche practice, car sharing becomes part of the regime because it represents a continuation of private car use. Car sharing is not a new dominant regime practice, but it plays a role in the transition of the mobility system. Car-sharing practices address the need for occasional, rather than daily, use of private cars—changing the role of private car use.

Finally, our analysis has also drawn parallels between MLP and SPTs by demonstrating how practice as performance, and contexts of providers and users, can help us to understand the process of moving from niche to regime practice. By showing empirically what is involved when a practice is reproduced, we shed light on how a practice evolves from novelty to normality. We find that the stabilization of these new practices relates to changes in the consumption as well as the production side.

Conclusion

This study has investigated the conditions under which car-sharing practices are reproduced and the implications for studying system change in the transition to sustainable mobility through qualitative research involving members of car-sharing services in Oslo. We distinguished three specific performances of the practice: FUSS (Frequent, Unplanned, Short term and Small-car use); POLL (Planned, Occasional, Longer-term and Larger-car use); and PERC (Purpose Elected from a Range of Cars) and showed how reproduction of the practice relates to how the practice is performed. The article explained the mechanisms affecting repetition of the coevolution of elements and showed how practices exist in the interactions between modes of access and modes of provision. We further demonstrated how car sharing relates to other mobility practices and household practices more generally.

Our empirical findings indicated that maintenance, insurance, and financing the cars are essential parts of the practice, going from the user context in car owning to the provider context in car sharing. Households have price perceptions favoring car sharing, prioritizing the extra time they spend on car sharing rather than car ownership, and planning travels and activities involving the use of car sharing. All of these factors support reproduction of the practice. We showed how practices that reduce the need for daily car use – such as online shopping, public transportation, and bicycles – affect the use of car sharing by reducing the need to own a car for daily use, instead creating a new demand for using cars occasionally. Further, we argued that stable and occasional practices such as certain shopping and sports activities, as well as cabin trips, affect the repetitive use of car sharing because of the continued need to be able to use cars in private settings. We also discussed how platform-enabled sharing economies do not always have outcomes favorable to sustainability: shifting to access instead of owning, and maintaining car-dependent activities, can in one scenario lead to more use of cars.

For policy makers and practitioners such as the operators of car-sharing services, our research offers insights on the factors that are important for the normalization of car sharing. A part of this is the concern of how car sharing is a kind of continuation of private car use, and this has implications for how policy makers should be involved in supporting car sharing. Specific regulations for car sharing such as subsidies for dedicated parking can be part of both the FUSS, POLL, and PERC use. Easy access to parking can, for instance, support FUSS spontaneous use, where cars can be chosen for shorter trips instead of bicycles or public transport. Another indirect way of supporting a shift from car-owning to car-sharing can be through promoting alternatives that reduce the need for daily car use, which we have shown contributes to the reproduction of car sharing because of the increased requests for occasional car use. By revealing the three different ways of doing car sharing, we offer insights of what types of cars are used and in what settings and these insights are likely to be relevant for provision of shared services. This article highlights that some associated practices such as trips to cabins or skiing destinations are important and may deserve further attention as part of efforts to expand car sharing. By shedding light on the user and provider contexts in the practice, we demonstrate the central importance of, in particular, maintenance responsibilities.

The limitations of this study mainly concern the data from household interviews with members of car-sharing services, and the focus on only the user

side and normalization process. Nonmembers and providers were not included, as we focused on user practices. Nevertheless, through the analytical process we acknowledge that although the present data is useful for studying the practices of car sharing, additional data from providers and policy makers could be useful for contributing to understanding of system change. We did not actively consider what hinders or breaks up the practice and paid limited attention to other aspects of system change such as new regulations and other mobility services. In addition, the use of the B2C cooperative option was more common among our respondents than the use of the P2P alternative. Accordingly, these newer services were not as widely represented in the resultant fieldwork. For a better understanding of the transition from one mobility regime to another further research could investigate these dimensions as well as how car sharing disrupts established mobility practices. Finally, we recommend more detailed consideration of the tensions between the flat and hierarchal ontologies of SPTs and the MLP.

Notes

1. Interviews were conducted as part of the data collection in the research project TEMPEST (see section on Funding for details) and have been used in other studies of car sharing (Julsrud and Farstad 2020; Julsrud, Farstad, and George 2020; Svennevik 2019).
2. Access to cabins and the role that these second homes play in Norwegian culture is relevant for these trips. The significance of the destinations as part of Norwegian lifestyles is central, as mountain and shore-side cabins represent a common leisure form for a significant proportion of the Norwegian population (Berker and Gansmo 2010; Garvey 2008; Kaltenborn and Clout 1998).

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Appendix: Data collection

Interview number and location	Type of car-sharing service
# 01 Etterstad	B2C Cooperative
# 02 Carl Berner	P2P
# 03 Bøler	P2P
# 04 Smedstad	B2C Corporate
# 05 Torshov	B2C Corporate
# 06 Barcode	B2C Corporate
# 07 Vika	B2C Cooperative
# 08 Storo	B2C Cooperative
# 09 Sinsen	B2C Cooperative
# 10 Manglerud	P2P
# 11 Veitvet	P2P
# 12 Pilestredet	P2P
# 13 Keyserløkka	B2C Cooperative
# 14 Ulven	B2C Corporate
# 15 Ekeberg	B2C Cooperative
# 16 Tøyen	B2C Cooperative
# 17 Fornebu	B2C Corporate
# 18 Nesodden	P2P
# 19 Grünerløkka, lower	P2P
# 20 Bygdøy Allé	B2C Cooperative
# 21 Rosenhoff	B2C Corporate
# 22 Sagene	B2C Cooperative
# 23 Schouterrassen	B2C Cooperative
# 24 Høybråten	P2P
# 25 Tøyen, nr prison	B2C Cooperative
# 26 Ensjø	B2C Cooperative
# 27 Sinsen west	B2C Cooperative
# 28 Årvoll	P2P
# 29 Vålerenga	B2C Cooperative
# 30 Bislett	B2C Cooperative
# 31 Torshovparken	B2C Corporate
# 32 Kampen	B2C Corporate
# 33 Adamstuen	B2C Corporate
# 34 Kvadraturen	B2C Corporate
# 35 St Hanshaugen	B2C Corporate
# 36 Bogstadveien	B2C Cooperative
# 37 Solli plass	B2C Cooperative
# 38 Hovseter	B2C Cooperative
# 39 Ruseløkka	B2C Cooperative

How do new mobility practices emerge? A comparative analysis of car-sharing in cities in Norway, Sweden and the Netherlands

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Abstract

The hegemony of the private car is increasingly challenged as new policies and technologies affect passenger mobility. This study investigates how car-sharing is emerging and unfolding amidst established urban mobility practices. We apply a conceptual framework with seven elements based on social practice theories and transition literature to deconstruct practices in order to reveal how such (relatively) new mobility practices emerge. Our comparative study uses qualitative methods with data from 58 household interviews and three half-day workshops with stakeholders in Oslo, Norway; Malmö, Sweden; and Rotterdam, the Netherlands. The research question asks how car-sharing practices unfold differently in different places. The results indicate how elements of mobility practices change from the situation *before* and *without* car-sharing to *after* and *with* car-sharing. The analysis reveals different changes in the three areas, with greater change in Malmö because of public procurement of car-sharing and less in Rotterdam, where there was interest in urban experiments directed at phasing out car use and supporting car-free city zones. The framework highlights that new digital technologies and regulations are important, influencing business models and the social meaning of mobility towards a broader acceptance of access-based transportation. For car-sharing to contribute to environmental sustainability, the three areas need to reduce the daily use of cars so car-sharing can become a viable option for occasional use of cars. Further, policies should combine Electric Vehicles (EVs) and car-sharing, e.g. in Oslo, the focus of promoting EVs should include shared EVs, and in Rotterdam, improved charging infrastructure would be effective.

Keywords

Social practice theories
Sustainable mobility
Sustainability transition studies
Car-sharing
Shared mobility

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The authors report no potential conflict of interest.

Declaration of interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

1 Introduction

Today's mobility systems are widely deemed environmentally unsustainable [1]. These mobility systems have the private car as the predominant mode of movement, leading to high fossil fuel consumption (with associated CO₂ and NO_x emissions), extensive land use for infrastructure, and the high production of vehicles. Various ways to improve the environmental sustainability of these systems have been proposed in previous decades. Technological substitutions, such as electric vehicles (EVs), have been envisaged to reduce vehicle emissions [2, 3]. Moreover, studies have highlighted the need for modal shifts in personal mobility, away from motorized forms of transport and towards public transportation or more active forms of transport [4, 5], such as biking and walking. Finally, other forms of car use and ownership have been proposed, most notably 'car-sharing,' to challenge the dominance of privately owned fossil fuel cars in cities, promising a reduction in kilometers driven.

This study is positioned within socio-technical perspectives on transitions, which conceptualize transport as a configuration that includes technology, policy, markets, consumer practices, infrastructure, cultural meaning, and scientific knowledge linked to various actor groups, such as firms and industries, policymakers, consumers, civil society, engineers, and researchers [6]. This perspective comes from an evolutionary system approach of innovation that does not prioritize social and technical elements but sees these as inexorably linked [7–11]. The concept of the *system of automobility* describes the continued, self-reinforcing dominance of privately owned, petroleum-powered vehicles used primarily by single occupants [12], resulting from path-dependent mobility patterns centered around the car [13].

The market for car-sharing has continued to grow steadily in North America and parts of Europe, with further expansion expected [14]. In Europe, traditional business-to-consumer (B2C) models, such as cooperatives and car-clubs, dominate car-sharing services. Recently, these solutions have been accompanied by peer-to-peer (P2P) business models, with people offering their private cars for rent on online platforms [15]. Shifts from product-to-service and integration of information technology into mobility, support the emergence of various forms of car-sharing, including car clubs with short-term membership-based rentals provided by not-for-profit organizations or for-profit firms [16]. New digital platforms offer opportunities for flexible shared transport, helping to overcome some barriers faced by many providers of public transport [17].

How car-sharing contributes to environmental sustainability depends on how it is used and how it is combined with or affects the use of other means of transport for personal urban mobility.

The potential for contributing to environmental sustainability through car-sharing lies mainly in the possibility of reducing the number of cars produced and the number of kilometers driven. A study from the Netherlands found that shared cars generally replace a second or third car and that kilometers driven were reduced by 15% to 20% as compared to before the commencement of car-sharing; further, there was 30% less car ownership among car-sharers [18]. However, the contribution to environmental sustainability involves other aspects as well, such as the growing presence of EVs offered by car-sharing services and how car-sharing affects the use of other modes of transport, such as cycling or public transport [19].

Several recent studies investigate the role of the user in the emergence of car-sharing, finding, for example, that outcomes associated with early adopters cannot be projected onto later adopters [20] and that different kinds of car-sharing services attract different user groups and are also used differently [21]. Other studies of the impacts of free-floating car-sharing on private-car ownership highlight that the early-stage impacts of car-sharing services may not be the same at later stages as the services mature and grow [22].

Recent empirical studies from Norway have investigated the influence of car-sharing on car ownership [23], travel patterns for new emerging car-sharing practices [24, 25], and the role of context and lifestyle on car-sharing [26], finding that car-sharing relate to other mobility practices. Other studies highlight how the current dominance of private-car ownership affects adoption patterns in car-sharing [27]; that motives for sharing may be environmental or economic [28]; and that well-designed car-sharing services can provide a sustainable, flexible mobility solution for urban residents [29].

Up until now, most of this type of research on car-sharing has examined its environmental impacts, focusing on the changes in vehicle ownership and vehicle kilometers traveled [30]. However, a focus on how car-sharing impacts and relates to other mobility modes is lacking. The limited research on this suggest that car-sharing members are more intermodal and multimodal in their travel behavior and cycle more [31], suggesting that car-sharing plays a role in changing mobility beyond just affecting vehicle possession or vehicle kilometers traveled. Car-sharing relates to changes in non-car modes as well [32]. Seeking to contribute to the attention on other modes of transport besides cars, this article investigates the types of changes in mobility that occur when car-sharing is introduced.

While earlier studies help to explain important aspects of the diffusion of car-sharing, less attention has been paid to how the emergence of car-sharing is different in different places because of how it interferes with particular local, established mobility practices. In order to fill this gap, we need to understand how urban mobility practices are reconfigured as car-sharing practices emerge. This article achieves this by deconstructing car-sharing practices and mapping changes that occur in various elements when new car-sharing practices emerge.

The study applies a practice and system change approach and joins research on the role of car-sharing practices on changes in the automobility system [33–35]. In line with our conceptual framework of social practices (see Section 2), we compare car-sharing practices in Oslo, Rotterdam, and Malmö by discussing and scoring the level of changes in elements.

This article is organized into six parts: introduction, conceptual framework, methods and data collection, analysis and results, discussion, and finally, a conclusion, which outlines implications.

2 Conceptual framing: Shared and actor-specific elements

This study draws on insights from social practice theories (SPTs) and transition studies. In this section, we define concepts, present research gaps, and explain the contribution made by this study and the analytical framework applied [36].

A widely used approach in SPTs is the three-element model of materials, meanings, and competencies [37]. This approach is increasingly applied in social science and energy research and has proven to be useful for policy because the studies move beyond behavior change [38–40]. In this study, we apply a conceptual framework in which practices are instead comprised of seven types of elements. This framework deviates from the existing three-element model by including shared elements and actors with actor-specific elements. We see practices as an entanglement of the performances of various actors, in the case of car-sharing: the use, the operation of the service, and the associated urban planning and regulation. Some elements are specific to these actors (i.e., knowledge and skills, financial capabilities, and values and feelings), while others are not and are instead seen as shared elements (i.e., infrastructures and artifacts, policy incentives, social norms and meanings, and business models), see Figure 1. These elaborations on the three-element model are useful for an analysis that goes beyond consumption and the user (as do most SPTs that are central to transitions studies) to include more of the supply and regulation aspect [36].

SPTs are a family of theories with some commonalities across a growing range of applications. The concept of practice comprises a ‘nexus of doings and sayings’ [41]: how people travel, eat,

shower, heat their homes, etc. Most definitions of practices include objects and the material world as part of that nexus [42–44]. Rather than focusing on individual behavior, these approaches take practices as the unit of analysis, showing how social activity is made up of a constellation of human, material, and discursive elements [38, 42].

Sustainability transitions concern changes in socio-technical systems and are defined as ‘long-term, multi-dimensional, and fundamental transformation processes through which established socio-technical systems shift to more sustainable modes of production and consumption’ [45]. Earlier studies have shown that social practice theories can be useful in transition studies by informing societal transformation [46, 47] and that policies can be targeted towards changing practices in a transition towards sustainability [48].

Whereas transition studies aim at studying system change, many empirical studies are criticized either for being overly focused on ‘the bigger picture’ or on ‘zooming in’ on technological development. This study seeks to address the gap in the middle: it de-constructs practices, provides a snapshot of many ongoing changes that are either actor-specific or shared, and discusses the consequences. We take social practices as the unit of analysis, in line with other works that apply practice theories to study system change [46, 48, 49]. We aim to contribute with a systemic approach that is related to other system studies, which look beyond users of transport and link the social with the technical [50].

SPTs have successfully been developed to remove the division between structure and agency and to focus on practices rather than individuals and several efforts have been done to study changes in practices. For example, Watson [46] suggested three mechanisms involved when a practice changes: how the elements change, how the carriers of the practice change, and how elements and carriers relate to changes in other practices. His study indicated that system change in transitions could be explained from a practice-based perspective.

In this study, the notion of practices as ‘entanglement of performances of actors’ implies that durable change of practices concerns reconfigurations to intertwined, differentiated, and interlinked practices that guide both daily consumption and processes of supply and policy [51–54]. From this practice-theoretical perspective, any durable reduction in the use of cars requires changes not only related to the availability of alternatives but also to the collective know-how in terms of their use and in the social and cultural meanings attached to car mobility and the alternatives.

The framework we apply in this study includes the social context in a different way than does the three-element approach because it highlights the interrelatedness of actors in shaping practices. The seven-element framework has previously been used to address factors that hinder resource-efficient practices in the case of mobility [36]. While the previous study mapped these factors and policies by tackling the ‘web of constraints,’ [36] this present focus is instead on mapping enabling factors as we apply the framework to study what type of changes happen in the elements when a practice emerges amidst existing mobility practices.

In this study, we therefore do not apply the well-known three-element SPT approach [37] but instead employ the conceptual framework in which practices are comprised of seven types of

elements: three *actor-specific* elements (knowledge and skills, values and feelings, and financial capabilities) and four *shared* elements (infrastructures and artifacts, business models, social meanings and norms, and regulatory incentives) [36].

The actor-specific element of knowledge and skills (or *competencies*) refers to practical know-how as well as bodily activities, similar to the three-element approach. Feelings refer to the stakeholders' specific emotions concerning the performance of the practice, and financial capabilities refer to the extent to which a stakeholder can afford the performance of the practice. For the shared elements, the infrastructures and artifacts refer to the *materials* that enable the performance of the practice, business models refer to the way firms create value or profit from selling products or services, such as the particular offer to the customer; social norms and *meanings* are the main ways the practice is framed, and (public) policy incentives are regulations, tax incentives or subsidies, etc. that promote, constrain, or dictate (part) of the practice.

The elements are not separate but collectively shape each other (see Figure 1). The three small blue-colored circles represent the actor-specific elements in the three dotted-lined circles (traveling, operating, and regulating), and the four outer circles in the other blue colors show the shared elements. The dotted circles surrounding the elements illustrate that the elements are interrelated, constituting the practices.

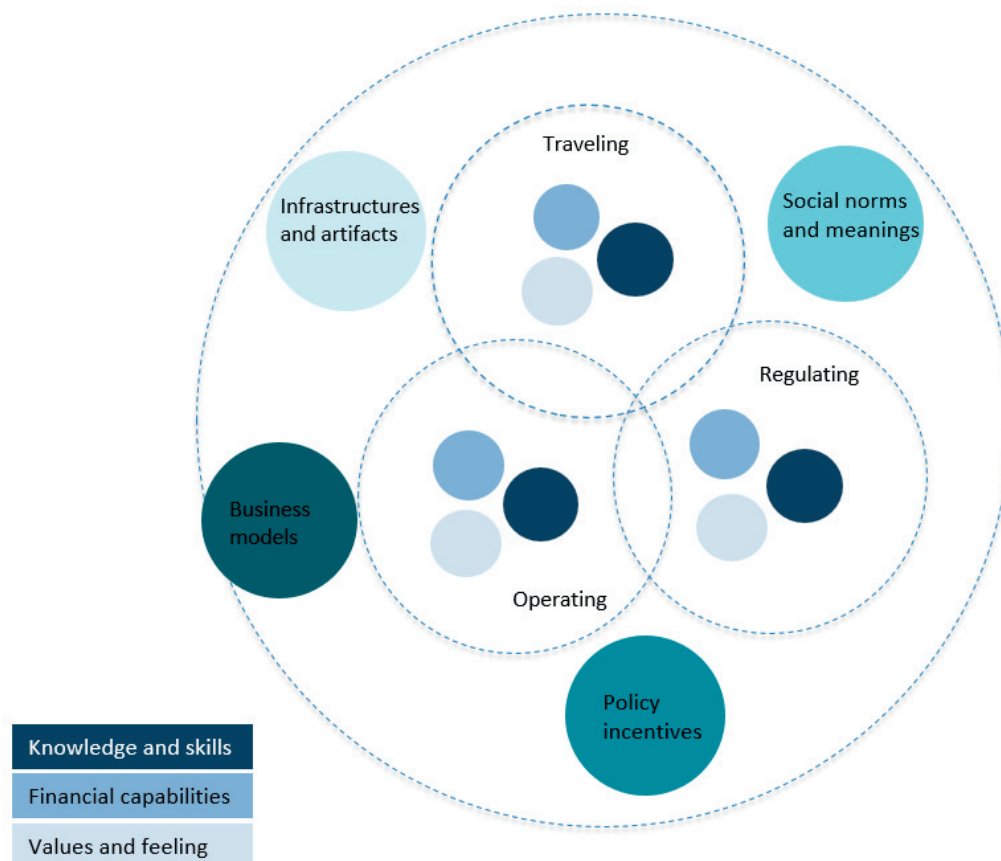


Figure 1: Conceptual framework of car-sharing as a practice comprised of seven types of elements

This framework enables a comparative practice analysis of three areas when describing the changes that occur in the various elements when new car-sharing practices emerge in each area. This study addresses the following research question: How does car-sharing emerge differently in different places, amid particular local, established mobility practices?

3 Methods and contexts

We combine two qualitative methods: household interviews and stakeholder workshops. Data collection was conducted in three areas: Oslo, Norway; Malmö, Sweden; and Rotterdam, the Netherlands.¹ Before describing the context of these three areas, we explain the data collection and analytical processes.

3.1 Methods

Data were collected through semi-structured household-level interviews on car-sharing and from stakeholder workshops in the three urban areas.² In total, 58 interviews were conducted, and three half-day workshops were organized. A general interview guide developed for the international research project, TEMPEST, was used as a starting point for the interviews in all three areas. Questions were both broad (life situation, daily travel, leisure travel) and specific (the use of car-sharing, motivations, practical elements, and implications). Interviews and workshops proved useful for obtaining data on practices, as participants talked about their experiences in revealing ways, mentioning actions they would have otherwise taken for granted [55, 56].

In the Oslo urban area, members of 39 households were interviewed in their homes by TEMPEST project participants. In most interviews, the driver and other adult household members were present. Semi-structured interviews were conducted in respondents' homes during three periods: May–July 2017, October–November 2017, and January–March 2018. All households were registered with one of three car-sharing services: Nabobil (a P2P service), Hertz Bilpool (a B2C corporate service), and Bilkollektivet (a B2C cooperative). Thirty-three households used vehicles from the car-sharing services in various ways, two were members who provided cars, and four were members but non-users. Ten households mainly used P2P; 11, B2C corporate and 18 used B2C cooperative. The need for interviewees was announced through the research project on the Facebook pages of the three car-sharing suppliers. An overview of possible participants was made, and interviews were then booked with various types of households—couples or singles in families with or without children. Interviewees were informed about the research and data collection process and signed a consent form allowing the data to be used for research purposes. This part of the research project is registered with and approved by the Norwegian Centre for Research Data.

In the urban area of Malmö, members of twelve households were interviewed in their homes by master's students in October 2017: six were users of Lund's Bilpool, four were users of Sunfleet, and two were non-user households. In order to create a sample with participants who used different

¹ This study is a part of the research project, TEMPEST, with partners in Norway, Sweden, the Netherlands, and the UK. These locations were the starting point for this specific study, and the data used here are part of the larger data collection for the overarching research project. Note that this study was conducted prior to the recent municipal reform in Norway: the earlier designations of municipalities and counties are used here.

² Quotes in the findings in this article are accompanied by place-specific acronyms and the number of the interview, for example OHI (Oslo household interview 1–39) and OSW (Oslo stakeholder workshop),

services, the researchers began the recruitment by identifying and inviting a few participants from their own network, and then some of these initial recruits invited people they knew to join the study. In the urban area of Rotterdam, seven telephone interviews with households were conducted in March and April 2018 with current users of three different car-sharing providers: two used Greenwheels, one used Snappcar, and four used Buurauto. In this location, the researchers also identified and invited participants based on their contacts, aiming for a sample with participants who used different services. Interviews in all areas lasted between 45 minutes and two hours. Table 1 provides an overview of the car-sharing companies and business models in the three areas. The provision of EVs in these schemes varied, with, for example, the P2P services offering a variety of EVs that people put out for rent, Buurauto focused on EVs, and the other cooperatives offering only some limited EVs in their fleets.

	Oslo	Malmö/ Lund	Rotterdam
P2P	Nabobil		Snappcar
B2C Corporate	Hertz Bilpool	Sunfleet	Greenwheels
B2C Cooperative	Bilkollektivet	Lund Bilpool	Buurauto ³

Table 1: Overview of car-sharing providers and business models

Half-day stakeholder workshops that followed similar formats were arranged by project partners in the three areas as part of the TEMPEST project: on October 31, 2018 in Oslo; on January 28, 2019 in Malmö; and on October 31, 2018 in Rotterdam. Participants were representatives from car-sharing operators, the public authorities, research institutes, and mobility organizations, such as public transport companies. In Malmö, this included, for example, the Swedish Association of Green Motorists; The Swedish Transport Administration; Trivector, a company offering transport R&D and consultancy services; K2 Sweden's national center for research and education on public transport; and Mobile Heights, a non-profit ICT cluster organization and networking community. Workshops involved group work followed by plenary discussions. Questions focused on three aspects of how car-sharing relates to the existing mobility system and participants' views on a) what needs to be developed (new), b) what needs to be changed (adapted), and c) what should be stopped (phased out) for car-sharing to enter the current mobility system. In other words, their opinions on what a mobility system with car-sharing would look like, with a focus on what could be done by these stakeholders to a) build 'the new,' b) customize, and c) phase out 'the old,' were collected. Although these questions initially focused on future change, in answering them, participants also noted how mobility practices of car-sharing have changed. In Oslo, for example, three groups, as shown in Table 2, first reflected on these questions and then presented their views in a plenary session. Then the groups continued separately by discussing all ideas and how car-sharing can enter the mobility system. In the end, a summary of the main outcomes was presented and discussed in a plenary session. The Oslo workshop offers an example of how the stakeholders interacted in groups and how this generated data for the research. The photo shows the workshop in Malmö, with the participants involved in group work.

³ Not organized strictly as a B2C cooperative or corporate company but with neighborhood arrangements.

Group 1	Group 2	Group 3
Oslo City Council, section for the urban environment	Akershus county, neighboring county to Oslo	Bærum municipality, neighboring municipality to Oslo
Bilkollektivet, car-sharing B2C cooperative	Bilkollektivet, car-sharing B2C cooperative	NSB Bybil, car-sharing from Norwegian State Railroads
Hertz Bilpool, car-sharing B2C corporate	Møller Mobility, car company	CICERO, research institute
	Ruter, public transport operator	

Table 2: Grouping of participants in the stakeholder workshop in Oslo



Photo. Malmö Workshop

The analytical work was conducted in four main steps. The transcribing, coding, mapping, and comparisons were discussed among the three researchers in several sequences, leading to adjustments and annotations. First, recordings from the household interviews and stakeholder workshops were transcribed, or notes were written and organized using the computer software NVIVO.

Second, the first author coded the interviews and workshop transcriptions and notes using the seven categories of the conceptual framework. In this step, we labeled what was said about mobility practices as referring to shared elements of ‘infrastructures,’ ‘business models,’ ‘social norms and meanings,’ ‘policy incentives’ or actor-specific elements of ‘financial capabilities,’ ‘knowledge and skills,’ and ‘values and feelings.’ The initial coding was discussed among all three authors in face-to-face and online meetings. This led to a new round of additional coding with some adjustments.

Third, we mapped how the elements changed due to the introduction of car-sharing. The changes in each element were estimated separately in order to gain insight into what and where changes were happening. The change in each element was scored from zero to two, with 0 for ‘no/little change,’ 1 for ‘some change,’ and 2 for ‘big change.’ This could not have been a precise measure, but these steps offered important insights, necessitating evaluations of changes that served as a basis for further analyses and discussion. For each element, we asked a question of change—for instance, concerning the shared element of infrastructures and artifacts, we asked about the extent to which infrastructures and artifacts of the established mobility practices have been adapted (to enable car-sharing) compared to the situation before the introduction of car-sharing.

The final step involved comparative discussion on what was place- and time-specific in the three areas, where we elaborated on the discoveries behind scoring the change and investigating similarities and differences. The findings were ultimately synthesized in Excel.

The limitations of this study concern data collection and the analysis with elements and scoring the change. The data collected from the three areas involved differences, such as not including P2P in Malmö and interviewing a few informants in Rotterdam. We have tried to take this into consideration but recognize that there could be one-sidedness, for example, with regards to the participation of different providers and policymakers in the stakeholder workshops. We examined the preliminary findings together to overcome some limitations of using qualitative methods, such as the fact that the results could be influenced by personal biases and idiosyncrasies, depending on the individual skills of the researchers. This was also done in order to deal with variations in the data collection resulting from differences in conducting the interviews (telephone vs. at home), in workshop participants (variety of stakeholders), and due to the three languages involved (Norwegian, Swedish, and Dutch). Moreover, because we wanted to map any changes in elements, it was particularly important to evaluate this part of the findings with the other researchers. The comparative analysis brings greater variation but frequently also less depth since not all relevant factors can be examined [57]. Despite these shortcomings, the analysis still provides data that is rich enough to enable a comparison of what enables car-sharing practices to emerge.

3.2 Contexts

Oslo is the capital of Norway and its most populous city. Its urban area includes some parts of the surrounding county now called Viken and has approximately 1 million residents. Malmö is Sweden’s third largest city; the Malmö Metropolitan Area has over 700,000 residents. Rotterdam is the second largest city in the Netherlands, and its urban area has slightly over 1 million residents.

Oslo, Malmö, and Rotterdam are all car-dependent cities dominated by the use of personal cars but also characterized by growth in public transportation and cycling. Oslo, for example, has new regulations aimed at reducing daily driving, such as higher road tolls and residential parking restrictions. Public transport is well established, and biking is becoming more widespread, supported by increased funding for bike lane construction and year-round maintenance. In the Malmö Metropolitan area, public transport is popular and well-functioning; bicycling infrastructure is extensive, with more than 500 km of bicycle lanes in Malmö alone. In Rotterdam, as throughout the Netherlands, bicycling is commonly used for daily travel. Recently, other personal mobility options have emerged in all three areas, such as car-sharing and bicycle sharing.

Although the three areas are all located in northwestern Europe, there are differences in mobility regarding policies and the use of EVs and bicycles. For example, the official policy in Norway is that, by 2025, all new cars sold should be EVs. Indeed, in Oslo, they are increasingly popular; the city is a world leader in EV growth: 60% of new cars sold in 2019 were EVs. In Rotterdam and Malmö, EV use is more limited, but the use of bicycles for personal mobility is firmly established.

Car-sharing has existed in Norway since the mid-1990s; as of 2020, there were more than 11 car-sharing service providers or platforms [26, 30, 58]. In Sweden, car-sharing can be traced back to the mid-1970s, rooted in the cooperative movement and local community initiatives. Before 2006, there were no commercial car-sharing companies in Malmö and only one private car club offering two vehicles. The Netherlands had approximately 41,000 shared cars and 400,000 users by early 2018, with a growth of 10,000 in the number of shared cars compared to the previous year. This increase occurred mainly in the four largest cities (Amsterdam, Rotterdam, the Hague, and Utrecht). The most rapid growth was in P2P platforms, which supply 81% of shared cars [59].

4 Results: Changes in elements of emerging car-sharing practices

Here, we compare the practices in the three areas by examining changes in the elements. In line with our conceptual framework of social practices (see Section 2), we discuss the seven elements of car-sharing practices. We score the level of changes in the four shared elements (infrastructures and artifacts, business models, policy incentives, and social norms and meanings) and in the three actor-specific elements (knowledge and skills, financial capabilities, and values and feelings). For the actor-specific elements, we score the changes for travelers, operators, and planners separately.

4.1 Shared elements

4.1.1 Infrastructures and artifacts

Car-sharing includes new technologies for accessing cars through digital platforms and integrated information technology. At the same time, many material aspects of car-sharing are similar to those in the existing mobility system, such as vehicles, roads, and parking infrastructure. The change relates more to communication than to physical artifacts and infrastructures: the main changes are in internet access, software and hardware devices with smartphones for maps, communication, keyless technologies, payment technologies, etc.

Regarding physical infrastructures, we found changes concerning parking and EVs. In Malmö, stakeholders from the municipality were involved in arranging dedicated parking in parking houses for car-sharing cars. In Rotterdam, the service Buurauto provided EVs. EVs require charging facilities, making charging infrastructure relevant for the use of EVs through car-sharing services, as put by this household informant in Rotterdam:

It's really a problem if you cannot charge the batteries. Then you've got to park somewhere else and then put it back on the spot with charging stations. When there's a shortage of charging stations, it becomes a problem for car-sharing. There's already a lot of hassle; and if, in addition, you have to look for parking, people will drop out (RHI 5).

Infrastructure and artifacts		
<i>To what extent does car-sharing entail new infrastructures and artifacts?</i>		
Oslo and Rotterdam scored 1, ‘some change,’ due to the new role of EVs, smartphones, and the internet for car-sharing, without the involvement in parking infrastructure. Malmö scored 2, ‘big changes’ because new, dedicated parking for car-sharing has been provided in garages in addition to new devices and supporting software.		
Oslo 1	Malmö 2	Rotterdam 1

Table 3: *Infrastructure and artifacts*

4.1.2 Business models

Before the recent emergence of new business models of car-sharing services, there were some variations in car rental services and car cooperatives in all three areas. Cooperatives were non-profit organizations, where one could purchase a member share and pay monthly or yearly membership fees in addition to charges per trip or kilometer. Rental services were for-profit models with daily, weekly, or monthly deals of car use through rental offices.

Then, new car-sharing services were launched, such as the B2C corporate car rental, Hertz Bilpool, which offers self-service and shorter-term car rentals, combining, for example, monthly membership for small, medium, or large use of cars matched with driving charges and handling costs, such as insurance, fuel, and road tolls. After 2015, new P2P services, which provided platforms for people to share their privately owned cars, emerged. These new business models have led to a greater supply of cars, new locations, new opening technologies for keyless alternatives, and new payment methods in all three areas.

Business models		
<i>To what extent does car-sharing entail new business models?</i>		
All three areas scored 2, ‘big change’, in the business model element because of the recent emergence of new services such as P2P car-sharing.		
Oslo 2	Malmö 2	Rotterdam 2

Table 4: *Business models*

4.1.3 Policy incentives

In Malmö, policy incentives have played a central role in facilitating and promoting the growth of one of the services, Sunfleet. The municipality was involved in dedicated parking for car-sharing and public procurement of their services. Civil servants attended seminars and discussed changes in regulations for housing and parking, with specific regulations for car-sharing lots replacing private cars. Through the subcontracted parking company P-Malmö, Malmö city has parking space dedicated to car-sharing in its garages. The city also temporarily assigned personnel to help introduce and implement Sunfleet there. However, the municipality was not allowed to offer dedicated or subsidized space (e.g., streets) for car-share vehicles to car-sharing companies or other public organizations. This has been an obstacle to growth and economic viability for car-sharing companies. However, other actions were taken to involve the public in Sunfleet, for example, via public procurement of their services.

In fact, the most interesting supporting move made by the city of Malmö (and adopted by other Swedish cities) was a suggestion to offer housing companies a reduced ‘parking norm’: the requirement to build a given number of parking lots in each newly built apartment complex. This norm can be reduced if the housing company can provide a sustainable mobility solution, such as a car-sharing scheme for residents.

One respondent expressed his thoughts on the role of policy incentives on car-sharing in Malmö:

I think that the government and decision-makers are more pro-sharing compared to private ownership, and it’s going to become more relevant. The bottom line is that if sharing is easy and cost-efficient for the users, it will continue to grow in popularity. It’s partly up to the decision-makers to continue to subsidize. I don’t see why sharing shouldn’t become more popular in the future (MHI 2).

This was further elaborated by another household respondent, who supported changing parking regulations for housing and also highlighted the difference between accessing cars as part of housing instead of parking them randomly in the streets:

If you buy an electric car to have in the condominium, you have it on the ground floor. Now if the state, the municipalities, had been smart, they could have reduced the parking norm requirement for the number of parking places. If they’d replaced it with carpool cars, instead of needing 20 places for a building, it would be enough to have maybe five plus two car-sharing cars or something like that. There’s a big difference between having the car under a roof right there and having to walk outdoors, maybe 500 meters, when it’s snowing or raining . . . (MHI 6).

In Oslo, there are fewer direct policy incentives for car-sharing. The focus has been on support for EVs and initiatives for reduced daily car use, although there has been some (limited) political interest in car-sharing, with proposals for providing free public parking spaces for car-sharing. Ultimately, policy incentives in the Oslo area came to focus on tax exemptions for EVs; more walking, biking, and public transportation; and reduced daily driving through new parking regulations restricting free parking and the imposition of higher road-tolls during rush hours. Some stakeholders expressed their concern for the (lack of) policy incentives specifically for car-sharing because of how the uncertainty affects the competition and providers in the market. One participant from a car company commented,

The issue of public-private collaboration keeps coming up. The big question is how to make it happen.

For us, I also think it is important for the public to clarify its role. It’s difficult for us to make big investments in an area where the government may suddenly come with a subsidized solution (OSW).

In Rotterdam, we found that the policy incentives were less directed towards cars and more towards other modes such as walking and biking. The focus was on phasing out car use in general and supporting car-free city zones, in contrast to Malmö and Oslo. Also, in Rotterdam, there was more

interest in pilot projects and urban experiments, as summarized here about car-free zones from the workshop in Rotterdam:

An emissions-free, collective-based mobility system in Rotterdam offers an attractive public space where having a car isn't necessary, but you can still go anywhere, and emissions-free mobility is always accessible and attractive for everyone.

Further, one idea is to set up area experiments, starting in neighborhoods where there are support and initiatives, and begin to completely phase out individual ownership of fossil fueled cars (RSW).

Policy incentives		
<i>To what extent does car-sharing entail new policy incentives?</i>		
Malmö scored 2, 'big change', because the municipality was involved in Sunfleet. Oslo and Rotterdam scored 0, 'no change', because policy incentives were limited to suggestions and ideas, with hardly any direct incentives actually implemented.		
Oslo 0	Malmö 2	Rotterdam 0

Table 5: Policy incentives

4.1.4 Social norms and meanings

Car-sharing entails a shift in the meaning of mobility. There is a change regarding the acceptance of *accessing* cars instead of *owning* them and using transportation through subscription models and internet access. The established norm of owning cars is challenged. The change involves a direct change in the sense of the increased role of information technology in accessing the cars and indirectly due to the acceptance of the *occasional* instead of the *daily* use of cars. The greater role of ICT is not unique to car-sharing but can be seen in developments in other areas, such as the access of bikes through sharing schemes, the planning of trips and buying of tickets for public transportation, or the booking of taxi services online. In general, the threshold for using car-sharing services is lowered through the acceptance of the use of the internet to arrange for transportation. In the Oslo workshop in a discussion on how to integrate car-sharing services in apps for public transportation, one participant from a car collective said:

It's getting easier, also for those who are new to it. Many city-people already use the Ruter [public transport] app, but very few use the car-sharing app. If it comes on the same platform, that lowers the threshold for trying it for the first time (OSW).

We also found changes in environmental concerns. In Malmö and Oslo, car-sharing is seen as a means to reduce regular car driving, facilitating the occasional use of cars. Car-sharing, we found, is seen as a sustainable option to promote less driving and private ownership. Workshop participants, both policymakers and practitioners, discussed how car-sharing contributes to environmental sustainability. There was a consensus that if car-sharing services were used in place of private cars, less driving would result. Car-sharing serves as a sustainable transportation alternative in all three areas studied because it reduces the need for the private ownership of cars. However, it is less clear whether this is seen as an element in 'sustainable urban mobility.' For example, in Rotterdam, it was noted that car-sharing also requires cars, whereas the overall

objective was to reduce all cars in cities, so car-sharing was not prioritized as a sustainable solution. Car-sharing is not seen as the ultimate solution, but it can play an intermediate role in reducing and changing car ownership. Introducing car-sharing in Rotterdam should lead to a bigger change in the mobility system compared to the two other places, because here it is a step towards creating car-free zones, as expressed in a household interview in Rotterdam:

A car is still a car; it does not change the mobility system very much. I think what really helps is that it means a shift from ownership to service. It's planting a seed for a larger step than that. If many people took up car-sharing, you'd see fewer cars in the streets. However, parking spaces are still needed everywhere and are still very dominant in the city. Maybe car-sharing would gradually help to reduce the problem (RHI 7).

We found that growing worries about daily private-car mobility (like congestion and parking restrictions) as well as a greater acceptance of car alternatives (like biking and public transport) promote norms for the acceptance of car-sharing. Transit and active travel infrastructure and culture enable the use of car-sharing. This interviewee in Rotterdam reported that bicycling and trains solved their household's daily travel needs, making car-sharing a suitable option for occasional car use, instead of private ownership:

It's no longer necessary [to commute] by car; it's easy to get to work by train. This also means that people in the neighborhood are flexible when it comes to car use. That's a specific reason why we have started to use car-sharing (RHI 1).

Social norms and meanings		
<i>To what extent does car-sharing entail new social norms and meanings?</i>		
Rotterdam scored 2, 'big change', because of how perceptions on the role of cars in the city have shifted towards the idea of phasing out cars. Malmö and Oslo scored 1 because the change in norms concerned reduction of daily use of cars.		
Oslo 1	Malmö 1	Rotterdam 2

Table 6: Social norms and meanings

4.2 Actor-specific elements

4.2.1 Knowledge and skills

Users need to be able to drive different vehicles, use technology to access and find cars, and use tools to plan and pay for trips. Users need to acquire certain new skills, such as ensuring to pre-book cars for peak hours and checking the status of the cars at pick-up and delivery times. Here, the use of EVs has also played a role, as this requires specific knowledge and skills for charging and range planning, as two household interviewees in Rotterdam explained:

There are two components: electric driving and opening and reserving (RHI 5).

I'm satisfied with this system; it is amazingly easy, works 90% of the time. But you have to be able to keep pace with the technology. My wife has had a lot more trouble. The threshold is higher (. . .) the system didn't work, she hasn't felt like continuing, especially with electric vehicles (RHI 4).

For car-sharing operators, digital competencies play a role. The B2C car cooperatives and corporate businesses have acquired expertise in developing and sustaining their car-hub services and P2P on their online platform. We found a focus on digital competencies in all locations.

Regarding the urban (mobility) planner, the introduction of car-sharing entailed some new skills. Malmö trained civil servants through seminars on car-sharing facilities. In Rotterdam, the focus for planners and policymakers was on experiments and was not directed at car-sharing but toward achieving a car-free city. Among planners in Oslo, we found a limited focus on knowledge in car-sharing: the set-up was geared largely towards EVs and reduced parking. In fact, some new regulations concerning residential parking were criticized for not considering car-sharing, as the parking permits required ownership of the vehicles.

Knowledge and skills		
<i>To what extent does car-sharing entail new knowledge and skills for travelers, operators, or planners?</i>		
<ul style="list-style-type: none"> • For ‘traveling’ we found ‘some’ changes (score of 1) in all three areas, mainly with regard to planning and using smartphones in connection with transportation. These were not big changes, as users were already familiar with booking sites and applications for transportation, and these skills were applied in the use of car-sharing services. • This was similar for ‘operating’ with ‘some’ change (score of 1) in all three areas due to new combinations of existing skills and digital competencies. • On ‘regulating,’ Malmö scored ‘big’ change (2), more than Rotterdam (1) or Oslo (0). This resulted mainly from how the planners in Malmö were involved in activities that fostered learning about car-sharing and developing regulations. In Rotterdam, some change was evident because of how the planners were involved in car-sharing as part of learning from experiments for car-free cities. Oslo scored ‘no change’ here because we did not find a new use of knowledge or skills for car-sharing per se. 		
Oslo Traveling 1 Operating 1 Regulating 0	Malmö Traveling 1 Operating 1 Regulating 2	Rotterdam Traveling 1 Operating 1 Regulating 1

Table 7: Knowledge and skills

4.2.2 Financial capabilities

For travelers, the extent to which car-sharing was seen as an affordable alternative compared to other mobility options was relevant. The way people evaluated the cost of car-sharing varied. For some households in Oslo, the car-sharing cost per trip was closely calculated by, for example, comparing the cost of train tickets versus car-sharing for a weekend trip. Others here considered their use of car-sharing as a total cost of yearly or monthly transportation for the family, as explained by these two household interviewees in Oslo:

We pay a monthly fixed fee to an account we have for car-sharing (OHI 9).

It has something to do with finances. When it becomes more expensive to use the car collective than to have our own car, there's an equilibrium point as to how much we use the car. We set aside an amount every month, so we know roughly what we'll use during the course of the year (OHI 30).

In line with this, one interviewee in Rotterdam noted that the costs were a central aspect:

What benefits are there to the use of car-sharing? Costs (RHI 6).

For the operator, financial capabilities differ in the various business models. For example, the P2P model is a business model that does not include responsibility for a car hub and consequently requires less financial resources. Common to all models is the significant financial investments and costs entailed in developing and running the digital elements of the businesses (software and ICT devices). In particular, providers in Oslo stressed their concern that the insecurity surrounding policy incentives could affect the financial position of their businesses.

For urban planners and regulators, we found involvement in the procurement of car-sharing services to be related to financial capabilities in Malmö. In Rotterdam and Oslo, however, there was hardly any direct public procurement or financial investment in car-sharing.

Financial capabilities		
<i>To what extent does car-sharing entail new financial capabilities for travelers, operators, or planners?</i>		
<ul style="list-style-type: none"> Concerning 'traveling,' we found 'big changes' (score 2) in Oslo and Malmö due to respondents' perceptions of financial differences between the variable costs of using car-sharing services compared to fixed costs through loans, insurance, and taxes related to owning cars, relating to the extent to which a stakeholder can afford the performance. Rotterdam scored only 'some change' (1) here, as our respondents focused more on comparing direct, variable costs for transportation, such as the use of trains or rental cars, to car-sharing. There has been a growing assortment of 'operating' and associated business models in each of the three cities since 2015. Their expertise and concerns vary: for instance, in cooperatives, the revenues go back to the company, whereas the P2P has private providers. On the whole, we saw some change (score of 1) but acknowledged that our assignment of a score of one on this has certain limitations in revealing differences for different business models. On 'regulating,' Malmö scored 'big change' (2); Rotterdam scored 'some change' (1), and Oslo scored 'little change' (0). In Malmö, the planners were involved in both procurement and subsidized parking. In Rotterdam, there was some change due to how financial support was directed at including car-sharing parking in certain areas to promote their efforts towards car-free cities. In Oslo, the planners were not involved in supporting car-sharing per se but focused on EVs. 		
Oslo Traveling 2	Malmö Traveling 2	Rotterdam Traveling 1

Operating 1 Regulating 0	Operating 1 Regulating 2	Operating 1 Regulating 1
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Table 8: Financial capabilities

4.2.3 Values and feelings

In Oslo and Malmö, travelers associated car-sharing with positive feelings of the freedom to drive and saw it as a solution to environmental concerns about car ownership. In all three areas, car-sharing played a role because it made it possible to use a car for specific purposes, instead of daily, as noted by this Rotterdam household interviewee:

The main reasons are environmental considerations and that we find that it's not necessary to have a car (RH17).

Some users in Rotterdam had seen economic concerns as being less important than environmental ones. They did not use car-sharing because of the financial aspect of saving money but because of environmental concerns:

It's not about the cost savings but about the environment (RH1).

It's not cheaper than your own old petrol fuel car. For me, the main point is electric driving. Electric driving is more important than car-sharing (RH11).

For the operator, ideas and ideals associated with the sharing economy and ditto subscription models played a role. However, the type of feelings varied among the different services and business models. In B2B corporate services, there was (understandably) an entrepreneurial spirit with a certain focus on profit. Otherwise, the environmental objectives varied, some with more focus on EVs and others, less.

For the planners and regulators, car-sharing was valued differently in the three places. We found these values reflected in their involvements in car-sharing and similar to their policy incentives. It was thus valued differently, ranging from 'more change' in Malmö, due to public procurement and involvement in learning; 'some change' in Rotterdam, where we found interest in experimenting with car-sharing for reduced car use; and 'little change' in Oslo, where there was little interest from the planners on car-sharing, as it was not seen as an alternative.

Values and feelings
<i>To what extent does car-sharing entail new values and feelings for travelers, operators, or planners?</i>
<ul style="list-style-type: none"> On 'traveling,' Oslo and Malmö scored 2 (big change) because of how car-sharing involved a change from the idea of using a car daily to instead, ideals of occasional, purpose-driven car use. Rotterdam only scored 1 (some change) here because of how this perception involved little change, as cars were already accepted as being used occasionally instead of daily.

<ul style="list-style-type: none"> On ‘operating,’ all three locations scored 1 (some change). Services have continued the earlier ideas for access-based car use but with some changes in values concerning their role in contributing to environmental improvements, for example, through EVs. Concerning ‘regulating,’ Malmö scored 2 (big change); Rotterdam, 1 (some change), and Oslo, 0 (little change) because of how planners valued car-sharing. In Oslo, planners generally ignored car-sharing, whereas in Malmö, some planners were keen on it, and Rotterdam was in the middle because interviewees were only interested in car-sharing as a transient option towards car-free areas. 		
Oslo Traveling 2 Operating 1 Regulating 0	Malmö Traveling 2 Operating 1 Regulating 2	Rotterdam Traveling 1 Operating 1 Regulating 1

Table 9: Values and feelings

5 Discussion: Interventions in interrelations

Scoring changes in the elements, albeit a clearly reductionist approach, offers a way of structuring the comparative analysis beyond bare qualitative descriptions—again, without any claims to quantitative precision. In the analysis, we scored changes in the shared and actor-specific elements. This is useful for further examining the interrelations between the elements and conceptualizing connections between the actor-specific and shared elements that can inform policy interventions.

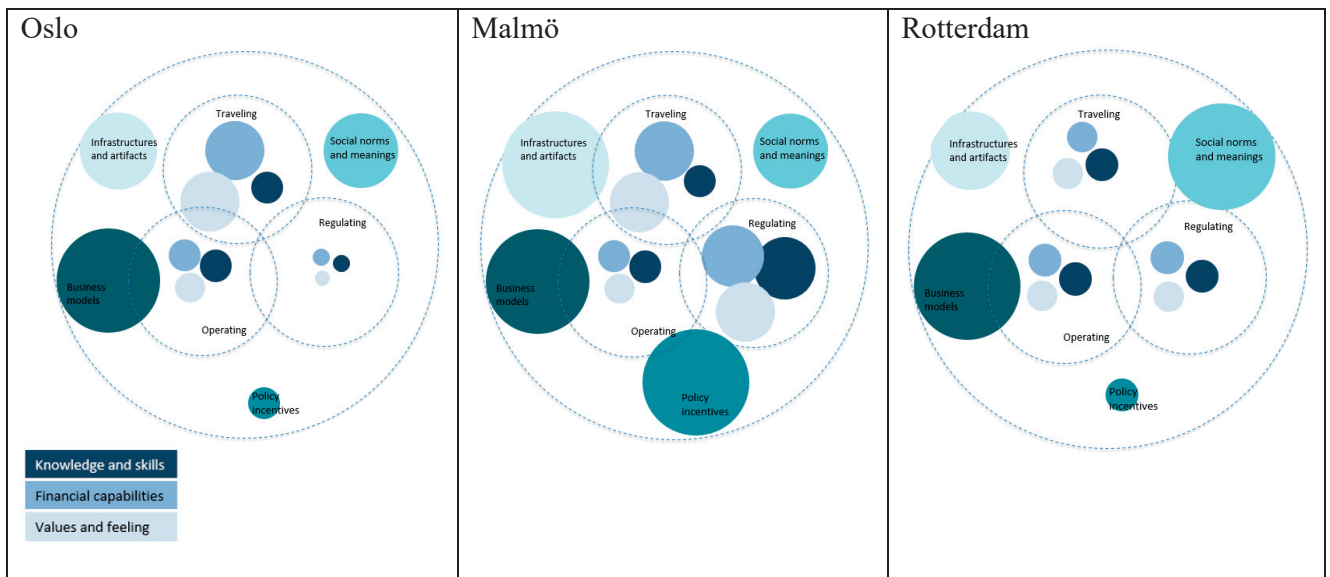


Figure 2: Comparing the score of change in the seven elements (Figure 4–6)

The figure is an illustration of the summary of the scoring of changes. These results emphasize that some elements are more “structural”, and some are more “actional”. It highlights, for example, the differences in the shared elements: the business models element represents a big change in all

three areas. Social norms and meanings score some change in Oslo and Malmö and a big change in Rotterdam. For the policy incentives, there is more of a difference, with a big change in Malmö and a small one in the two other places. For the actor-specific elements the figure places interest in the differences in the changes in elements for the regulating, operating, and traveling. For example, for regulating, there is big change in Malmö, some in Rotterdam and little in Oslo. Table 10 and 11 in the appendix shows the summary of scores in shared and actor-specific elements.

We found similarities in all three areas, such as how new business models for sharing schemes were introduced, both as P2P as B2C (corporate and cooperatives). In the three locations, a new group of car-sharing users has emerged (albeit very limited in modal share) with digital skills to access cars and the necessary financial capabilities for car-sharing. The three cities show a trend of more internet and smartphone use for mobility and slightly reduced daily car driving independent of car-sharing. The new group of car-sharing users has been successfully recruited by a growing supply of car-sharing schemes/vehicles and supportive or neutral local regulations. These interactions can be understood as a collectively shaped enabling environment for car-sharing. In all three locations studied, the daily use of cars has changed for some travelers, and we note emerging new social norms of using cars, through the internet and direct payment, instead of through private garages financed with car loans. The necessary ICT technologies and associated skills related to traveling and operating are in line with the general trend of more ICT use in mobility practices as well as with the trend towards more on-demand mobility.

As the figure highlights, we also found differences in the three areas. We found that policy incentives and regulations for car-sharing varied. In Malmö, there was strong municipal engagement and support in car-sharing, while policy incentives in Oslo and Rotterdam were limited to suggestions and ideas, with hardly any direct incentives actually implemented. In Malmö, the municipality was involved in dedicated parking for car-sharing and public procurement of their services. In Rotterdam, policy incentives were primarily directed towards car alternatives such as walking and biking. These differences seem to correlate with differences in the material infrastructure for car-sharing, especially the fact that parking infrastructure is well-developed in Malmo and much scarcer in Rotterdam and Oslo.

Another key difference between the three study areas concerns the role of EVs as shaped by different national and local policies (see Section 3). In Rotterdam, some users see car-sharing as the way to access driving an EV when buying one is too expensive (or undesired). However, here some users see electric shared cars as a more complicated option compared to fossil-fueled ones, requiring additional skills (related to recharging and range planning). In Oslo, electric driving is more common.

How car-sharing has emerged in each of the three areas is also influenced by a range of 'other' non-mobility-related practices. For instance, existing housing and working arrangements in these areas shape the timing of and demand for car use, and this also affects the development of car-sharing. However, our analysis has focused more narrowly on established mobility and car-sharing practices as though they exist in isolation from this wider urban system. Future research may take a broader scope, viewing urban mobility practices in relation to other urban practices, see Figure 2. The figure shows car-sharing in relation to established urban mobility practices as well as, neighboring other practices, such as working and shopping. Such an analysis paves the way for a

discussion on the effectiveness of policy interventions (i.e., whether the policy for sustainable mobility should be directed at mobility or at neighboring practices that trigger mobility). This relates to discussions in SPTs on what practices are *for* and where to direct interventions and, as others have noted, the fact that ‘invisible energy policy’ may be more significant than actual energy policy [60]. Similarly, the demand for mobility can also be studied as a derived demand driven by apparently non-mobility-related issues, such as the locations of homes and workplaces and out-of-town shopping centers.

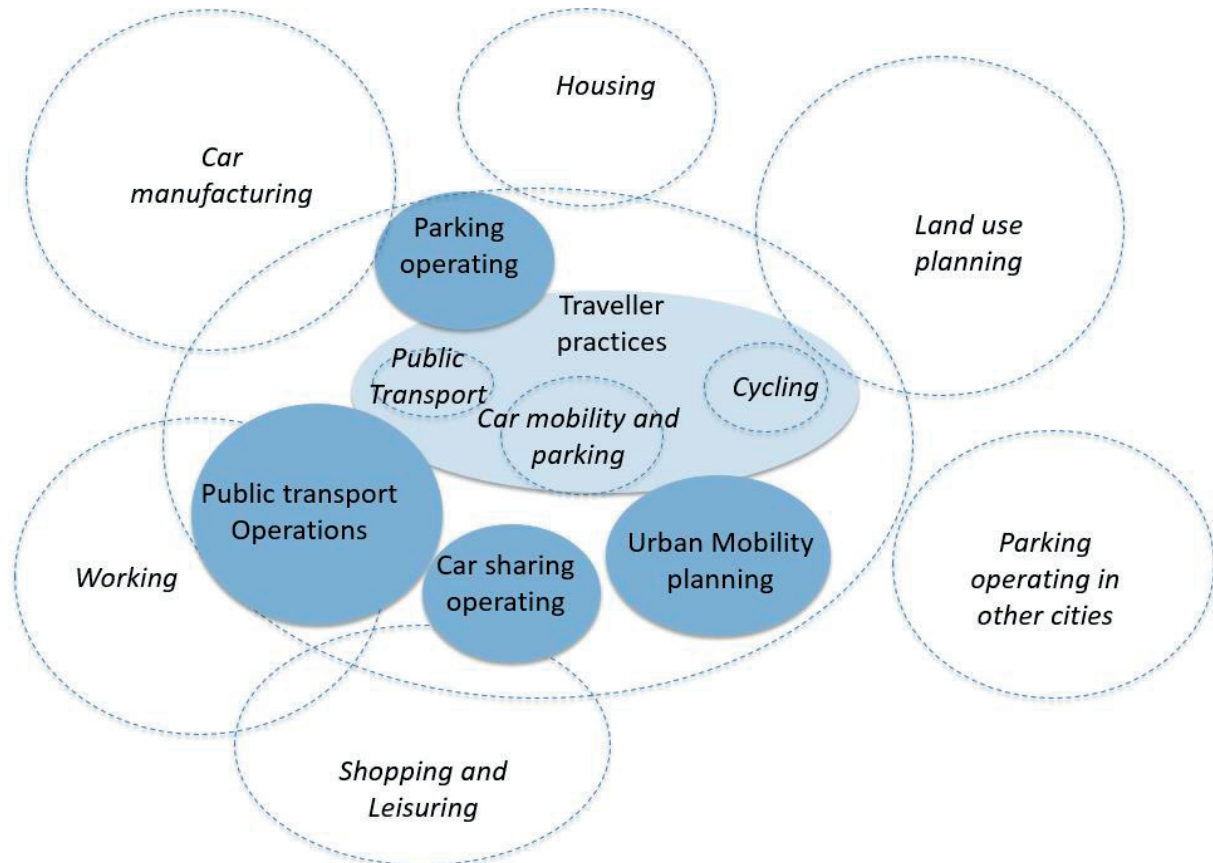


Figure 3: Urban mobility practices in relation to neighboring urban practices

6 Conclusions: Accepting access-based transportation

This study has investigated how mobility practices are reconfigured due to the emergence of car-sharing by deconstructing a practice into its shared and actor-specific elements. First, we examined changes in four shared elements: business models, artifacts and infrastructures, policy incentives, and social norms and meaning. We then investigated changes in three actor-specific elements—knowledge and skills, financial capabilities, and values and feelings—for ‘traveling,’ ‘operating,’ and ‘regulating.’ The application of the theoretical framework in this empirical study shows changes in emerging practices that go beyond a mere user perspective and the carriers of the practice. Figures 4 to 6 in the appendix show the changes in each element in the three areas; larger circles illustrate big change, and smaller circles illustrate little change.

The local peculiarities mostly refer to the policy incentives and associated involvement of urban planners. Changes vary among the three study areas, with greater involvement in Malmö with regard to public procurement of car-sharing services and informing planners and policymakers about car-sharing. The focus was different in Rotterdam, where there was interest in pilot projects and urban experiments directed at phasing out car use in general and supporting car-free city zones. Car-sharing is not the objective, but a temporary instrument for a bigger change of removing cars. In Oslo, regulatory incentives were mainly focused on EVs. More local peculiarities may be highlighted in a broader analysis that includes neighboring (non-mobility) practices, such as working, shopping, and leisure practices.

New digital technologies, EVs, and parking are important in the infrastructure and artifact elements in all three areas; and they affect the other shared elements (business models and social norms and meanings) in terms of the acceptance of access-based transportation. Changes in these three shared elements, together with regulations aimed at reducing daily car driving, can explain the reconfiguration in mobility practices that support the emergence of car-sharing.

For car-sharing to contribute to environmental sustainability in personal urban mobility, the three urban areas all need to work on different ways of reducing the daily use of cars, so that car-sharing can become a viable option for occasional use of cars. In all areas measures to reduce the daily use of cars involve support for public transportation and biking to become viable options for daily transport. This can imply new or increased support for bikes for transport of people/children and goods, possibly with (electrical) cargo bikes, and opportunities to combine biking and public transport, and bike parking in transport stations, housing, workplaces, and shopping areas.

On the one hand, in Oslo, the prominent focus on EVs has led to the continued use of these types of cars for daily travel. Thus, Oslo could instead focus beyond EVs for daily travels and could benefit from changing the focus from EVs to car-free alternatives. In Rotterdam, on the other hand, providers and policymakers should focus on EVs for car-sharing as EVs and associated charging infrastructure were pointed out to be desired but absent.

Dedicated parking for car-sharing is connected to the shared elements of infrastructures, business models, and regulations, and the actor-specific elements and different support for car-sharing parking will therefore have ripple effects. For example, changes in parking norms to also include car-sharing parking in housing will affect the business models providing car-sharing in such buildings.

In the three locations, *specific* actions targeted *indirectly* at car-sharing would be valuable to further promote the development of car-sharing practices. Changing existing mobility practices to further the occasional use of cars, meaning, for example, increased walking, biking, public transport, home deliveries, or work-from-home solutions, would pave the way for acceptance of access-based models by travelers, operators, and planners. This implies that interventions should thus not only be directed at car-sharing per se, rather it should be on urban mobility in general with associated infrastructure, business models, and social norms towards changing the daily use of cars.

This study has implications for transition studies and social practice theories because it demonstrates how an elemental approach of shared and actor-specific elements is useful for showing how changes in emerging practices relate to existing systems. The approach can be useful to map how actors react to changes in regulations, business models, or social norms and values. Future research should develop the framework further, examining connections to neighboring practices and applying them to other empirical topics, such as EVs or other areas involving relations between technology and policy and interventions dealing with interconnections between the shared and actor-specific elements.

7 Appendix

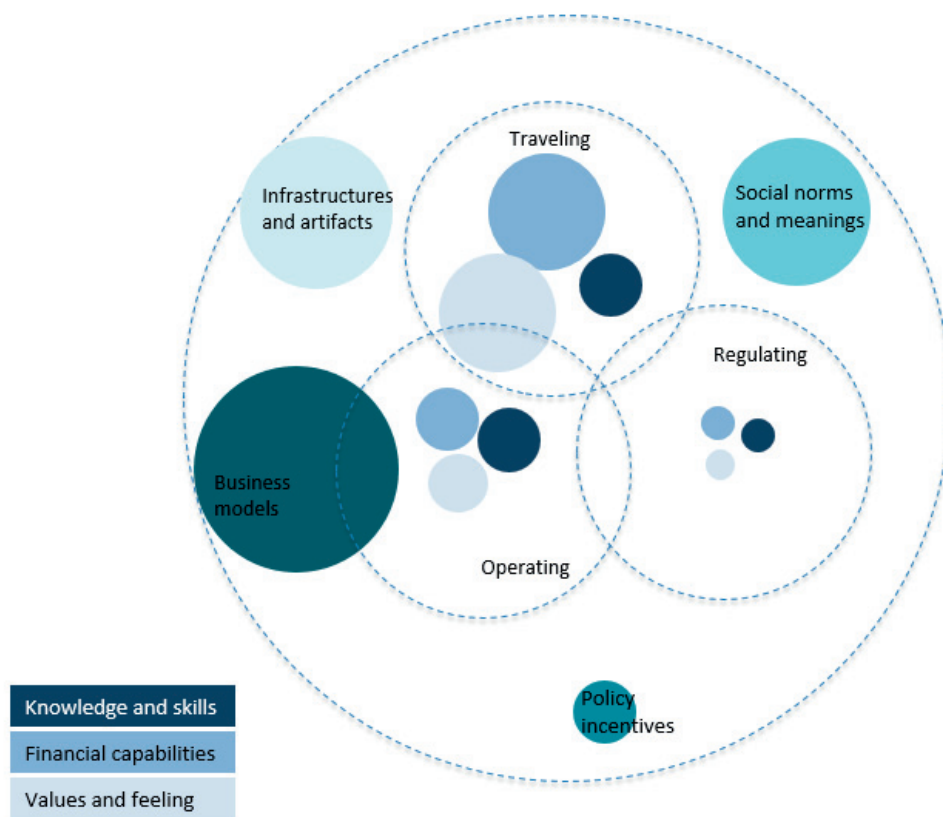


Figure 4: Changes in elements Oslo

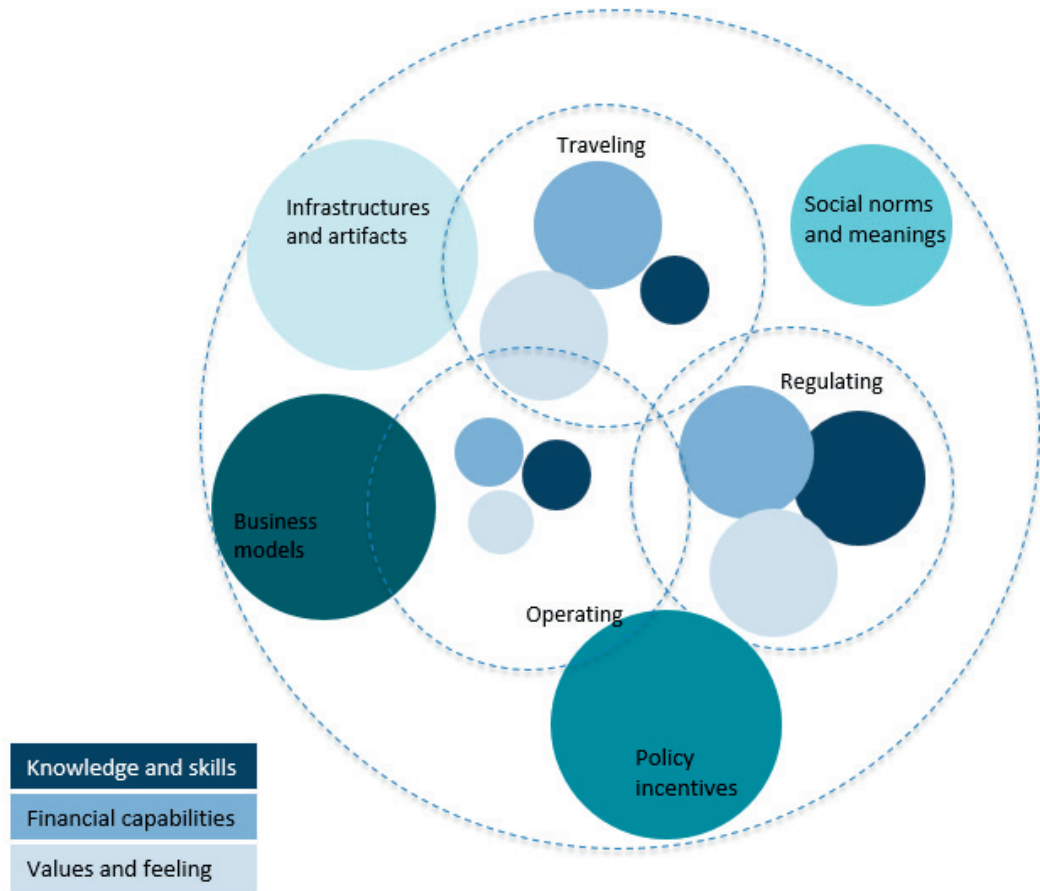


Figure 5: Changes in elements Malmö

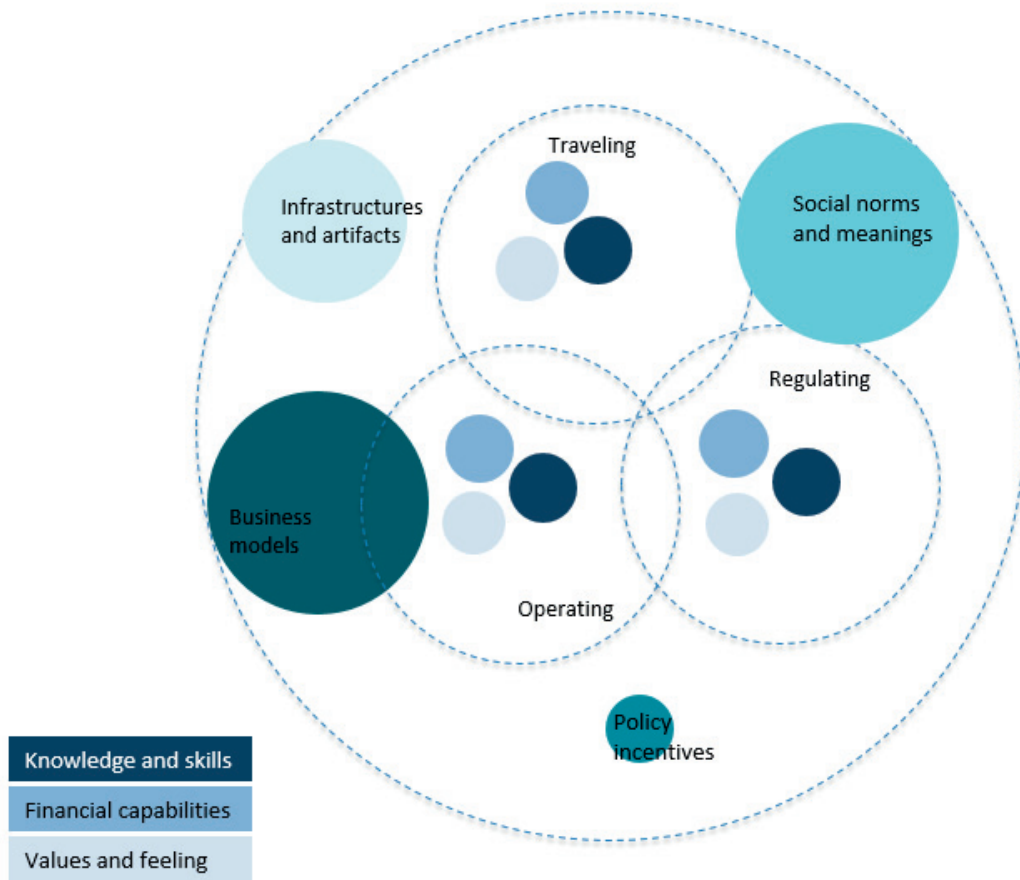


Figure 6: Changes in elements Rotterdam

Shared elements				
	Business models	Infrastructure and artifacts	Policy incentives	Social norms and meanings
Oslo	2	1	0	1
Malmö	2	2	2	1
Rotterdam	2	1	0	2

Table 10: Summary of scores in shared elements

Actor-specific elements			
	Knowledge and skills	Financial capabilities	Values and feelings
Oslo: traveling	1	2	2
Oslo: operating	1	1	1
Oslo: regulating	0	0	0
Malmö: traveling	1	2	2
Malmö: operating	1	1	1
Malmö: regulating	2	2	2

Rotterdam: traveling	1	1	1
Rotterdam: operating	1	1	1
Rotterdam: regulating	1	1	1

Table 11: Summary of scores in actor-specific elements

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Article

Providers and Practices: How Suppliers Shape Car-Sharing Practices

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Abstract: Social practice theories can be useful for studying changes in mobility systems as regards automobility practices. However, many studies address the demand side and the user practices of consumers, without examining the supplier side. This Norwegian study focuses on the role of providers in car-sharing practices, using data from household interviews with car-sharing users, stakeholder workshops, and interviews with providers of car-sharing services. How are car-sharing providers shaping car-sharing practices, and with what implications? How do business models and platform technologies affect car-sharing practices? The results show how new car-sharing service companies, in addition to established firms such as car dealers and car rental companies, affect car-sharing practices by offering several alternatives for accessing cars. The implications of this are discussed, noting how car-sharing practices are shaped by car-sharing providers in the recursive relationship between practice-as-entity and practice-as-performance. The conclusions offer a critical view of how the providers contribute to various kinds of car-sharing understandings, as well as the implications for policy and practitioners.

Keywords: social practice theories; sustainability transitions; shared mobility; car-sharing



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1. Introduction

Problems related to climate change, pandemics, and urbanizations put pressure for change on societies, organizations, institutions, and individuals [1]. Mobilities research, in particular on transitions of the system of automobility, can address challenges and changes in car-dependent societies [2]. Car-sharing has the potential to increase the overall efficiency of automobile use [3]—it can reduce the costs of travel to the individual as well as to society [4] by making it possible to rent locally available cars at any time and for any duration [5]. However, given the dominance of automobility and the expansive growth in communication technologies, a change like this is no simple matter. In a ‘risk society’ [6] where social structures become unstable and permeable, phenomena like these cannot be analyzed with the traditional categorical toolbox of mobility research [7].

Alternatives to car ownership are emerging in the transformation of the “system of automobility” [2] to the “system of mobilities”. Using cars for private transport facilitates the flexible mobility that society demands and is involved in shaping everyday life in modern societies—with major consequences for all competing transportation services [8]. Sharing platforms for bike and car use are new forms of the rental economy, enabled by the internet and the many new portable technologies increasingly used today [9]. Multiple models of mobility and transport shape this system; sharing becomes a way of connecting people, places, organizations, and events [7]. Sharing mobilities as an emerging system of socio-material relations, digital and tangible infrastructures, politics of access and connectivity, and co-created values offer potential as well as challenges [7].

The concept of “sustainable mobility” has evolved [10]. The uncertain sustainability implications of shared mobility create a need for new approaches [11] for analyzing multiplicity [12], low-energy innovation in everyday mobility [13], and a shift away from traditional vehicle ownership towards new concepts from the sharing economy [14]. We

need to examine the mundane and stable continuation of existing structures, while taking social and technical innovations into account [15].

Social practice theories (SPTs) with transition studies can be relevant here, suitable for studying aspects concerning everyday life [16] and consumption in socio-technical sustainability transitions [17–23]. The multilevel perspective (MLP) in the transitions literature [24,25] has proven useful as an analytical tool for identifying and engaging with diverse stakeholder groups, including mainstream (‘regime’) and alternatives (‘niches’) in the domain of sustainable transport research [26]. SPTs can deepen our understanding of the key social mechanisms and dynamics underpinning transitions in everyday life, and of the role of agency and collective action in processes of social change [27], such as understanding the role of users and car-sharing practices in puncturing the regime of automobility [28].

Various forms of car-sharing services are emerging as information technology is incorporated into mobility [29]. Recent empirical studies from Norway investigate the potential influence car-sharing has for car ownership [30], travel patterns for emerging new car-sharing practices [31,32], and the role of context and lifestyle for car-sharing [33]. Alternatives to car ownership are emerging in connection with decarbonizing Nordic transport systems [34]—and here the development of organized car-sharing in Norway can play a role [35].

There is a considerable body of knowledge on household practices associated with activities such as mobility and energy use [36,37], and car-sharing [32], but less is known about the dynamics of business models, platforms, and providers for car-sharing practices and mobility-system change. The present study addresses this gap by examining how providers contribute to shaping car-sharing practices. This approach is in line with suggestions to look at providers [38] and how new practices arise through the active and ongoing integration of images, artifacts, and forms of competence—a process involving consumers as well as producers [39]. An earlier related study focused on the user side, showing how car-sharing practices are executed, conceptualized as practice-as-performances [40]. Seeking to show how services shape practice, the present study turns to what is usually recognized as the practice of car-sharing, the generally understood type of practice, conceptualized as practice-as-entity. The empirical study is based on household interviews, stakeholder workshops, and interviews with providers.

Section 2 presents the literature on social practice theories and sustainability transitions. Section 3 presents materials and methods, Section 4 gives an outline of results, and Section 5 provides an outline of points to discuss. Section 6 concludes with implications for policy and research, and suggestions for future research directions.

2. Literature

2.1. Sustainability Transitions and Social Practice Theories

Sustainability transitions are conceptualized as a shift from a dominant socio-technical regime to a new regime, formed by interactions between the three levels of landscape, regimes, and niches. Established socio-technical systems can shift to more sustainable modes of production and consumption, with systemic changes in long-term, multidimensional, and fundamental transformation processes [41]. They may involve changes in environmental performance, economic prosperity, and societal equity [42].

SPTs are a family of theoretical approaches focusing on the multiple, everyday, routinized actions that constitute society [38]. Although “there is no unified practice approach” [43], a key assumption is that social structures are reproduced by performances of everyday practices [44–46]. Social practice theories connect micro- and macro-approaches to a social analysis by highlighting the interconnections between routinized everyday life and larger-scale sociotechnical developments [16], emphasizing that drivers of action tend to be located in “the site of the social”, rather than being driven by deliberative processes [47]. According to SPTs, changes in what people do cannot be reduced to the attitudes, behavior, or choices of individuals [48]. Social structures and technologies do not

exist outside or above individuals; rather, they are reproduced through routines performed by “practitioners” [49–51].

A “practice” refers to a routinized way in which objects are handled, bodies moved, subjects treated, things described, and the world is understood [50]. Practices are procedures of actions, seen as shared routinized ways of performing something [36,50,52]. Practices are constituted by distinct elements, such as people, forms of knowledge, artifacts [44,47,53,54], and their use [38]. This process is simplified in the suggestion to involve dynamic connections among the three main elements: materials, meanings, and competencies [51]. Elements and co-evolution between elements can uncover actor agency and changes in practices [46,50,55,56].

While earlier research with SPTs tended to focus on the continuation and persistence of practices, more recent studies have focused on how practices develop, sustain, and disappear. Thus, SPTs can offer insights into innovation and deep structural change in the context of sustainability [38]. SPTs show that human action depends on elements beyond the individual. Practices are more than what people choose to do, because forms of knowledge and technologies beyond the realm of individual actors are also implicated [38].

Such practice-based analysis takes everyday practices as the unit of analysis and considers individuals as the carriers of practices. Practices may be approached as entities and as performance [50]. Practice-as-entity refers to practice as the generally understood ideal type of practice—what people usually recognize as a practice and what kinds of elements are connected to it. People can talk about and understand it, also without performing it. Practice-as-performance, by contrast, is the unique performance of a practice in a specific time/place setting. Although a performance will always differ somewhat from other performances of the same practice, it resembles the general doing of the practice enough to be recognized as the practice [57].

2.2. System of Practices

A general (mis)understanding and mistaken simplification is that transition studies focus on production, and SPTs on consumption. Connecting production and consumption, and overcoming these misinterpretations, SPTs in transition studies are applied beyond the user-practice focus [38,57–61], challenging the supply/demand dichotomy [62]. Applying social practice theory to studies of the supply side and businesses and organizations is common elsewhere, as within management studies indicating a practice-based view of knowing and learning in organizations [63,64]. Practice theories are used for studies of social and organizational phenomena, such as interaction processes in business network businesses [65], building on practice-based approaches within organization studies [43,50,51,54,64,66–68], and market studies [69–76]. By contrast, the present study does not investigate practices within organizations and business developments, but instead includes relevant business models and platform technologies in seeking to explain how providers contribute to shape practices.

In transitions to a decarbonized transport system, a systemic practice approach can draw attention to how practices co-evolve across diverse locations and levels of the socio-technical system [36]. Instead of studying this solely in terms of niche and regime dynamics, such processes can be seen as co-evolutions of practices—as with the shift from driving and recruitment to cycling [36]. Such a “system of practice” approach implies that changes to the system may result from shifts in practice at any level—for example, changes such as peak oil at the landscape level of the MLP may result in recruitment to cycling practices [36].

Building on this “system of practice” approach, studies of energy and food practices have paid attention to networks and providers [37,38,77]. Further, a “system-of-provision” perspective for studies of changes in energy systems examines how the uptake of new technologies relates to connections between providers of energy services, consumers, and infrastructure networks [59]. Other studies have included providers when drawing on practice theory and socio-technical sustainability transitions [58]. For example, an integrated approach for regime analysis has been developed [61] and changes in agricultural

fertilization practices analyzed by focusing on the practice elements of materials, meanings, and competencies [57].

Although practice theories represent an emerging approach to analyzing sustainability transitions [57], and studies show examples of this [78–82], the integration of SPTs with transition studies has been questioned due to different ontologies [52,83–85]. Regardless, applying SPT in connection with sustainability transition studies is held to be useful because individualized models of consumption—like marginal lifestyle changes, consumption emissions reduction, and technological innovations—cannot alone satisfy the ambition of achieving an environmentally sustainable society [86,87]. By foregrounding practice as the central unit of social scientific analysis, SPTs transcend the dualisms of agency/structure and holism/individualism, offering insights into processes of socio-technical change [27].

Although this increasing body of work includes networks and providers, most research still uses SPT in transition studies to examine aspects of the users. Few empirical studies have focused on the role of providers in practices involving new technologies and policies. This study seeks to fill that gap by addressing the research question: how do car-sharing providers shape car-sharing practices, and with what implications? The research objective is to explore how business models and platforms contribute to shaping car-sharing practices.

3. Materials and Methods

Qualitative methods of interviews with households and providers of car-sharing services and stakeholder workshops were chosen for this study because people can talk about practices [88]. The combination of different types of data corresponding to the demand and supply side provides opportunities for analyzing car-sharing in a mobility-system context [89]. Primary data were obtained through household interviews with users and a stakeholder workshop with representatives from car-sharing services, public transport companies, members of city councils, and neighboring counties and municipalities. The secondary data stem from interviews with representatives of providers of car-sharing services in Oslo.

On 31 October 2018, a half-day stakeholder workshop was organized with representatives from three car-share operators (Bilkollektivet, Hertz Bilpool, NSB/VY Bybil), public transportation services (Ruter), public authorities (Oslo City Council, Akershus County, Bærum Municipality), mobility organizations (Møller Mobility Group), and research representatives (CICERO). The workshop involved groupwork, followed by plenary discussions. The three groups (SWG1, SWG2, and SWG3) discussed car-sharing as part of a sustainable transport system, and shared opinions on how car-sharing in a mobility system would look like, focusing on what can be done by various stakeholders. Groupwork conversations were recorded and transcribed; see Table 1 for list of participants and the three stakeholder workshop groups (SWGs).

Table 1. Stakeholder workshop participants.

Stakeholder Participant	Stakeholder Description	Stakeholder Workshop Group SWG ID
Bilkollektivet	CS Cooperative	SWG1
Bilkollektivet	CS Cooperative	SWG2
Hertz Bilpool	CS Service Corporate	SWG1
Møller Mobility	Car company	SWG2
NSB/VY Bybil	CS from Norwegian State Railroads City Car	SWG3
Ruter	Public transport operator	SWG2
CICERO	Research institute	SWG3
Oslo City Council	Section for the Urban Environment	SWG1
Akershus county	Neighboring county to Oslo	SWG2
Bærum municipality	Neighboring municipality to Oslo	SWG3

The household interviews were conducted in the respondents' homes in May–July 2017, October–November 2017, and January–March 2018. Semi-structured interviews

were held with 39 households; the author of this study was involved in 34 interviews. Respondents were recruited through an announcement on the Facebook pages of car-share suppliers. An overview of possible participants was made, and interviews were then booked, targeted towards variation in age, location, and the number of family members. The households were registered members of three different kinds of car-sharing services: a business-to-consumer (B2C) cooperative (Bilkollektivet), a B2C corporate provider (Hertz Bilpool), and a peer-to-peer provider P2P (Nabobil). Table 2 gives an overview of the interviews. The households varied—couples or singles, with and without children living at home. Thirty-three of the households used car-sharing services (two were members who provided cars on the peer-to-peer platform; four were members but nonusers). Interview guides for users and nonusers were developed; these included questions about life situation, daily travels, leisure travels, car-sharing use, motivation, and implications. Respondents were informed about confidentiality and privacy and agreed on a confidentiality statement. Interviews lasted from 45 min to two hours, mostly with all adults in the household, and were recorded and transcribed.

Table 2. Overview of household interviews.

Type of Car-Sharing Service	Household Interview Oslo HIO ID
B2C cooperative	1,8,9,13,15,16,20,22,23,25,26,27,29,30,36,37,38,39
B2C corporate	4,5,6,7,14,17,21,31,33,34,35
P2P	2,3,10,11,12,18,19,24,28,32

Interviews with providers were conducted with employees in six car-share companies in January 2017. Providers were a car-sharing cooperative (Bilkollektivet), services providing car-sharing (AVIS NOW) in collaboration with housing corporations (OBOS), a platform providing peer-to-peer car-sharing services (Nabobil), and two companies providing hubs of station-based car-sharing (Move About and Hertz Bilpool). The interviews followed a semi-structured interview guide, with initial questions concerning the establishment of the company, services provided, and further plans for the company, followed by questions concerning customer relations, channels for customer communication, sales of the services with revenue streams, ownership structures, and core competence in the company. Ultimately, questions concerned connections with other car-sharing companies, policymakers, and public transport providers, and their views on the prospects of car-sharing as part of alternatives for urban mobility. (See Table 3). These interviews were used as secondary data in this study as the author was not present.

Table 3. Interviews with car-sharing providers.

Provider	Description	Interview ID
AVIS Now	CS with housing companies	IAN
Nabobil	Peer-to-peer CS, P2P	INB
OBOS	Housing company	IOB
Move About	CS	IMA
Bilkollektivet	CS Cooperative	IBK
Hertz Bilpool	CS Corporate company	IHB

Some of the data have previously been used for other studies, for example in a published study that used the household interviews to show performances of car-sharing practices [40]. The present study is a continuation of this. Data analysis involved three steps: data were first synthesized; then, the coding was guided by concepts from social practice theories and transition studies; thirdly, the results from the coding were combined, evaluated, and cross-checked and also compared against the other, related, studies.

Possible limitations of this study concern the data collection and analytical process; biases concern the possible self-selection issues in the sample of respondents. Further, it should be noted that the study was conducted by only one author.

4. Analysis and Results

The results address the research question of how car-sharing providers shape car-sharing practices. Section 4.1 presents car-sharing services by first explaining how new actors offer car-sharing services in the Oslo urban area, and then notes how existing auto-mobility actors also offer variants of car-sharing services. Section 4.2, on the providers' role in car-sharing, describes this as a practice-as-entity and elaborates on three elements: meanings of mobility, car and communication competencies, and objects and infrastructures.

4.1. Car-Sharing Services in Norway

Both new actors and established companies offer variants of car-sharing services in Norway. Cooperatives are nonprofit car-sharing services offering station-based, round-trip car-sharing through fleets of cars available for their members in specific locations. Other types of car-sharing services include free-floating models, where cars are not station-based, but are picked up and delivered within a delimited area. Car-sharing is also offered through online sharing platforms, where cars owned by persons using the platform are announced, organized as peer-to-peer (P2P) business models. In addition to the emergence of these recent car-sharing services, existing actors, such as established automotive companies, now offer types of car-sharing services—for example, through subscription models, short-term leasing, and/or apps for using station-based cars. Services may be used by private consumers in a business-to-consumer (B2C) model, or by companies in business-to-business (B2B) models.

“Bilkollektivet” (lit: “the car collective”) is a user-owned, nonprofit organization, established in 1995 as the first formal car-sharing service provider in Norway [35]. Members may be companies or private customers; they buy a share on joining, and book cars and pay for their use through an online service. “Move About”, another station-based car-sharing service, is organized as a corporate company, as a for-profit organization.

The peer-to-peer car-sharing platform “Nabobil” enables communication and payment of sharing of privately owned cars. Nabobil (lit: “neighbor car”) is often compared to Airbnb, as a sharing platform for cars instead of housing. Like Airbnb, which rents out rooms and apartments on a short-term basis, P2P car-sharing is suitable for people seeking to rent vehicles for use, as well as car-owners who want to earn something from the excess capacity of the vehicles they own [35].

Public transportation actors also offer car-sharing. One of the largest transport groups in the Nordic countries is the Vy Group, owned by the Norwegian government and Ministry of Transport and Communications. Their car-sharing service, “Bybil” (lit: “city-car”), was launched as the first free-floating car-sharing platform in Norway in 2018, at the time provided by the Norwegian State Railways (NSB), in partnership with the Danish company GreenMobility [35].

Further, the established car rental companies Hertz and Avis provide station-based car-sharing services. “Hertz BilPool” was started in 2010 as a corporate acquisition of Oslo Bilpool. “AVIS Now” is part of the car rental company, AVIS Budget Group, established in 2016 as a pilot project with the housing cooperative OBOS [90]. These various services differ in their models for access, such as memberships, whereby one can, for example, pay a higher monthly fee with a cheaper price per kilometer, or a smaller monthly fee at greater cost per kilometer.

Companies that previously only sold cars are now developing their own car-sharing services and are otherwise involved in developing new alternatives to ownership, such as short-term leasing and subscription models. For example, the retail automobile company, the Møller Group, marked the shift by symbolically adding “Mobility” to the company name. In 2017, they were engaged in establishing “Mobility Lab”, a project intended to provide an arena for exchanging ideas and experiences, and networks aimed at promoting an entrepreneurial environment for developing mobility solutions to deal with environmental problems and transport challenges. In 2018, they established the car-sharing service Hyre (“hire”), which offers station-based car-sharing through an app used to book and open

cars and pay for usage [91]. Further, Hertz and AVIS Now are examples of established car rental companies that now offer car sharing.

Car owning and car rental and the various types of supporting services (car loans, insurance, maintenance plans, used car sales, etc.) have been the dominant way of obtaining and using cars. This is now changing, with both established and new actors offering variants of car-sharing services. Table 4 shows the variants of car-sharing services investigated in this study.

Table 4. Variants of car-sharing services investigated in this study.

Provider	Scheme	Type of Car-Sharing
Platform	Peer-to-peer	“Neighbor” car-sharing
Car collective	Station-based	“Cooperative” car-sharing
Car rental company	Station-based	“Self-service rental” car-sharing
Housing company	Station-based	“Community” car-sharing
Public transport company	Free-floating	“City-car” car-sharing

4.2. Practice-as-Entity

Practice-as-entity is how people usually recognize an action—it includes the elements that constitute the practice and elements that connect to the practice. In the three-element approach, practices are constituted by the elements of meaning, material, and competence and their interconnections. Car-sharing practices include processes of searching and booking a vehicle, finding and opening it, driving and parking, and completing the transaction and paying. Through Internet access, hardware devices, and software programs, users can access cars, organize insurance, maintenance, communication, and key-less opening technologies. The various ways car-sharing services are offered are here explained as consisting of elements, and connections and co-evolutions between the elements.

4.2.1. Meanings of Mobility, Objects and Infrastructures, Car and Communication Competences

A common concern for new services and incumbents alike was whether cars will continue to be part of the mobility system. Some incumbents aimed to identify ways of continuing with cars as part of the mobility system. This also involved preventing the demand for private cars from disappearing. According to a respondent from a (former) car rental company, they wanted to participate “in the war for car customers” and needed to find new ways of renting out cars that will prove profitable in the long run (IAN).

A representative of the new actor Move About explained that their main objectives were to provide mobility solutions instead of cars as such:

Move About simply does not focus on the car itself, but on the users who need mobility (IMA).

We want there to be as few cars as possible that are used as much as possible (IMA).

A reduction in the car fleet means that Move About does a good job. That contrasts with car-sharing companies that view this as short-term car rental. Mobility is the key, not the cars themselves (IMA)

Representatives of Move About stress that their business is not cars as such: offering mobility solutions are the core value and goal of the company (IMA):

Today, car-sharing is our main task, but in the future, other solutions concerning mobility on demand are the main goal: the mobility you need, when you need it. Car-sharing is part of this picture and does not exist alone (IMA).

We do not provide car-sharing, but the delivery of mobility services. Today, the car is the key asset, but in the future, we cannot know for sure what it will be (IMA).

Representatives from Hertz stated that they wanted to contribute to sustainable urban development, adding that the station-based round-trip model can contribute to reduced car ownership and driving. They do not aim to eliminate the need for cars, but

to change the use-patterns (IHB). Also, Bilkollektivet was concerned with changing the use patterns for cars—they provide vehicles when these are needed, offering accessibility and flexibility. Further, as a cooperative, they listen to the users, as they are also the owners. Representatives stressed the importance of long-term profitability (IBK). Nabobil spokespersons explained that the objective is to be responsible for providing distribution channels for cars (INB).

The material element of car-sharing practice includes physical and digital objects and infrastructures related to cars and platform technologies. The car is the object in use, and the various car-sharing business models and platforms provide ways of accessing these vehicles. For example, the car collective owns or leases a hub of cars, which are made available to members, whereas the P2P car-sharing service provides only the platform. All providers of car-sharing saw technology as central.

Competencies on both cars and communication matters, where car fleet management is central for the providers of station-based and free-floating schemes, and the P2P services need competence for the platform technology. Some providers stated that they drew on their experience within the automotive industry. Services that previously provided car rentals—AVIS Now and Hertz—emphasized the importance of the already established skills in handling cars in their new car-sharing services. Hertz representatives saw their core competencies—operation, large network, car dealers, service, and research experience—as important for their car-sharing service (IHB). AVIS Now stated that their core competence is related to logistics, car rental, car technology, and is a foundation for their work with car-sharing (IAN). They emphasized that new ways of renting and sharing vehicles through online communication can reduce employment costs compared to car rental offices (IAN).

4.2.2. Connections between Elements and Connections to Other Practices

Three types of connections tie the elements together and affect what is understood and recognized as car-sharing. The various business models and platforms and the ways in which they offer solutions for booking and payment, opening and accessing the vehicle, and driving and parking.

Associated with booking and payment, the business models and platforms are relevant because of which costs are covered—for example, usage in time periods and distances, fuel and parking, and insurance and maintenance. This leads to variations on how car-sharing is used for preplanned travels or impulse trips, and whether members are committed to specific services through monthly fees or use multiple services randomly. The providers offer insurance and maintenance options as part of the car-sharing practice. Many households see car-sharing as a way of having access to cars without committing to obligations concerned with repairs and annual vehicle fees.

Take the opening of a car by means of a smartphone instead of a key. This involves both the material element, with the communication devices, and the competence element, because of the knowledge on how to open the car this way, as well as the meaning element, with the flexibility to open the car without needing a specific key.

Parking is involved in the beginning, throughout, and at the end, depending on whether the services are station-based or free-floating. There can also be other specific encounters, e.g., charging electrical vehicles (EVs). The car-sharing service AVIS Now collaborated with the housing cooperative OBOS and had their cars parked in housing companies, and they saw facilitating necessary infrastructure, especially charging and parking, as important parts of their car-sharing service (IOB). Hertz Bilpool has supported this view of the importance of public parking spaces and charging. They addressed two issues concerning public parking spaces. First, they raised a concern that current parking policies regarding, for instance, residential parking should also deal with parking for car-sharing cars, and not be restricted to privately owned cars. Second, they proposed that local regulations with building norms for minimum parking spaces in a housing development could be reduced if they include car-sharing (IHB). OBOS has supported this as well,

viewing dispensations from the parking norms, good public transport, and dedicated parking spaces for shared cars as drivers for the further development of car-sharing (IOB).

Connections to other elements and practices include connections to other shared-mobility alternatives, such as bike-sharing schemes, as well as public transport, housing, and workplaces. As one respondent noted, car-sharing relates to other mobility practices, public transport in particular:

Good public transport is important for alternative systems such as car-sharing to work well enough and be a good alternative to private car ownership. (IMA)

Travelers use car-sharing services in addition to public transportation; partnerships, especially in collaboration with public transportation or towards the mobility-as-a-service model (MaaS), is, therefore, a possible future scenario (IAN). Here, bicycle-sharing and electric bicycles also play a role—the idea for the future is for users to request mobility roundtrip to a certain destination, through a mobility service offering various alternatives in addition to car-sharing (IMA).

5. Discussion

We have seen how providers are involved in shaping car-sharing practices, but what are the implications of this? The services examined in this study include cooperatives with station-based cars, peer-to-peer platforms with access to privately owned cars, and a public transport company offering free-floating services. The various ways cars are made accessible through these services affect the way car-sharing is used. First, I look at what this implies for changes in the (auto)mobility system. Then, I discuss how car-sharing practices are shaped and steered by car-sharing providers in the recursive relationship between practice-as-entity and practice-as-performance.

5.1. Moving Mobility

The analysis has shown how car-sharing providers are contributing to changes in the mobility system, as car-sharing services are part of providing mobility to users. Alternatives to car ownership are emerging in the transformation of the “system of automobility” [2] to a “system of mobilities”. Car-sharing providers are causing both stability and instability when they provide access to cars, because of how this affects consistency in cars for personal mobility. The providers contribute to making cars available through access-based models. Instead of contributing to change, the providers of car-sharing also contribute to reinforcing old, persistent meanings. With the incumbent’s role in continuing with automobility, in addition to facilitating the generation of new meanings of accessibility to cars, existing meanings of cars for mobility were stabilized. This is in line with former research stating that carsharing is both immersed in and distinct from the regime of automobility [28].

The established car retailers and car rental companies offering car-sharing services indicate changes in both the regime and niches. Developments in business models and platform technologies contribute to incumbents changing in the existing regime of automobility. This implies that providers play a role in changes both in regime- and niche- practices, adding to research that suggests including providers, and regime- and niche- practices in integrated frameworks of social practice theories and transitions theories [36,39,92–96].

5.2. Shaping and Steering Practices

The provision of mobility services shapes what is understood as car-sharing, the “practice-as-entity”. Social practice theories (SPTs) can be used to explain a social phenomenon as an alternative to studying action resulting from intentional individual interests. SPTs see practices as everyday actions of individuals that recursively make up the social structures. Phrased in terms of structuration theory [44], practices entail both structure (as an entity of related elements) and agency (concrete enactment and performance) [97]. Following this understanding, we can see a recursive relationship between the practice-as-entity as something that holds together an understanding of a phenomenon and as a

type of “structure”, and the practice-as-performance in ways of executing and doing a phenomenon as a kind of “agency.”

We have seen that car-sharing practices involve several business models and platform technologies. The types of services offered are emerging, leading to a larger understanding of what car-sharing involves, in turn leading to emerging ways of doing car-sharing. Figure 1 illustrates this by showing that practice-as-entity is what is commonly thought of and recognized as a “doing”, whereas practice-as-performance is what is involved when people actually carry out this doing. Practices can also be further changed when practitioners perform new practices in new situations, and different practices come into contact with each other [98].

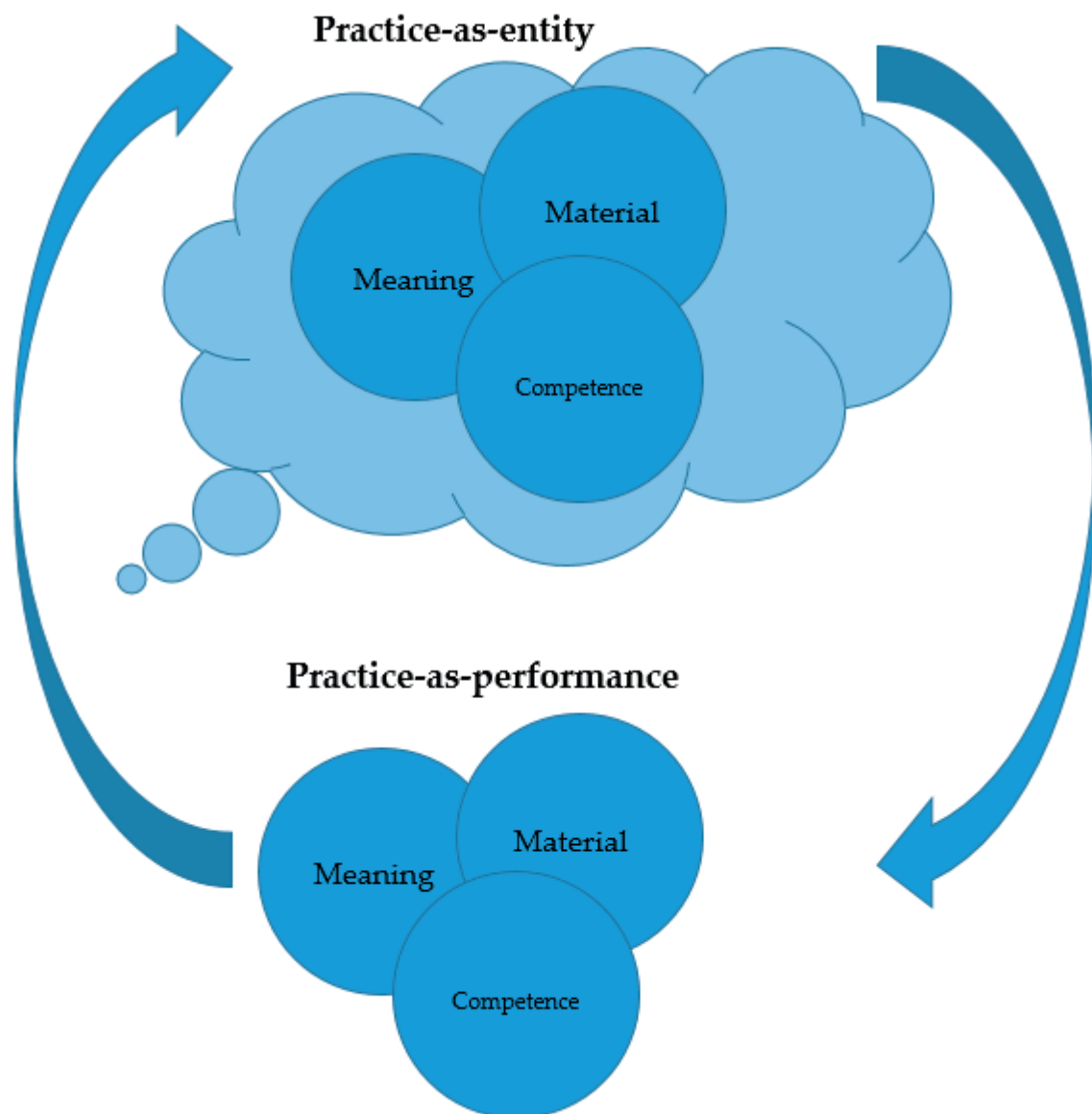


Figure 1. Recursive relationship between practice-as-entity and practice-as-performance.

This means that neither car-sharing practice-as-performance nor practice-as-entity is fixed or static. Car-sharing is both understood differently and done differently, and the results of this study highlight how providers contribute to different understandings. This analysis sheds light on how the increased provision of car-sharing services constitutes a central part of this relationship between what car-sharing is understood as “the entity”—

with implications for how it is manifested and executed in the “performance”. The analysis, therefore, sheds light on the role of providers in this recursive relationship.

With the growing provision of car-sharing services and access to these, car-sharing becomes more acceptable. If car-sharing gradually is adopted as an unwritten rule or norm, in turn, that may influence the performances of individuals. With this recursive two-way relationship, a wider understanding of what car-sharing is can lead to more ways in which it is done. Practices can reinforce existing norms or create new potentials for expansive action that deviates from social norms, creating dissensus and transformative change within social structures. Therefore, in addition to examining how car-sharing is done, it is crucial to understand what car-sharing entails and how this can differ.

6. Conclusions

This article has shown how new and incumbent actors offer car-sharing services in the urban area of Oslo in Norway, as part of the practice of car sharing. The providers’ role in car-sharing is described as practice-as-entity, with elaborations of connections between the three key elements described as meanings of mobility, objects and infrastructures, and car and communication competencies. By investigating the recursive relationship between practice-as-entity and practice-as-performance, the findings show how car-sharing practices are shaped and steered by car-sharing providers.

This gives rise to critical concerns as to how car-sharing is perceived in terms of the sharing economy, service innovation, and social innovation. This article does not aim to add further explanations to the variations of car-sharing definitions in these fields, instead, it aims to highlight that car-sharing can be done and understood differently depending on developments in business models and platform technologies. Policy interventions should thus take into account that the practices are not static and fixed. Further research could investigate these matters more, especially concerning policy interventions, by, for example, relating this to research on other sharing schemes such as within housing. Other forms of car use such as subscription models and short-term leasing could also be further studied to shed light on changes in car-sharing practices.

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Practices in transitions: Review, reflections, and research directions

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Abstract

Social Practice Theories (SPT) can contribute to transition studies by deepening our understanding of the key social mechanisms and dynamics underpinning transitions in everyday life and the role of agency and collective action in processes of social change. Several studies have applied SPTs with concepts from transition studies, and these connections merit attention. The review of 83 articles presented here shows how SPT are applied in studies of system change by i) considering change and continuity in practice elements, niches and regimes, ii) connecting consumption and production, iii) going beyond user practices, iv) mapping diffusions of innovations in daily life and v) examining policy implications and interventions. This is followed by a discussion of how the studies contribute to a practice paradigm for the Multi-level Perspective (MLP), proposing a ‘practice innovation system’ PIS approach for future research.

Keywords

Social Practice Theories

Sustainability Transition Studies

Innovation System Approaches

Practice Innovation System Approach

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1 Introduction

Ordinary citizens can contribute, beyond their position as consumers, to system change towards sustainability. New communication technologies and platform services offer new user opportunities, in turn requiring a new understanding of dynamics for system change. Concepts originating from Social Practice Theories (SPT) may deepen our understanding of the key social mechanisms and dynamics underpinning transitions in everyday life and the role of agency and collective action in processes of social change (Köhler, et al., 2017).

Some scholars are sceptical towards using SPT in transition studies, arguing that the approaches and theories are incompatible due to fundamentally different ontologies (Shove & Walker, 2007; 2010; 2014). We need to understand how SPTs are used in transition studies, what lies in the call for doing this more, and what opportunities exist for further integrating SPT in transition studies.

The emerging field of sustainability transition research, or transition studies, addresses fundamental changes in existing socio-technical systems. The Multi-level Perspective (MLP) conceptualises sustainability transitions as a shift from a dominant socio-technical regime to a new regime, formed by interactions between the three levels of landscape, regimes, and niches relating to environmental performance, economic prosperity, and societal equity (Truffer & Coenen, 2012). Sustainability transitions concern changes where established socio-technical systems shift to more sustainable modes of production and consumption, through systemic changes that are long-term, multi-dimensional, and fundamental transformational (Markard et al., 2012).

Many early transition studies were based on systems approaches to innovation, highlighting the interrelatedness of technological, organisational, institutional, and socio-political change. System change, with discussions of stability and instability and the role of innovations, has been a key research objective in such studies. Socio-technical systems concern the realisation of societal functions that cover basic needs such as energy, food, mobility, and housing, and therefore, innovation systems (IS) approaches go beyond studying independent products, processes, or technologies (Smith et al., 2010). Transition studies initially looked back, studying long-term, fundamental shifts. The focus has now shifted towards examining what steers, governs, or accelerates these changes, to understand these complex processes.

Variants of IS approaches have been formulated and applied empirically (Binz & Truffer, 2017), using national (Freeman, 1987; Lundvall, 1992; Lundvall & Dosi, 1988), regional (Cooke et al., 1997), sectoral (Malerba, 2002), and technological (Bergek et al., 2008; Carlsson & Stankiewicz, 1991) approaches. These innovation system approaches have focused on the national level and boundaries in the national innovation system (NIS), regions in the regional innovation system (RIS), sectors in the sectorial innovation system (SIS), and technologies in the technological innovation system (TIS).

Basically, these approaches concern system boundaries, identifying which elements contribute to the generation of innovation-related positive externalities and which ones do not (Bergek et al., 2015). These approaches have many shared features, as innovation and diffusion processes involve collective and individual acts (Jacobsson & Bergek, 2011). However, there are also significant differences in each tradition's epistemology, research objectives, and methodological approach (Coenen & López, 2010). Because of the focus on national, regional, or sectoral and technological

capabilities, approaches have typically been concerned more with the supply side (Nelson & Rosenberg, 1993; Wieczorek & Hekkert, 2012).

In addition to NIS, RIS, SIS and TIS, a Global Innovation Systems (GIS) framework has been proposed. This framework examines innovation dynamics in transnational contexts, conceptualised around knowledge creation, market formation, resource mobilisation, and technology legitimation (Binz & Truffer, 2017). Recently, given the focus on transformative innovation policy and challenge-based innovation missions, a Mission Innovation System (MIS) approach has been proposed (Hekkert et al., 2020). Innovation policy is shifting towards addressing societal challenges by transforming socio-economic systems.

I hold that concepts from SPT can contribute to a Practice Innovation System (PIS) approach. A PIS approach can offer an innovation system perspective where practices form the innovation and diffusion process as both a collective and an individual act, contributing to the generation of innovation-related externalities. Unlike other IS approaches, a PIS approach can foreground the practices, acknowledging that practices are shaped by the supply side (Dijk et al., 2019).

Combining SPT and MLP can be controversial. Nevertheless, several studies have applied SPTs with concepts from transition studies, and these connections merit attention. This article offers a review of research on practices in transition, asking: ‘How are social practice theories applied in sustainability transition research?’

2 Theoretical contexts

2.1 SPT and MLP

SPT and the MLP have emerged as approaches for understanding the complexity of socio-technical change (Hargreaves et al. 2013). Research on sustainability transitions is motivated by the recognition that environmental problems such as climate change are major societal challenges resulting from unsustainable consumption and production patterns in socio-technical systems such as electricity, heat, buildings, mobility, and agro-food. Technological solutions and incremental improvements alone cannot address these problems: they require radical shifts to new socio-technical systems – ‘sustainability transitions’ (Elzen et al., 2004; Grin et al., 2010; Köhler et al., 2017; Smith et al., 2005). Transitions research seeks to explain how such radical changes can occur in ways enabling them to fulfil societal functions. As the unit of analysis is situated at the ‘meso’-level of socio-technical systems (Geels, 2004), the focus of research on sustainability transitions differs from sustainability debates at the ‘macro’-level (e.g. changing the nature of capitalism or nature-society interactions) or the ‘micro’-level (e.g. changing individual choices, attitudes, and motivations) (Köhler et al., 2017). Similarly, SPTs have been proposed in order to avoid the pitfalls of the individualist and systemic paradigms that have dominated sustainable consumption research (Spaargaren, 2011). We need a more balanced approach which pays attention to both agency and structure, which makes room for (combining) the bottom-up and top-down dynamics of change, and which recognises the mutual influencing and co-shaping of human actors on the one hand, and objects and technological infrastructures on the other (Spaargaren, 2011: 815).

According to the MLP, transitions occur through dynamic interactions involving three levels: niches, regime, and landscape (Geels, 2011; 2012). Niches are the locus for radical innovations;

regimes are the locus of *established practices* and associate rules that stabilise existing systems; the landscape is the wider context influencing niche and regime dynamics (Geels, 2011; Rip & Kemp, 1998). ‘Transition’ is generally understood as a change from one established regime and its practices to a new regime with new rules and practices (Geels et al., 2015).

However, what is treated as a ‘practice’ here varies, which connects to how practice theory is applied in transition studies. SPT adopts a flat ontology where practices are the primary unit of analysis, whereas MLP sees practices as having graded levels of structuration: this has led to discussions of incompatibilities due to alleged hierarchical views (Geels, 2011: 37). Geels notes that the niche, regime and landscape levels in the MLP are often incorrectly referred to as micro-, meso-, and macro-levels. Such levels are properly defined as referring to different degrees of structuration of local practices, which relate to differences in scale and the number of actors that reproduce regimes and niches. ‘Levels refer to different degrees of stability, which are not necessarily hierarchical’ (ibid.: 37–38).

Further, Geels (2011) discusses flat ontologies in SPT versus hierarchical levels in the MLP, noting that SPT has a relationist ontology which assumes a ‘flat’ world. Thus, the idea of the ‘levels’ in the MLP are to open criticism. Noting how Shove and Walker (2010: 474) have proposed replacing the MLP with SPT, Geels points out that SPT operates with horizontal circulation of elements, whereas Shove and Walker argue for a flatter model with multiple relations, rather than hierarchical levels, of reproduction across different scales. Practice theory can explain transitions by distinguishing between new practices, which are more fluid and unstable, and more ‘enduring and relatively stable practices’, which are routinely reproduced and characterised by predictable trajectories (Shove & Walker, 2010: 475). Transitions can be studied by analysing how new practices come into being, how they stabilise, and how established practices disappear. Geels acknowledges that flat ontologies conceptualise transitions differently because the foundational assumptions differ from the MLP. Nevertheless, finding similarities in the types of phenomena of interest, he notes that practice theory could be reformulated in MLP-terms of regimes and niches: stable/routinised practices can be seen as ‘regimes’, whereas emerging fluid practices can be seen as ‘niches’ (Geels, 2011: 37).

2.2 Social practice theories

There is no such thing as one unified social practice theory. SPT are a set of cultural and philosophical accounts that focus on the conditions surrounding the practical conduct of social life. Since 2000, practice-theoretical ways of thinking have been adopted in fields ranging from education, geography, history, art, sociology and political science, to organisational studies and studies of, *inter alia*, consumption, learning, teaching, professions, migration, organisations, international relations, sustainability, and energy use. However, this has not been matched by corresponding refinements in the theory applied to inform empirical research (Hui et al., 2016).

In the context of the continuing debate about the structure-agency problematic in social theory and philosophy, scholars have used SPTs to (re)turn to this theoretical complexity (Halkier et al., 2011). However, applying SPT together with other theories has been criticised because of the differences in ontology (Shove & Walker, 2007; 2010; 2014), although proponents hold that

combinations with SPT can assist empirical research by directing attention towards *actions* (Frezza et al., 2019; Gram-Hanssen, 2011; Lamers et al., 2017; Perera et al., 2016).

The research field of sustainable consumption has fruitfully used SPT in ways relevant for transition studies (Spaargaren, 2003; Spaargaren et al., 2006; Warde, 2005). Practice-based approaches can reveal processes of reproduction and change in forms of consumption, bringing new conceptual insights on sustainability transitions (McMeekin & Southerton, 2012). More empirical studies are needed to develop a practice-theoretical understanding of sustainability transitions that can address consumption patterns, with the recurrent relationship between collective agency and the everyday performances of practices (Welch & Yates, 2018). Relevant here are discussions on the usefulness of applying SPT in connection with sustainability transition studies (Kennedy et al., 2015; Welch & Southerton, 2019).

SPT are cultural theories that treat societal aspects as practices (Reckwitz, 2002). SPT sees the procedures of actions as a practice, understood as a commonly shared routinised way of performing something (Reckwitz, 2002; Shove & Walker, 2010; Watson, 2012). This implies that social structures and technologies are reproduced through routines enacted by ‘carriers’ or ‘practitioners’ of social practices, and do not exist outside or above individuals (Reckwitz, 2002; Shove et al., 2012; Strengers & Maller, 2014: 3).

Here SPT moves from focusing on individual interests, and analyses practice by examining performances in the context involved. Systemic change is thus conceptualised beyond individuals that change and beyond individual attitude, behaviour, choice (Shove, 2010). However, looking beyond the individual does not mean reverting to the systemic, structuralist perspective that often ignores agency and subjectivity (Spaargaren, 2011). Practice theories go beyond individuals but emphasise how human subjectivity is at the heart of processes of structuration, reproduction, and environmental change (Spaargaren & Oosterveer, 2010).

Shove et al. (2012: 22) present a scheme of a co-evolution of three elements: competence, meaning and material, and hold that change and stability can be described and analysed by focusing on the trajectories of these elements and the making and breaking of links between them. These three elements are based on earlier concepts (Gram-Hanssen, 2010; Reckwitz, 2002; Schatzki, 1996; Warde, 2005). ‘Competence’ concerns skills, techniques, and know-how (Shove et al., 2012). ‘Meaning’ concerns ideas, aspirations and symbolic meanings (Shove et al., 2012) – with, for example, Reckwitz (2002) holding that it is about emotions, motivational knowledge and mental activities. However, it may also concern the history and setting of what people do, enabling this element to handle past, present and future aspects (Schatzki, 1996, 2002). ‘Material’ is about things, tangible physical entities, and technologies (Røpke, 2009; Shove et al., 2012). Earlier considerations of how things are involved in practices range from disregarding them (Bourdieu, 1984; Giddens, 1984) to counting them in various ways (Reckwitz, 2002; Schatzki, 2002; Schatzki, 2010).

‘Practices’ are established if elements are connected and co-evolving when links are made. The elements may also exist separately, as ‘proto-practices’ before being linked and as ‘ex-practices’ after links are broken (Schatzki, 2011; Shove et al., 2012). Schatzki (1996) presented a division between practice-as-performance and practice-as-entity. Although the two are intertwined, the

practice-as-entity sees practices as distinguishable concepts (e.g. eating, driving, reading), and practice-as-performance describes the conduct or performance of practice in a precise moment in time (Shove & Pantzar, 2007; Shove et al., 2012; Warde, 2005). Practice-as-entity can identify elements that configure recognisable patterns of action that can be understood without performing it (Higginson et al., 2015; McMeekin & Southerton, 2012; Spurling et al., 2013; Strengers & Maller, 2014). Practice-as-performance concerns how these actions are observable, making it possible to identify the space- and time-specific aspects involved in the production and reproduction of practices in daily life (Maller, 2015).

3 Methodological approach

In this study, I apply a systematic literature review approach to identify and synthesise research findings involving a seven-step process (Petticrew & Roberts, 2008): 1) define the questions that the review sets out to answer; 2) determine the types of studies that need to be located in order to answer the questions; 3) conduct a comprehensive literature search to locate those studies; 4) screening the results of that search; 5) critically appraise the studies to be included; 6) synthesising the studies and assess heterogeneity in the findings; 7) disseminate the findings of the review. Seeking to disseminate the findings and contribute to theory development, I then reflect on the findings and propose a synthesised PIS framework.

This systematic review covers articles indexed in the Scopus database.¹ A preliminary study started with a search on 8 April 2020, where a total of 70 articles were found. After reviewing the items in this selection, I selected 59 articles for closer examination; steps 1, 2 and 3 were conducted in iterations, reframing the research question and adjusting the search string. The study presented here is based on a new search conducted on 8 February 2021, where 121 articles were found. These were found through this search string, identifying articles where the title, abstract, or keywords contained: (("social practice theor*" OR "social practice" OR "practice theory") AND ("innovation system" OR "multi level perspective" OR "energy transition" OR "sustainability transition*" OR "socio-technical transition*" OR "socio-technical transition*" OR "socio-technical innovation" OR "socio-technical system" OR "socio-technical change")) limited to journal articles in English.

As part of step 4, I sorted through the studies retrieved, deciding which appeared to meet the inclusion criteria and merited more detailed examination. Content analysis of the abstracts, headings, and introductions revealed, unsurprisingly, that some items concerned *practice* in other senses, e.g. 'research practice'. Such articles were omitted, leaving out 38 articles, so that the analysis was based on the sample of the remaining 83 articles.

As part of steps 5 to 7, I coded the articles in two steps. First, I undertook a broader content review of the items, to clarify their input with theoretical and empirical positioning, the research processes in the studies, and the output of specific contributions. I wanted to map the relations between these studies and emerging tendencies, such as how certain articles built on each other, or discussion of specific research traditions within, for example, consumption research. Here I noted several ways

¹Scopus is the largest abstract and citation database of peer-reviewed literature. It lists publications issued by Elsevier, Springer, Wiley-Blackwell, Taylor & Francis, Sage, Oxford University Press, Emerald, among others.

in which SPT was used in studies of system change. Second, I started categorising the types of applications, which revealed five central tendencies. I also noted bibliographical data – research disciplines, research institutes, location, year, and publication journal. Having considered how this relates to action paradigms in the MLP, I synthesised this to clarify the premises for further research.

This approach is not unproblematic. There is a risk of not including articles that used other words in titles, keywords and abstracts than those in my search string. Also, the search involved journal articles only – not doctoral theses, books or book chapters. As part of steps 6 and 7, I sought to clarify how SPT is used in studies of system change. Presenting the studies in five distinct ways involves simplifications, leaving out explanations of complementary contributions of the articles. Further, as I was the sole investigator, the research depended heavily on my individual skills; the possibility of personal biases influencing the results should also be noted.

4 Results: Review

Guided by the main research question, ‘How are social practice theories applied in sustainability transition research?’ this section presents my findings. I begin with a short bibliographical overview of the articles, and then explain how they in five ways used SPT in studies of system change. The appendix shows the articles in the sample.

The articles covered empirical topics within housing, transport/mobility, energy, food, water systems, and related (sub-) topics, such as heating, agriculture, fertilisation, sanitation, and building. The articles are mainly published from 2010 and onwards, with increased publications in the following years. They appeared in various relevant journals, including *ERSS Energy Research and Social Science*, *Journal of Cleaner Production*, and *Technological Forecasting and Social Change*, and were published in Australia, Austria, Belgium, Denmark, Finland, Germany, Italy, Netherlands, UK, and the USA. The studies covered cases in those countries as well as others, like China and Kenya.

4.1 Change and continuity in practice elements, niches, and regimes

Many of the articles in my sample are empirical studies of change and continuity regarding practices and transitions, with some emphasising stability and continuity. For example, Wells and Nieuwenhuis (2012) hold that theoretical expectations of systemic change need a greater emphasis on how technological transition as a process may mean that many existing practices and structures are retained more or less intact rather than entirely replaced by new practices and structures.

Some studies stand out, studying the tension between stability and instability by investigating dynamics between practice elements, niches and regimes. Hargreaves et al. (2013) and Seyfang and Gilbert-Squires (2019) use SPT and MLP to reveal critical points or constraints blocking transitions in regimes and practices. Hargreaves and colleagues argue that both the MLP and SPT are ‘middle-range’ approaches that refuse to give predominance to either structure or agency in socio-technical change processes and instead focus on the dynamics of ‘structuration’ that drive both system stability and change (Hargreaves et al., 2013: 407). Applying SPT and MLP, Seyfang and Gilbert-Squires (2019) acknowledge differences between MLP and SPT but propose that parallels exist in particular between the stability of regimes and practices and possible disruption by niches and proto-practices. These parallels concern how regimes and practices are seen as

stable, supported by existing rules, regulations, institutions, and innovation and change, need to deal with such stable elements. Figure 1 shows a continuation of this argument. Based on Gazull et al.'s (2019) study of household energy transition policies in Mali, the underlying assumption of this figure is that transitions in regimes (vertical circle) and transitions in everyday practices (horizontal circle) follow different dynamics that interplay (points of convergence or divergence) and then either reinforce or hinder each other.

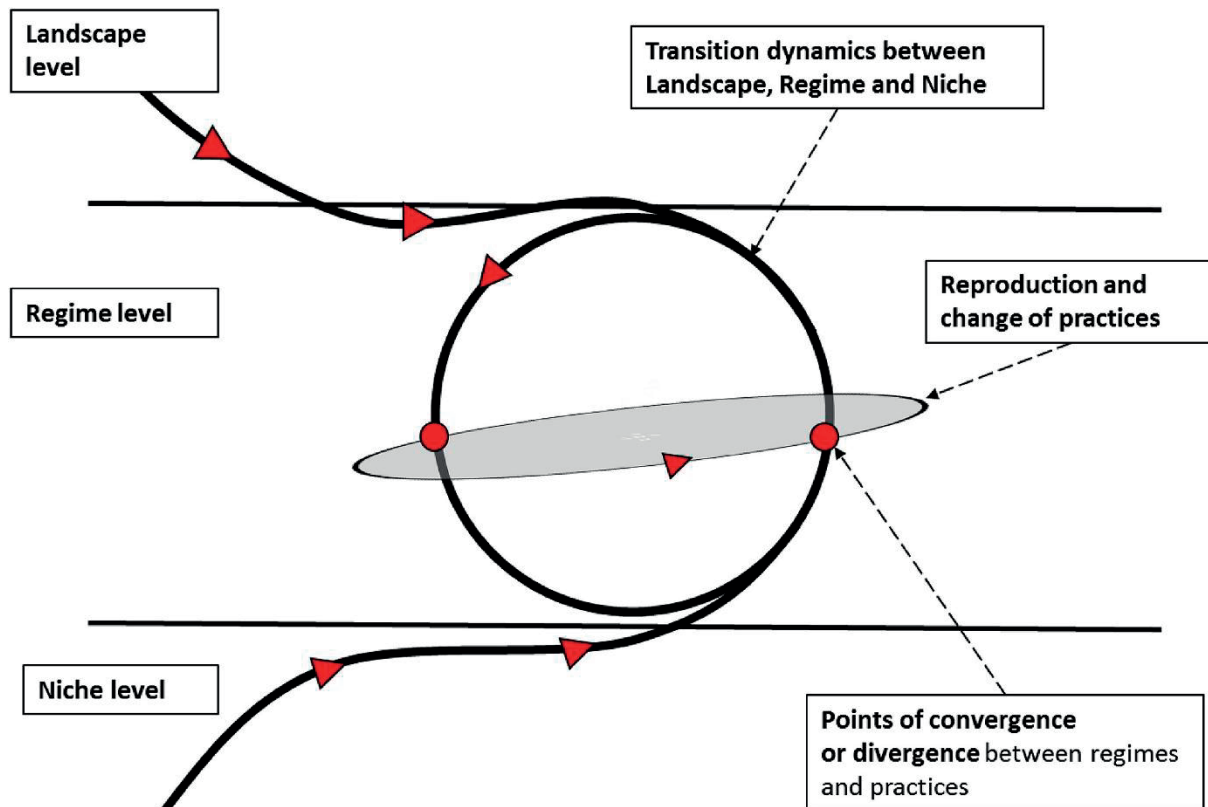


Figure 1: Combining MLP and SPT (Gazull et al., 2019)

Watson (2012) explores the relations between micro- and macro-change through a systemic approach, examining the potentials of a practice theory approach to shed light on systemic change in transport. He confronts two key criticisms of practice theories: first, concerning their apparent difficulty in accounting for *change*; second, concerning their limited ability to move beyond a micro-level focus on doing. In his ‘systems-of-practice approach’, he identifies three mechanisms involved when practice change: how elements change, how people change, and how this relates to changes in other practices. Watson’s study indicates that system change in transitions could be explained from a practice-based perspective. He proposes conceptualising the regime as a system of interrelated social practices, as ‘[...] practices (and therefore what people do) are partly constituted by the socio-technical systems of which they are a part; and those socio-technical systems are constituted and sustained by the continued performance of the practices which comprise them. Changes in socio-technical systems therefore only happen if the practices which embed those systems in the routines and rhythms of life change; and if those practices change, then

so will the socio-technical system...[As such] any socio-technical transition has to be a transition in practices' (Watson, 2012: 488–489).

Also Huttunen and Oosterveer (2017) study how practices change, and how this is linked to the socio-technical system surrounding the practices. They identify five 'fertilisation practices' consisting of links between the elements of meaning, materials, and competencies. In turn, they identify five mechanisms influencing changes in practices (1) the core purpose of the practice; (2) the nature of connections between elements and practices; (3) multiplication and diversification as dynamics of a practice, (4) the power of performance; and (5) the practitioners (Huttunen & Oosterveer, 2017). These issues relate to three distinct circuits of reproduction through which practices are maintained and stabilised (Hargreaves et al., 2013, p. 406; Pantzar & Shove, 2010: 458). Here, the focus is on the stabilization of practices. Similarly, in their study on the reproduction of car-sharing practices, Svennevik et al. (2020) find three specific ways in which practices are performed when certain elements are linked. They further suggest that practices are stabilized through combinations of complementary practices, certain connections between particular elements, and content in current practices coming from previous practices and later serving as a foundation for future practices.

Other empirical studies map different dynamics of early change, including studies of 'proto-practices' (Julsrud & Farstad, 2020) and 'niches-in-the-making' (Paschen et al., 2017). In an empirical study of collaborative consumption for housing, Huber (2017) indicate two areas where MLP insights might complement SPT in understanding practice evolutions – through 'niche ripening' and 'regime resistance', shedding light on the systemic processes that affect practice configurations.

In addition to empirical studies, three review articles map dynamics of change and continuity in practice elements, niches, and regimes, focusing conceptually on reconfiguration research (Laakso et al., 2021), empirically on agro-food research (El Bilali, 2018) and theoretically on socio-technical change research (Sovacool & Hess, 2017).

4.2 Connecting consumption and production

Sustainability transitions concern how socio-technical systems shift to more sustainable modes of production and consumption (Markard et al., 2012). Changes in consumption and production are central in sustainability transition studies and in SPT research alike. A general misunderstanding and mistaken simplification are that transition studies focus on production and practice theory on consumption (Köhler et al., 2017). My literature review shows that accusations of the narrow focus on consumption (in practice theory), and production (in transition studies) are incorrect as these approaches take in both aspects. Scholars applying SPT to transition studies go beyond the simplification of the focus on consumption-for-practice theory and production-for-transition studies, elaborating instead on the interaction between providers and users to explain the role of practices in system change.

Some studies investigate how consumption connects to social structures. For example, Liu et al. (2016) discuss various theoretical perspectives on sustainable consumption and argue that neither an 'individualist' nor a 'system- or structural' perspective alone is sufficient to understand and analyse the transition towards sustainable consumption. They propose applying a Social Practices

Approach (SPA) that combines human agency and social structures to understand sustainable consumption issues. Earlier, Spaargaren and Oosterveer (2010) had proposed using consumption practices as basic units of analysis, to avoid individualist and privatised accounts of the role of citizen-consumers in environmental change while making possible a comprehensive analysis of the relationship between the personal and the planetary in the process of ‘greening’ everyday life consumption.

Welch and Yates (2018) argue that a practice-theoretical understanding of sustainability transitions can reveal the recursive relationship between collective agency and the everyday performances of practices that produce consumption patterns. Similarly, an empirical study of plastic packaging has explored the interplay of technological innovation and consumer practices to better account for processes of change (Evans et al., 2020). Further, in an introductory article to a special issue of *Energy Research & Social Science*, Ockwell and colleagues (2018) argue that applying social practice perspectives to the energy-access challenge offers a perspective where energy access drops the distinction between producers and consumers.

Households are of particular interest here. They can act as agents of change (Naus et al., 2015); and, by being the analytical foci, households can account for intermediary interactions between the individual and the collective – in studies of retrofitting (Rodriguez & Calderon, 2014; Willand et al., 2019), laundering (Pettersen et al., 2013) and connecting energy and water provision to laundering, eating and heating practices (Strengers, 2011).

The Sustainable Product-Service Systems (S.PSS) approach also links consumption and production, and questions if models can create equitable and sustainable economic and social values decoupled from material and energy consumption. The introductory article in *Journal of Cleaner Production* by Vezzoli and colleagues (2015) reviewed the current state of such research and summarised articles that offer insights into the potentials of the S.PSS concept for understanding and accelerating sustainability. Research applying SPT here sheds new light on consumer practices in S.PSS configurations, and strategic niche management to foster a suitable design and experimentation milieu. Liedtke et al. (2015) further emphasise experimentation, arguing that real-life socio-technical experiments are essential infrastructure for designing S.PSS in collaboration with stakeholders and users.

4.3 Beyond user practices

In addition to connecting production and consumption, SPT is used beyond a user or consumer perspective. For example, the study by Huttunen and Oosterveer (2017) explores the prospects of applying practice theory for analysing changes in agricultural fertilisation practices. They note how a sustainability transition in agriculture requires a shift from a regime oriented towards increasing productivity to one where the environmental and social effects of production are central. Focusing on the three practice elements – materials, meanings, and competencies – they explore the prospects of applying practice theory for analysing the change in agricultural fertilisation practices. Similarly, Jakku et al. (2019) use the MLP combined with SPTs. Their empirical analysis of advances in Smart Farming and Big Data applications, shows the divergence of expectations and norms between actors and institutions at the niche and regime levels. They argue that bridging this divide will require niche-level interventions to enhance farmers’ agency and their

local networks, and the design of new institutions at the regime level to facilitate a fair and transparent allocation of risk and benefits in farming-data information chains.

Other studies tackle practices beyond a user focus or perspective, indicating the possibilities of using SPT to study variants of ‘provider practices’ in firms, organizations or networks. For example, Hinrichs (2014) finds SPT with MLP useful for studying the dynamics, durability and significance of innovations in food and agriculture, noting that a broad application of SPA includes examining transitions in food consumer practices, food retail practices and also food production practice. Another study drawing on practice theory develops a conceptual framework to explore the firm’s sustainable innovation journey, conceptualised as practices (Langendahl et al., 2016). Their findings show that a firm can usefully be treated as a flow of practices that either resist or accommodate new practices deemed more sustainable. Another example is a study that applies the transition approach to a novel food production context by examining the food production side of permaculture (Maye, 2018). Here, Strategic Niche Management and Communities of Practice theory are combined to examine how the permaculture community has evolved and has sought to influence the agro-food regime. Further, Verkade and Höffken (2019) develop the concept of Collective Energy Practice building on earlier practice-based thinking for a new understanding of a ‘system of energy practices’. This expands the practice-based understanding of energy, which, they hold, has focused on energy practices of the home.

Another study investigates how new technology uptake is shaped by energy services provision and everyday practices, and how such technologies mediate and reconfigure relations between users, providers, and infrastructure networks (Judson et al., 2015). The authors find that, although new technologies do lead to the rearrangement of practices, this is often disrupted by obduracy in conventions and habits around domestic heating and hot-water practices that have been established in relation to existing systems of provision. Their study demonstrates how, rather than simply increasing levels of knowledge to ensure that such technologies are adopted efficiently and effectively, systemic arrangements of energy provision and everyday practice are co-implicated in socio-technical innovation.

SPT has been used to address variants of collective practices and aspects beyond the consumer or user discourse, as in studies of networks of food-purchasing groups in Belgium (Zwart & Mathijs, 2020). Further, attention is paid to collective energy practices – as in studies of energy participation (Chilvers et al., 2018), prosumers (Standal et al., 2020), practices of energy infrastructure provision (Edomah et al., 2017), local actors (re)producing contexts (Faller, 2016), and repair infrastructure reshaping systems of provision (Ariztia et al., 2019).

Also other ‘scales’ of collective practices have been studied – urban neighbourhoods in grassroots initiatives (Slater & Robinson, 2020), grassroots and community-based initiatives (Seyfang & Haxeltine, 2012), grassroots innovators in ecovillages (Roysen & Mertens, 2019), the transition movement in Canada (Poland et al., 2019) energy- and sustainability cultures (Stephenson, 2018), broader understandings of energy cultures (Ford et al., 2017) and actions embedded in institutions (Novalia et al., 2018).

With yet another different theoretical positioning, Morrissey et al.(2014) discuss *global* agri-food systems. In the context of globalized supply chains, they focus on energy, materials and practice

elements that promote sustainable outcomes across the system and aim to develop an integrated approach for regime analysis. Their study seeks to elaborate the MLP by proposing ‘strategic regime mapping’ (SRM) – an integrated means through which complex transition dynamics can be mapped across (a) energy and material flows and (b) social practices which shape, direct, and determine these energy and material flows.

4.4 Diffusions of innovations in daily life

The issues of connecting consumption and production and going beyond the user relate to the role of everyday life for transitions. Hargreaves et al. (2013) argue for integrating MLP and SPT because of how innovations connect with everyday life. Although the MLP offers a valuable framework for understanding sustainability transitions in particular systems and regimes, it needs to be extended to account for activities that cut across existing regimes and systems to account for multiplicity, such as in transport, food, and ICT. For example, Jones (2012), using a multi-sector approach, finds that the non-transport sector influences travel behaviour; Mu et al. (2019) show how mobile apps can be developed for linking everyday food practices with sustainability transitions; Røpke et al. (2010) show how ICT-related transformations of everyday practices have implications for residential electricity consumption; and Lane et al. (2018) focus on life course and find that the use of domestic information technology (IT) such as live-streaming of video can lead to unsustainable trajectories of IT use.

Activities that engage more directly with people’s everyday practices can facilitate accounts of normality as much as novelty. For example, Twine’s (2015) study of understanding ‘snacking’ through a practice-theory lens argue that applications of practice theory in the field of sustainability transitions aim to move beyond individualistic assumptions of behaviour change and instead situate snacking as an eating practice that has emerged within the social, temporal, economic and cultural organisation of everyday life today.

Some studies find space-specific aspects helpful for understanding daily life. Cherunya et al.’s (2020) study on sanitation access in informal settlements of Nairobi draw on insights from ‘socio-technical transitions’ and ‘practice theory’ in developing the concept of oscillating domestic spaces. Noting how context and daily lives matter for the implementation and diffusion of innovations, they argue that an insufficient understanding of the context in which users must manage their daily lives is a major reason why newly provided and improved basic services are not maintained despite their seemingly superior functionality and user convenience. They propose an approach to analysing the embedding of basic services that focuses on the users’ daily practices, explaining how users take part in sustainability transitions, and noting the added value of the time-space dimension in analysing practices in highly complex contexts. Their study also highlights the lack of research on issues concerning the global South, such as informal settlements.

Pilloni et al. (2020) propose another way of including space. They apply SPT with concepts of social niches and niche development to describe spatial differentiation in their study of the success and failure of biogas units. They find that knowledge and financial and policymaker support were critical drivers, and that the involvement of women and young people was crucial for the adoption – whereas patriarchy and financial capability represented barriers.

Relating to earlier stages of innovation diffusion processes, several articles focus on experimentation, such as the study by Kaljonen et al., (2019) on the value of practice theories through studies of sustainable eating in the Finnish and Nordic context. They argue for a practice-oriented approach to experimentation to map out interventions in integrated elements of practice stemming from path-dependencies in recurring everyday practices. For example, cultural differences in meanings attached to meat can create resistance to vegetarian food.

Other contributions on experimentations, like Jalas et al.'s (2017), focus on tensions between novelty and normality by viewing experimentation as novelties that involve citizens as active participants in new practices in sustainability transitions. Similarly, Horne and Moloney (2019) examine how low-carbon experiments are sustained and whether they can generate more systemic changes in carbon-related consumption.

Järvensivu (2017) examines a socio-technical experiment to explore the cultural complexities that arise when typical fossil-fuelled practices are changed. He shows that shifts in the material arrangements for energy, food and transportation reconfigure meanings and competencies. Transitioning to a post-fossil fuel society emerges as not only a technical matter, but has deep cultural implications.

As to the steps after experimentation, Birtchnell et al. (2018) find that ‘practice-consensus’ on local practices in early processes of ‘niche’ innovations can be drivers of transitions. Further, in their study of the failure of innovation in the sanitation sector, Kokko and Fischer (2021) propose dividing practice into elements of material, activity, competence and meaning, to facilitate detailed analysis of how an innovation interacts with existing practices, and how understanding the various elements of practice can help to identify lock-ins that prevent niche innovations from succeeding. They conclude that it is necessary to change the practices of more resourceful actors, especially as regards policy, in order to move beyond experimental stages of innovation.

In line with this study arguing for a focus on resourceful actors, other articles further investigate actors in various ways and show how the roles played by humans and everyday life matter. For example, Greene (2018) argues the need for human-centred, contextual approaches to sustainability transitions that consider social differentiation in complex lived experiences, to design more integrated and resilient energy futures. Other studies include more broadly those involved in the social when aspects of daily life are taken into account. On the one hand, Birtchnell (2012) finds that elites and events play a role in shaping practices for transitions, as elites assemble new practices from often-disparate elements and influence others through events where they attempt to establish a new consensus. On the other hand, Ockwell et al. (2019) include the daily lives of poor and marginalised women and men, and argue that SPT is more explicit than socio-technical transitions theory in emphasising the lived realities of the people who are supposed to benefit from access to new, sustainable technologies. Further, Winther et al.'s (2018) study of solar-powered electricity access shows how energy impacts women’s empowerment in rural Kenya; and the study by Groves et al.-(2017) on ‘energy justice’ shows why energy use matters in everyday life.

Other studies focus on daily household routines and economic activities. Bisaga and Parikh (2018) examine energy consumption patterns and shifts in practices due to access to improved energy

services among solar home system adopters in Rwanda; Boamah and Rothfuß (2018) look at decentralised solar PV electrification in Ghana; and Boamah (2020) investigates solar energy in the context of daily life in the Kenyan periphery.

Some studies emphasize the role of learning in daily life. Plummer and Van Poeck (2020) introduce the concept of ‘educative practices’, arguing that one role of learning at the niche level within sustainability transitions is to interrupt the reproduction of norms and attitudes within socio-technical systems. Further, Roysen and Cruz (2020) examine educating for transitions with ecovillages as transdisciplinary sustainability ‘classrooms’.

Hölsgens et al. (2018) take an SPT perspective to investigate whether the MLP approach is suited for analysing and understanding the diffusion trajectories of social rather than technological innovations. A significant challenge for social innovation research is translating *social innovation* from a high-potential novelty into actual mainstream practice. They argue that elements of socio-technical systems can be portrayed as social practices, which are shown in Figure 2. Here, practices are at the levels of regimes and niches with practices of management, design and producing, consumption practices, governance practices, epistemic practices, inscribed practices, and cultural practices are illustrated as part of the socio-technical regime.

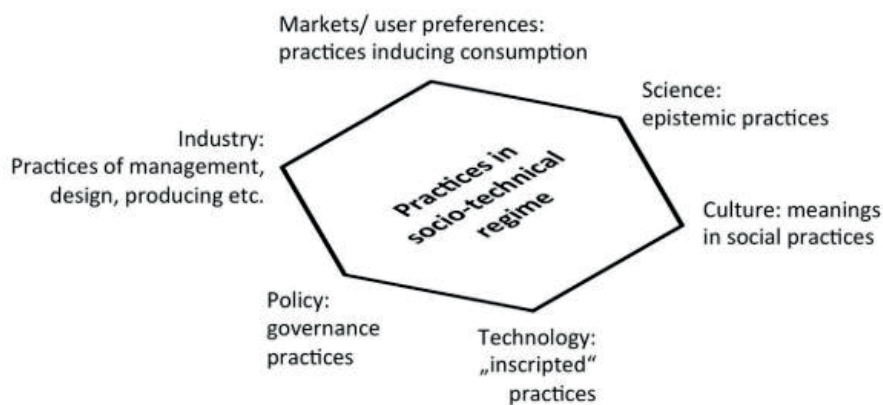


Figure 2: Elements of socio-technical systems from a practice perspective (from Hölsgens et al., 2018)

4.5 Policy implications and interventions

The above-mentioned themes all relate to policy because these studies offer implications for systemic interventions that go beyond behavioural change. In addition, certain articles stand out as studies of policies or as contributions on how to steer policy interventions.

In their seminal paper, Shove and Walker (2010) use practice theory to conceptualise the dynamics of demand. Using two cases – daily showering, and the congestion-charging scheme in London – they consider the challenges of understanding transitions in practice and governing these. They argue that practices of daily life interrelate, erode and reinforce each other, so various types of interventions may be involved in the dynamics. Instead of intervening in, for instance, driving, one needs to understand and intervene in the nexus of practices where driving is situated. Following this line of reasoning, Labanca et al. (2020) argue that policies should go beyond techno-centric

views; they advocate for research and policy agendas that are firmly grounded in social practices and that take complex and dynamic energy supply and demand as the point of departure.

Some studies are specific contributions on how to use policy interventions to steer for future change. For example, Rohracher (2008) argues that energy policies could use a range of strategies inspired by a socio-technical understanding of transition processes, such as visions, expectations, and scenario-building. Schwanen et al. (2011) find SPT helpful for challenging established views, because, given existing economic, social, and political systems and ideals, transport research on climate-change mitigation tends to revolve around reducing carbon use. They want to challenge the focus on merely optimizing the status quo, and ask ‘What is the kind of world that we would like to live in and find desirable, and how should mobility be configured in that world?’

SPT is also used to emphasize particular types of actors when the analytical focus is on policies. For example, Smith’s (2019) study of governance imaginaries uses SPT to centre the *figure* of the policymaker in order to reveal ‘governance on the inside’. Rauschmayer et al. (2015) propose a heuristic combination that returns individual agency into the study of sustainability transitions by complementing transition management approaches with practice theory. They argue that research for sustainability transitions as policy-oriented transdisciplinary research calls for a well-grounded comprehension of the societal problem involved. Scotti and Minervini (2017) propose putting the community in focus in considering environmental governance and regulations; and Cohen and Ilieva (2015) examine how cities engage in ‘strategic practice management’ to support shifts toward sustainable practices, and thus sustainable socio-technical systems.

Some articles are more explicitly studies of policy. Drawing on MLP and SPT, Little et al.-(2019) present an ethnographic case study of a failed tax on plastic bags, identifying the mechanisms that reinforce unsustainable marketing systems. Mapping these system mechanisms highlighted regulating loops that lock-in system behaviours at the macro- (landscape), meso- (regimes of technology and practice), and micro- (individual consumer and firm) levels. Further examples are a study that finds that deliberate technology phase-out is recognised as a viable policy option to weaken incumbent socio-technical configurations (Koretsky & van Lente, 2020); and another arguing that interventions may concern upscaling alternative practices (Laakso et al., 2021). Other policy-focused articles include studies of regulatory environmental taxation as part of a ‘smart policy’ mix (Bachus & Vanswijgenhoven, 2018), energy policy (Sovacool et al., 2020) and innovation policy (Smits & Kuhlmann, 2004).

5 Discussion: Reflections

5.1 Practice paradigm in the MLP

My review has shown how social practice theories are applied in sustainability transition research for more purposes than studying users, and that applying SPT can contribute to additional extensions of the MLP. Here I elaborate on how SPT can help to account for past, present and future *local actions* not covered by the four other action paradigms under the MLP. There is a need – and a possibility – for a fifth paradigm in the MLP: *the practice paradigm*.

Building on Nelson and Winter’s (1982) concept of the technological regime as a domain where the cognitive *routines* of different actors are coordinated, Rip and Kemp (1998) expanded this idea

to include not only *routines* but the wider cognitive *rule-set* embedded in engineering practices, production process technologies, product characteristics, skills and procedures, ways of handling relevant artefacts and persons, and ways of defining problems. All these are embedded in institutions and infrastructures.

Following Giddens (1984), the MLP and transition theory views these *rule-sets* as existing in practices, where actors are *rule-followers and rule-makers* at the same time (Geels, 2011). These regime rules are both the medium and the outcome of actions, the ‘duality of structure’. With *rule structures* seen as gradually rigidifying when moving from individual to community to the wider organizational field, *rule-sets* become constraining institutional habits and routines effectively reproduced in practices by narrowing the search space for new ideas, practices and visions (Geels, 2011; Graugaard, 2014).

A transition is a system-wide transformation of the rules encompassing formal regulations, normative assumptions and cognitive heuristics (Scott, 1995). This is why transition theory sees innovation within socio-technical regimes as incremental and looks to niches, conceived as protected spaces where rule structures are less rigid, for path-breaking innovations (Smith & Raven, 2012).

Geels and Schot (2007) hold that a *rule-based model of action*, like that underlying the MLP, incorporates several ways of conceptualizing *agency*. Rule-based action involves various types of rule-following, rule-using, -creation and -alteration that relate to four foundational paradigms: (1) Rational action, involving conscious attempts to determine the best action among possible choices. This entails rule-using because cost-benefit calculations are possible only when formal, normative and cognitive rules provide a stable frame for calculation (Callon, 1998; Hodgson, 1997). (2) Interpretative action, with interpretations and sense-making that involve rule-using, e.g., through cognitive frames, and rule-creation and rule-alteration. (3) Power-based action with formal rule-alterations, e.g., through lobbying and institutional entrepreneurship from collective actors, such as professional societies, industry associations, and social movements. (4) Routine actions, where deep structures are usually reproduced through routine action that consists of rule-following.

This rule-based model of action is multi-dimensional. The paradigms follow Giddens (1984) in viewing rules as recursively reproduced structures because they are used and changed by actors. This agency-structure dynamic thus is open to account for different kinds of actions: Detailed multi-level studies will reveal combinations of these four types of rational, interpretative, power-based and routine actions. These forms of agency are simultaneously present, contributing to change, stability or forming a taken-for-granted backdrop. Their contributions to transitions can vary depending on the unfolding pathway. Transitions may be induced through rational action, as well as through changing interpretations or power struggles. However, while the Multi-Level Perspective provides an overall ‘global’ framing for all transition pathways, the narrative event-sequences are always enacted and leave space for different ‘local’ subplots (Geels & Schot, 2007).

As Kanger (2021) notes, this ‘global’ model of MLP has been accused of various shortcomings: of lacking agency with an accused structuralist mode of explanation (Berkhout et al., 2004; Shove & Walker, 2010; Smith et al., 2005), relative neglect of power and politics (Kern, 2011; Meadowcroft, 2006; 2009), possible omissions of institutions and ideologies (Meadowcroft,

2011), excluding the spatial dimension (Coenen et al., 2012), conceptual vagueness (Markard & Truffer, 2008), inconsistency in methodologies (Genus & Coles, 2008) and neglecting economic variables (Foxon, 2011). Noteworthy is the lack of policy intervention in practices (Shove & Walker, 2007) and that the MLP fails to provide a conceptualization of practices that go across levels and regimes (Hargreaves et al., 2013).

Seeking to deal with some of these limitations, scholars have extended the MLP in several directions. These include developing local models for niche formation (Geels & Raven, 2006; Raven & Geels, 2010) and regime destabilization (Penna & Geels, 2012; Turnheim & Geels, 2013), refining the methodology of transitions research (Köhler et al., 2018; Papachristos, 2018), specifying the geography of transitions (Boschma et al., 2017; Hansen & Coenen, 2015), giving different consideration to actors and power (Avelino et al., 2016; Avelino & Rotmans, 2009; De Haan & Rotmans, 2018; Hoffman, 2013; Schot et al., 2016), deliberate development through Strategic Niche Management (Kemp et al., 2000), and multiplicity (Hodson et al., 2017) – and, as I have shown here, extended with the use of SPT.

6 Conclusion: Research direction

I propose a *Practice Innovation System* approach to conceptualise this practice paradigm for innovation studies and sustainability transition research. This approach can account for the role of social systems within innovation development, with a different (and reduced) focus on organizations than is the case with other innovation systems approaches. The approach is aimed at not only studying practices but studying innovations through a practice theoretical perspective. It joins the other Innovation Systems approaches in breaking with the linear model of innovation. It goes beyond the boundaries and perspectives of the other IS approaches, making it possible to study cross-national -regional, -sectoral and -technological practices. With the PIS, the rule-based action regime is changed to a practice-based action regime. This makes it possible to study actors and actions differently to, e.g. markets and institutions, when innovations happen in the social realm – for example, concerning the citizen instead of the user.

6.1 Practice Innovation System PIS Approach

Despite the many fruitful studies that apply SPT in transition studies, concretization is still lacking. Based on this review and the discussion of a practice paradigm in the MLP, I propose concretising the connections between SPTs, MLP and innovation systems approaches to form a *Practice Innovation System* framework. This would involve a ‘3x3’ conceptual framework consisting of three elements, three levels, and three layers: elements of meaning, material, and competence, levels of niche, regime, and landscape, and layers of practice-as-performance, practice-as-connections, and practice-as-entity. This framework integrates these perspectives, showing how the concepts complement one another and providing a more comprehensive picture of how the various dynamics of change and continuity. I suggest placing the PIS in the “innovation system” approach “family” because it can be used to consider how social practices structure the development, diffusion, and use of new technologies, products, and processes (Edquist, 2005). The PIS is helpful because, instead of studying institutions and organizations directly, the approach makes the practices the unit of analysis (which indirectly takes institutions into account) but focuses on how these are recursively shaped.

The three elements come from the elemental approach in SPT. I propose highlighting the co-evolution of elements by elaborating on Shove's (2012) three colours – yellow ‘meaning’, red ‘competence’, and blue ‘material’ – by adding the connections between the elements shown as orange, green and violet blend in between the elements (see Fig. 3).



Figure 3: Co-evolution of elements

The three levels come from the MLP. I propose highlighting regime and niche practices and including other regime practices, as presented earlier in Figure 2.

The three layers come mainly from Schatzki's (1996) original distinctions between practice-as-entity and practice-as performance (see Higginson et al., 2015; McMeekin & Southerton, 2012; Shove & Pantzar, 2007; Shove et al., 2012; Spurling et al., 2013; Strengers & Maller, 2014). I propose conceptualizing these as *layers* and introducing a new layer, ‘practice-as-connection’, inspired by the concept of the nexus of practices (Hui et al., 2016). Practice-as-performance refers to the actual doings, the repeated performances seen as observable action. Practice-as-entity concerns the general understandings and sayings that make practices distinguishable concepts, as recognizable patterns of action. Practice-as-connection, then, is the context surrounding the performances, e.g., neighbouring practices and the setting for the practices performed or understood. I distinguish the ‘practice-as-connections’ to amplify the space- and temporal-specific aspects involved in the production and reproduction of practices in daily life and to emphasise new possibilities for analytical foci of investigating what practices are *for*. The connections between the layers are crucial here. Such a distinction deviates from other SPTs that sees practices as flat and not disconnected from their surroundings. This layer acknowledges that practices are interconnected, and this distinction is suggested as a way of studying the nexus of practices. The layers also make it possible to identify shifts in the development of new practices when the understandings of practices are different or more developed than is the doing of the practice, say when the *understandings* of a vegan diet or solar energy are present, but the actual execution of it is not yet present.

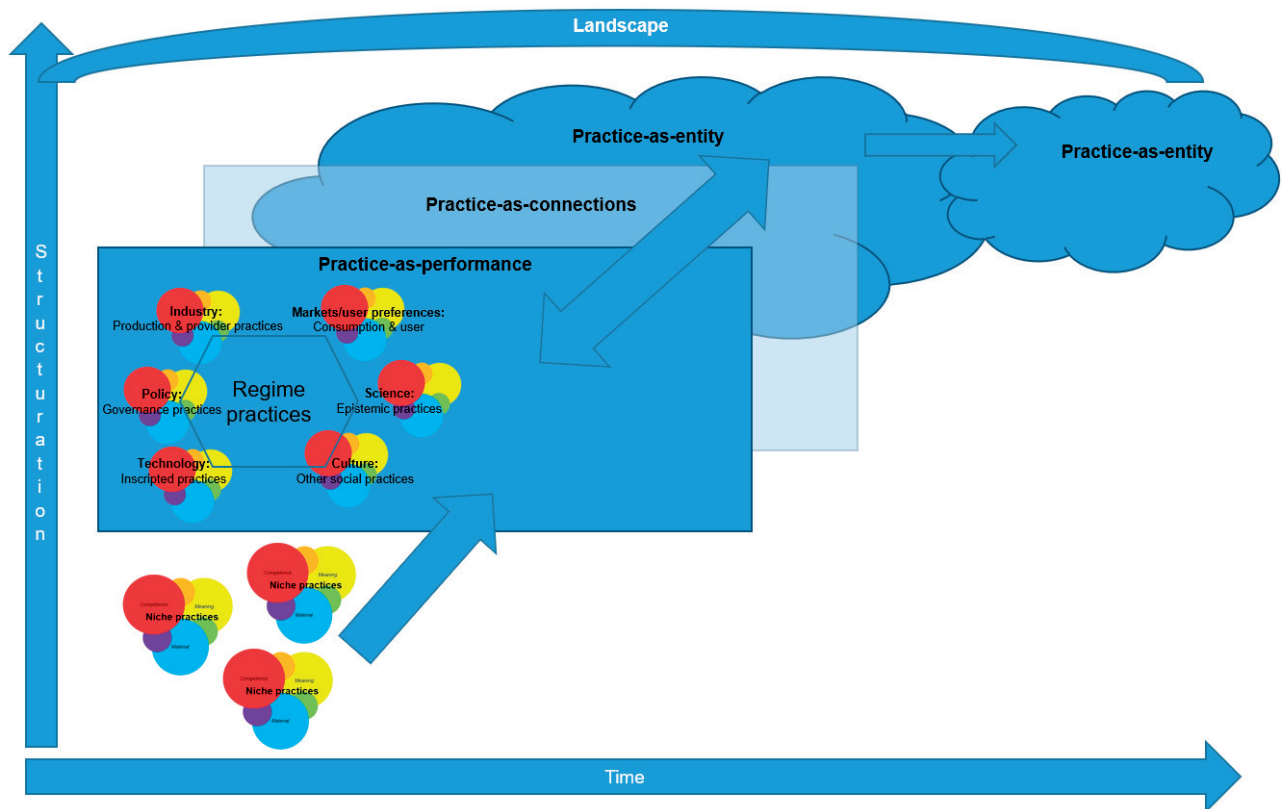


Figure 4: Conceptual framework PIS

Figure 4 show the ‘3x3’ conceptual framework consisting of three elements, three levels, and three layers². The y-axis shows increased structuration for the practices and the x-axis show time development. The arrows suggest some dynamics in the model, for example, as just mentioned on how the entity can develop before the performance. Also, a two-sided arrow illustrates the dynamics between the layers going both ways and in iterations.

6.2 Suggestions for future research

SPT is increasingly used in transition research in contributing to overcome the structure–agency division. My review of the literature shows that this also concerns overcoming six related dichotomies: consumption and production, normality and novelty, stability and instability, micro- and macro-levels, social and technical change, and flat and hierarchal levels (see Fig. 5). This review reveals that SPT in transition studies are used to study local time- and space-specific changes beyond individuals’ behavioural change, connecting practices to societies by studying different ‘scales’ of collective practices, such as grassroots and community-based initiatives. The role of citizens and concepts of collaborative consumption and circular economy call for new

² A larger version of Figure 4 is shown in the Appendix.

understandings of the role of practices in transitions. The PIS approach is well-suited for accounting for this and other concepts such as prosumers and intermediaries, as well as in studies of informal practices, power distribution, and social justice.

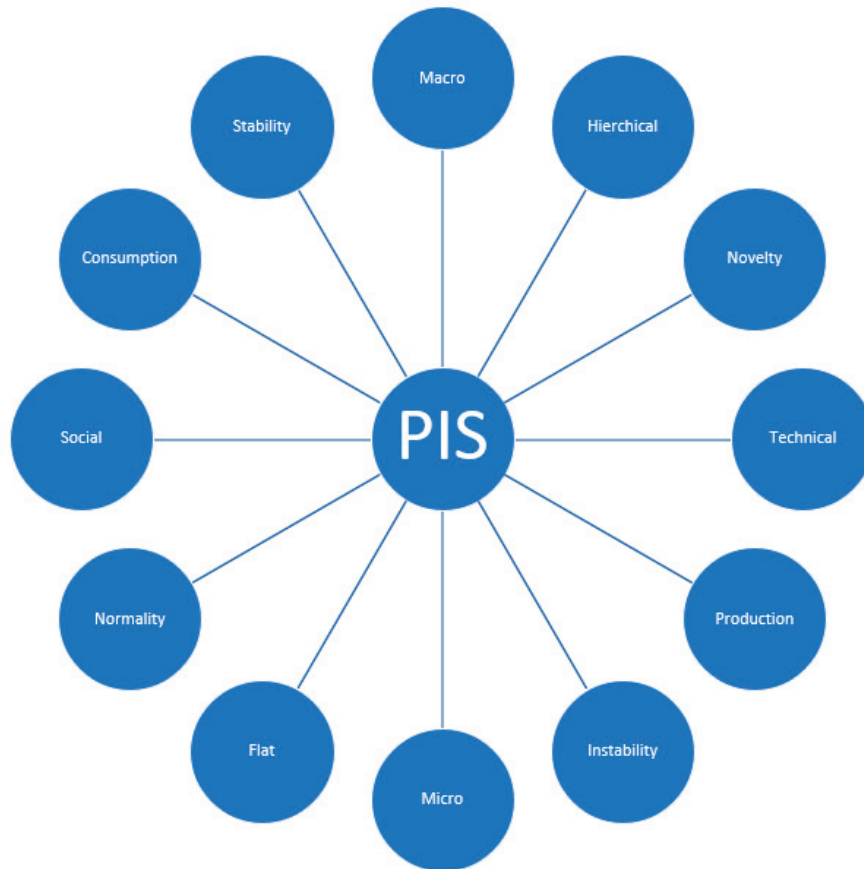


Figure 5: Overcoming six dichotomies

I suggest eight avenues for applying the PIS approach in transition studies: 1) disruption, 2) experimentation, 3) destabilization, 4) failures, 5) unsustainability, 6) social sustainability, 7) informal practices and 8) interventions. 1) The PIS approach can be suitable for analysing the disruptiveness of disruptions. Alongside technological disruption, disruption in transitions focuses on policies and institutions, actors and ownership models, markets and business models, and behaviour and practices. While markets, regulations, and actors are the most commonly identified non-technological issues connected to disruption, an important neglected dimension is disruption in the context of behaviour, practices, and culture (Kivimaa et al., 2021). 2) Experimentation concerns, for example, living-labs and pilot projects and the PIS approach can be used to study practices in experimentations revealing how new everyday practices relate to existing everyday practices. 3) These issues also relate to phase-out and decline in sustainability transitions. While much attention has been on technology phase-out in conjunction with industrial diversification (Andersen & Gulbrandsen, 2020), destabilization can be studied by revealing declining practices and how to phase out existing practices, also in terms of de-learning. 4) The PIS approach can also

be applied to investigate innovation failures, and this can be useful because understanding the different elements of practice helps identify lock-ins that hinder niche innovations from succeeding (Kokko & Fischer, 2021). 5) Also, knowing more about unsustainability is relevant for knowing more about sustainability, and the PIS approach can be used to study unsustainable practices (Antal et al., 2020). 6) Social justice and social sustainability also need more attention. Sustainability transitions research is criticized for focusing too heavily on environmental issues at the expense of equality problems, which could result from a Global North bias. I suggest that future research can apply the PIS approach for research beyond environmental sustainability, focusing in particular on social justice and power relations beyond Global North cases. 7) Studies of informal practices found both in the Global South and Global North need further attention (Cherunya et. al., 2020), and a PIS approach can be used for such a purpose. 8) Lastly, the PIS approach is suitable for studies directing attention to innovations and interventions. By ceasing to exclusively put behaviour and technological change under the microscope, the approach is suitable for a range of empirical studies that seek to investigate innovations and the role of policy incentives to reveal change and continuation in sustainability transitions.

Appendix

Transition studies: How SPT are applied in studies of system change	
Change and continuity in practice elements, niches, and regimes	
Existing practices and structures remain intact	Wells and Nieuwenhuis (2012)
Parallels exist between the stability of regimes and practices, possible disruption by niches and proto-practices	Hargreaves et al. (2013) Seyfang and Gilbert-Squires (2019)
Interplay (points of convergence or divergence) between transitions in regimes and transitions in everyday practices	Gazull et al. (2019)
‘Systems-of-practice approach’	Watson (2012)
Five mechanisms influencing changes in practices	Huttunen and Oosterveer (2017)
Practices are stabilized through reproduction	Svennevik et al. (2020)
<i>Dynamics of early change:</i>	
- ‘Proto-practices’	Julsrud & Farstad (2020)
- ‘Niches-in-the-making’	Paschen et al. (2017)
Practice evolutions: ‘niche ripening’ and ‘regime resistance’	Huber (2017)
<i>Literature reviews:</i>	
- conceptually on reconfiguration research	Laakso et al., 2021
- empirically on agro-food research	El Bilali, 2018
- theoretically on socio-technical change research	Sovacool & Hess, 2017
Connecting consumption and production	
Social Practices Approach (SPA): Combines human agency and social structures to understand sustainable consumption	Liu et al. (2016)
Consumption practices as basic units of analysis: the connection between the personal and the planetary	Spaargaren and Oosterveer (2010)
Recursive relationship between collective agency and the everyday performances of practices that produce consumption patterns	Welch and Yates (2018)
Interplay of technological innovation and consumer practices	Evans et al. 2020
Energy-access: instead of distinction between producers and consumers	Ockwell et al. (2018)
<i>Household to account for intermediary interactions between the individual and the collective</i>	
- as agents of change	Naus et al. (2015)
- in retrofitting	Rodriguez & Calderon (2014) Willand et al. (2019)
- in laundering	Pettersen et al. (2013)
- connecting energy and water provision to laundering, eating and heating practices	Strengers (2011)
<i>Sustainable Product-Service Systems (S.PSS):</i>	
- consumer practices in S.PSS configurations	Vezzoli and colleagues (2015)

- experimentation in designing S.PSS in collaboration with stakeholders and users.	Liedtke et al. (2015)
<i>Farming, beyond user practices:</i>	
- fertilization practices	Huttunen and Oosterveer (2017)
- smart farming	Jakku et al. (2019)
<i>'Provider practices':</i>	
- Food consumer practices, food retail practices and food production practices	Hinrichs (2014)
- Firm's sustainable innovation journey: Flow of practices	Langendahl et al. (2016)
- Food production: permaculture community influence the agro-food regime, Strategic Niche Management and Communities of Practice.	Maye (2018)
- Collective Energy Practices	Verkade and Höffken (2019)
Practices established in 'systems of provision': Technologies reconfigure relations between users, providers, and infrastructure networks.	Judson et al. (2015)
<i>Collective practices, beyond the consumer or user discourse:</i>	
- Studies of networks of food-purchasing groups	Zwart & Mathijs (2020)
<i>Collective energy practices</i>	
- Energy participation	Chilvers et al. (2018)
- Prosumers	Standal et al. (2020)
- Practices of energy infrastructure provision	Edomah et al. (2017)
- Local actors (re)producing contexts	Faller (2016)
- Repair infrastructure reshaping systems of provision	Ariztia et al. (2019)
<i>Other 'scales' of collective practices</i>	
- Urban neighbourhoods in grassroots initiatives	Slater & Robinson (2020)
- Grassroots and community-based initiatives	Seyfang & Haxeltine (2012)
- Grassroots innovators in ecovillages	Roysen & Mertens (2019)
- Transition movement	Poland et al. (2019)
- Energy- and sustainability cultures	Stephenson (2018)
- Broader understandings of energy cultures	Ford et al. (2017)
- Actions embedded in institutions	Novalia et al. (2018)
- Global agri-food systems: 'Strategic regime mapping'	Morrissey et al. (2014)
Diffusions of innovations in daily life	
Role of everyday life for transitions	Hargreaves et al. (2013)
<i>Account for multiplicity: activities that cut across existing regimes and systems.</i>	
- Transport: multi-sector approach, non-transport sector influences travel behaviour	Jones (2012)

- ICT and food	Mu et al. (2019)
- ICT and residential electricity consumption	Røpke et al. (2010)
- Domestic information technology	Lane et al. (2018)
Everyday practices to account for normality, snacking	Twine (2015)
<i>Space-specific aspects for understanding daily life:</i>	
- Oscillating domestic spaces: context and daily lives matter for the implementation and diffusion of innovations	Cherunya et al. (2020)
- Social niches and niche development to describe spatial differentiation	Pilloni et al. (2020)
<i>Experimentation as earlier stages of innovation diffusion processes:</i>	
- Practice-oriented approach to experimentation to map out interventions in integrated elements of practice stemming from path-dependencies in recurring everyday practices	Kaljonen et al. (2019)
- Experimentation as novelties, involve citizens as active participants in new practices	Jalas et al. (2017)
- How experiments are sustained and whether they can generate more systemic changes in carbon-related consumption	Horne & Moloney (2019)
- Experiment to explore cultural complexities	Järvensivu (2017)
<i>Following stages after experimentation:</i>	
- ‘Practice-consensus’ on local practices in early processes of ‘niche’ innovations can be drivers of transitions	Birtchnell et al. (2018)
- Change practices of more resourceful actors, especially as regards policy, to move beyond experimental stages of innovation	Kokko and Fischer (2021)
<i>Actors in various ways/ how roles in everyday life matter:</i>	
- Human-centred, contextual approaches	Greene (2018)
- Elites and events: assemble new practices from often-disparate elements and influence others through events where they attempt to establish a new consensus	Birtchnell (2012)
- Daily lives of poor and marginalized women and men, lived realities of the people	Ockwell et al. (2019)
- Energy impacts, women’s empowerment	Winther et al. (2018)
- ‘Energy justice’, shows why energy use matters in everyday life	Groves et al. (2017)
<i>Daily household routines and economic activities for energy consumption patterns:</i>	
- Energy consumption patterns, solar home system adopters	Bisaga & Parikh (2018)
- Decentralized solar PV electrification	Boamah & Rothfuß (2018)
- Solar energy in the context of daily life	Boamah (2020)

<i>Learning in daily life:</i>	
- 'Educative practices' learning at the niche level to interrupt the reproduction of norms and attitudes	Plummer & Van Poeck (2020)
- Ecovillages as transdisciplinary sustainability 'classrooms'	Roysen & Cruz (2020)
Social innovation, practices in socio-technical regime: practices of management, design and producing, consumption practices, governance practices, epistemic practices, inscribed practices, and cultural practices	Hölsgens et al. (2018)
Policy implications and interventions	
- Interventions should follow dynamics of demand, intervene in the nexus of practices	Shove & Walker (2010)
- Policies should go beyond techno-centric views	Labanca et al. (2020)
<i>How to use policy interventions to steer for future change:</i>	
- Visions, expectations, and scenario-building	Rohracher (2008)
- Challenge the focus on merely optimizing the status quo	Schwanen et al. (2011)
<i>Emphasize particular types of actors when the analytical focus is on policies:</i>	
- Governance imaginaries, figure of the policymaker in order to reveal 'governance on the inside'.	Smith (2019)
- Individual agency by complementing transition management approaches with practice theory	Rauschmayer et al. (2015)
- Community in focus	Scotti & Minervini (2017)
- Cities engage in 'strategic practice management'	Cohen & Ilieva (2015)
<i>Studies of policy:</i>	
- Regulating loops that lock-in system behaviours	Little et al. (2019)
- Deliberate technology phase-out as the policy to weaken incumbents	Koretsky & van Lente (2020)
- Interventions concern upscaling alternative practices	Laakso et al. (2021)
- Regulatory environmental taxation as part of a 'smart policy' mix	Bachus & Vanswijgenhoven (2018)
- Energy policy	Sovacool et al. (2020)
- Innovation policy	Smits & Kuhlmann (2004)

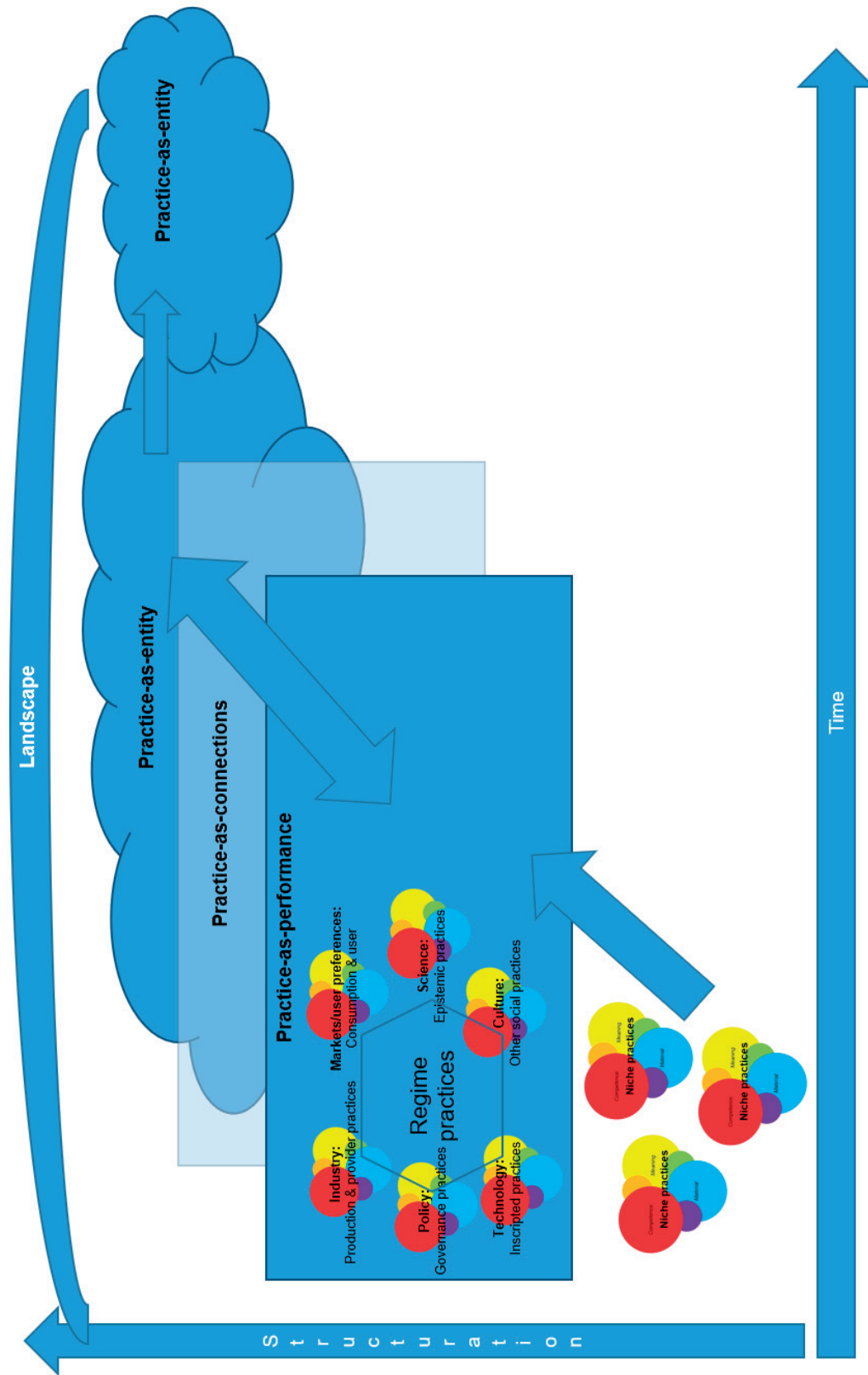


Figure 4: Conceptual framework PIS

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