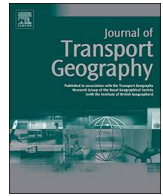




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The dynamics of modal shifts in (sub)urban commuting: An empirical analysis based on practice theories

Franziska Meinherz*, Claudia R. Binder

Laboratory for Human-Environment Relations in Urban Systems, Faculté de l'environnement naturel, architectural, et construit, Ecole Polytechnique Fédérale de Lausanne, Station 2, 1015, Lausanne, Switzerland

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ABSTRACT

A modal shift away from the private car onto low-carbon transport modes is an essential part of decarbonising the transport sector. The dynamics of modal shifts are, however, not yet well understood. In particular the interrelations between structural and individual dynamics require further investigation. Furthermore, a better understanding is needed of how new transport modes become integrated into existing mobility practices. In this article, we address these questions in a qualitative study of modal shifts in (sub)urban commuting in three major Swiss cities. We analysed the interview data by means of a qualitative content analysis informed by practice theories. We found that modal shifts can arise i) from dynamics related to the conditions of use of different transport modes, ii) the coordination of everyday mobility with other people, iii) the coordination of resources between different daily practices, and iv) from dynamics related to the intrinsic motivation of everyday mobility. We found that these different dynamics are intertwined and that to understand how modal shifts arise, they must be analysed conjointly, rather than in isolation. And we identified three patterns in how modal shifts play out, and which describe different ways in which the new transport mode becomes integrated into everyday mobility practices. The first pattern describes modal shifts which require no adaptation of existing commuting practices. The second pattern describes modal shifts after which a new everyday mobility routine must be built. And the third pattern describes modal shifts that coincide with a lifestyle change. We conclude by discussing the implications of our findings for decarbonising everyday mobility.

1. Introduction

There is an urgent need for reducing the greenhouse gas emissions originating from the transport sector. Transportation accounts for one third of European domestic greenhouse gas emissions (BAFU, 2017; EEA, 2013). Tackling private car mobility is a key lever for decarbonising transportation. In Switzerland, individual car travel is responsible for 71.3% of the total health, accident, and environmental costs of transportation (BFS, 2019). In particular the share of work-related trips in Swiss cities is on the rise and has now reached 20% (DETA, 2014; BFS, 2018a). Overall, between one fourth and one third of the commutes within and to Swiss cities are made by car (Basel Stadt et al., 2017). A modal shift in commuting away from individual car travel is feasible given the currently available modal infrastructure. Switzerland in general and Swiss cities in particular have well-developed multi-modal transport infrastructures (Basel Stadt et al., 2017; BFS, 2018b). With the present study of modal shifts in commuting in Swiss cities, we aim to contribute to the 'challenge [...] of finding ways

to engender recruitment to different modes of mobility, which can operate in the current socio-technical landscape' (Watson, 2012, p. 493).

Research on modal shifts in commuting is vast and methodologically broad. Some studies analysed to which degree policy interventions aiming at fostering the uptake of low-carbon transport modes result in the corresponding modal shifts. Other studies analysed to which degree different (infra)structural elements, life and mobility events result in modal shifts (see Section 2.1). However, these studies concluded that several aspects need further exploration. Notably the dynamics of modal shifts are not well understood. More research is needed regarding how modal shifts are intertwined with and become embedded in commuting routines (De Haas et al., 2018; Döring et al., 2019; Janke and Handy, 2019; Kent et al., 2017; Lanzendorf, 2010; Scheiner, 2014; Utley and Lovelace, 2016; Yang et al., 2017). Also how dynamics at the structural and the individual level are intertwined in triggering and shaping modal shifts is not well understood (Greene and Rau, 2016; Lanzendorf, 2010; Nkurunziza et al., 2012; Rau and Manton, 2016;

* Corresponding author.

E-mail address: franziska.meinherz@epfl.ch (F. Meinherz).

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Sattlegger and Rau, 2016).

With this study, we contribute to addressing these knowledge gaps. Our aim is, firstly, to shed light on how modal shifts arise from commuting as an inextricable part of everyday life. Secondly, we aim to better understand how using a new transport mode affects how commuting is performed and embedded in everyday life. In approaching these questions, we acknowledge that commuting is but one of the trips combined into the performance of everyday mobility (see Cass and Faulconbridge, 2016; Kaufmann, 2008). Therefore, we study performances of everyday mobility that include, but are not limited to, commuting.

In our study, we draw on practice theories, based on the premise that 'a practice approach draws attention to the ways in which practices bundle together in the organisation of people's days' (Watson, 2012, p. 493). Thereby, it allows us to see how everyday mobility is embedded in and made sense of through practices such as shopping, working and socialising, which create specific mobility needs (Watson, 2012, p. 493 f.). A practice theoretic stance invites us to set the analytical focus on practices that are deeply engrained in the tissue of people's everyday life and their social and material environment, all while being sensitive to how they are experienced and made sense of (Sahakian and Wilhite, 2014; Shove et al., 2012).

In the remainder of this article, we first discuss existing empirical research on modal shifts in commuting and introduce practice theories and their applications to mobility research (section 2). In section 3, we outline our methodological approach, which is based on a qualitative content analysis that combines deductive and inductive methods, and show how we operationalise practice theories for this purpose. We also provide information on the study context and present our interview sample. In section 4, we present our findings, and we close with a concluding discussion in section 5.

2. Theoretical background

2.1. Modal shifts in commuting: State of the art

The field of empirical research on modal shifts in commuting is vast. For the purpose of this article, we focus on research that analyses actual modal shifts, and exclude studies that explore intentions or attitudes towards modal shifts or focus on stated preferences. This selection is motivated by our interest in understanding how the dynamics of modal shifts arise from how everyday mobility is embedded in everyday life. Behavioural intentions or stated preferences are less relevant in this context, because multiple studies have shown that behavioural intentions do not necessarily translate into behaviour, notably because behaviour is embedded in structural constraints and habits (Shove, 2010).¹

Some studies on modal shifts focus on the transport modes between which modal shifts take place. Shaheen et al. (2013) and Fuller et al. (2013), for instance, studied in how far the installation of bike sharing schemes led to a modal shift away from the car and found that the resulting modal shifts are complex and can result in higher multimodality. This finding is mirrored by studies looking at modal shifts following policy interventions on existing transport infrastructure, and which also concluded that there were few discrete modal shifts (e.g. Hu and Schneider, 2015; Heinen et al., 2017). Some studies analyse which socio-demographic variables are associated with modal shifts between specific transport modes, thus pointing to potential influencing factors shaping modal shifts (e.g. Martin and Shaheen, 2014; Song et al., 2017). Whereas such studies are of great interest to understand in how far a modal shift actually contributes to a less carbon-intensive mobility, they do not provide any insights on why specific modal shifts are observed in a given study context. This has motivated research which

focuses on the factors that are thought to influence modal shifts.

Some studies analyse the impact of policy interventions on modal shifts. Uttley and Lovelace (2016) studied the long-term impact of a cycling challenge on cycling commuting. They found that people who adopted the bicycle for the duration of the challenge tended to fall back to their original transport mode afterwards. They conclude that a better understanding of how commuting is embedded in routines is necessary. Nkurunziza et al. (2012) analysed in how far interventions on transport infrastructure and different personal, social and infrastructural factors affect shifts onto bicycle commuting. They found that their effect depends on the life stage. This reflects the research focus of mobility biographies research. Much research in this domain analyses the impact of specific life events on commuting. Some studies explore the impact of residential relocation on modal shifts in commuting (e.g. Gerber et al., 2017; Scheiner and Holz-Rau, 2013; Yang et al., 2017). Yang et al. (2017) conclude that a better understanding is needed of how mobility patterns evolve following a modal shift, mirroring the conclusion of Uttley and Lovelace (2016). Others explore the impact of childbirth on commuting (e.g. Lanzendorf, 2010; McCarthy et al., 2019). Lanzendorf (2010) highlights the complexity of the patterns of modal shifts following childbirth and points to the necessity to conduct qualitative research to disentangle their underlying dynamics. Yet other studies look at how life events in general interact with commuting behaviour (e.g. De Haas et al., 2018; Döring et al., 2019; Janke and Handy, 2019). And some studies analyse whether the impact of life events on commuting is gendered and conclude that it is the case (Oakil, 2016; Scheiner, 2014). Scheiner (2014) further concludes that to understand how life events affect mobility patterns, more research is needed on learning and adaptation processes in order to understand how life events affect mobility patterns. Other studies focus not only on life events, but also on mobility events, such as acquiring new means of being mobile (e.g. Oakil et al., 2011, 2016; Rau and Manton, 2016). They find that whereas the impact of life events is mixed, mobility events related to a specific transport mode tend to lead to an increase in its use. Rau and Manton (2016), who used a qualitative approach, further conclude that a better understanding of the structural factors leading to mobility events is needed; Oakil et al. (2011, 2016), who used a quantitative approach, point to the necessity to better understand lag and lead effects.

Much fewer studies explore how the impact of life events on modal shifts is intertwined with structural dynamics. Chatterjee et al. (2013), for instance, work within the realm of mobility biography research and develop a conceptual model that accounts for both life events and structural factors surrounding cycling practices. They found that whereas life events tend to be the trigger of shifts in cycling behaviour, structural elements play a mediating role in shaping such changes. Sattlegger and Rau (2016) combine mobility biographies research with narrative-interpretative enquiries to broaden its focus beyond studying singular life events and their immediate effects. This allowed them to capture the interrelations between structural dynamics and the individual life course. Their conception of mobility as an embedded practice relates their approach to authors who, in the aim of capturing and understanding the interrelations between individual life courses and structural dynamics, combine mobility biography research with practice theories. We elaborate on this research strand in the next section, after presenting the key notions of practice theories.

2.2. Practice theories and their applications to research on mobility

Practice theories originated in social philosophy and have been developed by Bourdieu and Giddens and more recently by Schatzki and Reckwitz (Bourdieu, 1972; Giddens, 1984; Reckwitz, 2002; Schatzki, 1997). Since the early 2000s, practice theories have found application in consumer studies, where they have guided research aimed at better understanding the persistence of unsustainable consumption patterns (Corsini et al., 2019). Shove's work has been paramount in

¹ This excluded work based on the Theory of Planned Behaviour, as such studies tend to explore stated preferences or behavioural intentions.

Table 1
Summarised description of the sample cities. Sources: BFS (2013–2015, 2018). Data from 2013.

City	Inhabitants	Inhabitants per km ²	Cars per 1000 inhabitants	Modal distribution of commuters in and to city		
				Bicycle / Walking	Car	Public transportation
Geneva	349'305	756	368	23%	27%	50%
Basel	338'285	740	336	21%	25%	55%
Lausanne	214'872	787	362	19%	29%	51%

conceptualising and promoting practice theories for this purpose (Shove, 2003, 2010; Shove et al., 2012).

In practice theories, so-called contextual elements do not frame action; rather, they are a constituting part of the practices in which actions are bundled: '[A] practice represents a pattern which can be filled out by a multitude of single and often unique actions reproducing the practice' (Reckwitz, 2002, p. 250). And it is through such practices that people make sense of their actions: '[P]eople [...] think of themselves as being involved in meaningful practices [...] [m]otivations and wants are the outcome of practices, and the conventions and standards of practices steer behaviour' (Røpke, 2009, p. 2495). In their performance of practices, people make use of material artefacts, infrastructures, skills, and they draw on social norms and past experiences (Gram-Hanssen, 2011; Reckwitz, 2002; Sahakian and Wilhite, 2014; Shove et al., 2012). And it is through their integration in enactments of practices that material objects, skills, and social norms gain meaning and form the structure in which people coordinate their actions into practices (Sahakian and Wilhite, 2014; Schatzki, 1997; Shove et al., 2012). Practices, therefore, describe not only 'individuals' action patterns', but also 'the structural foundations of practices, including common rules, shared understandings and social meanings' (Heisserer and Rau, 2017, p. 7).

Applications of practice theories to the study of mobility are motivated by what have been identified as their main strengths regarding the study of consumption patterns: '[E]nabl[ing] new understandings of past dynamics; and [...] revealing the profound embeddedness of patterns of doing' (Watson, 2012, p. 490). Research focused on exploring past dynamics has produced insights on macro-historical developments in mobility and the processes through which some transport modes become prevalent in mobility practices and others fall into insignificance (e.g. Shove et al., 2012; Watson, 2012).

Research on the embeddedness of patterns of doing focuses on how the use of specific transport modes is engrained in everyday mobility routines, and on how the latter are embedded in everyday life. Most research in this domain has focused on everyday mobility practices based on a specific transport mode, rather than on modal shifts. Exceptions are Laakso (2017), who study a Give Up Your Car experiment from a practice theoretic perspective and find their approach useful to understand how processes of de- and re-routinisation are shaped by an interplay of structural and individual factors. And Cass and Faulconbridge (2016) use a practice theoretic approach to understand the challenges that a modal shift from car- to bicycle- or bus-commuting presents. Some authors analyse modal shifts by combining practice theories with mobility biographies research (e.g. Kent et al., 2017; Rau and Sattlegger, 2018; Uteng et al., 2019). Kent et al. (2017) found that modal shifts can either manifest as single shocks or as a form of bundling or re-ordering of existing mobility practices, and highlight the importance of accounting for the temporalities of transitions in mobility practices. They conclude that more research is needed on how new modal practices become settled or remain fragile. Uteng et al. (2019), using a quantitative approach, found the integration of practice theories and mobility biographies research useful for capturing the heterogeneity of mobility practices and the micro-dynamics of adoption and retention processes at different life stages. And Rau and Sattlegger (2018) found that social relations play a key role in holding mobility practices together, and that shifts in social relations and roles can have

implications for mobility practices. They conclude that conceptualising mobility through practice theories is purposive for analysing the interplay between structural and individual dynamics.

Our aim is to contribute to this emerging body of research. We aim to disentangle the interplay between the structural and individual dynamics giving rise to modal shifts. We analyse not only the moment of the modal shift, but also how it becomes integrated into performances of everyday mobility. Given our focus the dynamics which play into and result from changes in one of the components of everyday mobility—the transport mode—we draw on practice theories in our study.

3. Methodology and study context

Data for this study was collected in 21 semi-structured qualitative interviews with short-distance commuters in and to three Swiss cities. We analysed the interviews by means of a qualitative content analysis combining deductive and inductive approaches (for a description of the origins, epistemic position and methods of this approach, see Mayring, 2000, 2015). In this section, we present the study context and sample as well as our analytical approach.

3.1. Study context and sample

As the study's scope is exploratory, we were determined to account for a variety of experiences in the selection of the study sites and the constitution of the sample (see Graneheim and Lundman, 2004). Given our interest in modal shifts in multi-modal environments, we decided to situate our research in three Swiss cities, namely Geneva, Basel and Lausanne.

The public transportation infrastructure of Swiss cities and their agglomerations is well-developed (BFS, 2018a). This is reflected by the modal distribution of commuters in the three selected cities (see Table 1). Nonetheless, some regional differences persist. Whereas Basel's German agglomeration is accessible by a well-developed trans-border public transportation network, in Geneva, much fewer public transport connections cross the border into its French agglomeration (Dubois, 2019). And according to the results of a survey that is regularly undertaken by a cycling interest group, Basel is the only major Swiss city to score higher than the national average and obtain a sufficient grade to qualify as a cycling-friendly city, whereas Lausanne and Geneva obtained insufficient grades below the national average, with Geneva scoring slightly lower than Lausanne (Pro Velo Schweiz, 2014). These differences motivated our selection of these cities. They allow us to further diversify the experiences present in our sample.

In the constitution of our sample, we strived to include men and women with and without children whose collective experiences encompassed modal shifts between all available transport modes (car, public transportation, (electric) bicycle/walking).² To recruit

² To ensure that based on the infrastructural conditions, interviewees had all the different transport modes at their disposition, we focused on commuters with commuting distances of less than 17 km. According to a personal communication by a representative of Pro Velo, the Swiss cycling interest group, this corresponds to a commuting distance which can reasonably be accomplished by electric bicycle, given the average commuting time of 30 min.

interviewees, in each city, we approached between three and five large employers.³ Two companies in Geneva and one in Basel and Lausanne respectively, which are active in three domains of the tertiary sector (media, health and insurances), agreed to search their employee databases for individuals who corresponded to our sampling criteria and to ascertain their willingness to participate in our study. We received a total of 15 contacts in Geneva, 11 in Basel and 10 in Lausanne. In selecting interviewees from the contacts provided, we strived to constitute a sample that covered all of our sampling criteria in each city, all while maintaining a sample size between 20 and 25. Table 2 presents a summary of the sample.

We conducted the interviews at interviewees' workplaces during their regular working time. The interviews lasted between 45 and 75 min and were recorded and transcribed verbatim.⁴ 11 transcripts are in French, five in German and four in Swiss German.⁵ The quotes provided in this article were translated to English by the authors. We used an interview guide that we developed based on our operationalisation of practice theories for this research (see section 3.2), and which we tested and refined based on pilot interviews with commuters in our research group. We asked interviewees to provide an overview of their everyday mobility and the trips it entailed, their main transport mode(s), what mattered to them regarding their everyday mobility, and how they experienced it. We also asked interviewees about how their performances and experiences of everyday mobility had changed over their life course. By asking interviewees about important life events in relation to their everyday mobility, we aimed to reduce recall bias and assist them in establishing a coherent timeline (see Brod et al., 2009). We also gathered accounts of the mobility habits in their childhood home. We collected demographic information by means of a short questionnaire that was sent to the interviewees in electronic form prior to the interviews.

3.2. Operationalising practice theories to empirically investigate modal shifts in everyday mobility

A plethora of operationalisations of practice theories for empirical work exist (Gram-Hanssen, 2011). For our purposes, we operationalised practice theories by drawing on how Schatzki theorised them. His conception of practice theories was found purposive by previous studies on commuting (see Heisserer and Rau, 2017). Notably Schatzki's focus on the teleo-affectivity of practices has been found useful to capture both how individual ways of going about a practice such as commuting emerge from what makes sense to a given person, and how the latter is embedded in socio-cultural dynamics (Cass and Faulconbridge, 2016). Teleo-affectivity describes that '[w]hat makes sense to a person to do largely depends on [...] how things matter to her; thus on her ends, [and] the projects and tasks she will carry out for the sake of those ends given her beliefs, hopes, and expectations, and her emotions and moods' (Schatzki et al., 2001, p. 60). We expected that adopting such a focus allows us to conceptualise commuting bottom-up, 'based on

³ Focusing on large employers allowed us to maximise our chances of finding amongst the employees a sufficient number of people who correspond to our sampling criteria and are willing to participate in the study, all while minimising the time-consuming task of establishing a contact with a company and clarifying their willingness to assist us. We focused on companies with over 250 employees at their main site in the respective city, which corresponds to the definition of a large employer according to the Federal Statistical Office.

⁴ The anonymised transcripts can be found on FORS Base <https://forsbase.unil.ch/project/study-public-overview/15898/0/> (Meinherz, 2019).

⁵ Switzerland has four national languages (German, French, Italian and Rhaeto-Romance). In the German speaking part, the spoken language is an Alemannic dialect (Swiss German). Basel is located in the German-speaking area, and Geneva and Lausanne are located in the French-speaking one. Some interviewees had mother tongues other than the national languages; in such cases, the interview was conducted in their main national language.

individuals' subjective understanding', and thus to draw a picture of commuting 'that closely matches people's perceptions and experiences of everyday life' (Sattlegger and Rau, 2016, p. 30); an approach that Sattlegger and Rau (2016) found useful in their analysis of carelessness as an embedded practice. While we recognise that acts of sense-making are but one part of practices, next to elements such as competences and materials (see, for instance, Shove et al., 2012), we captured these other elements by how they make sense and matter to commuters regarding their performance of commuting. Table 3 summarises the concepts through which we operationalised practice theories in this sense. In the remainder of this section, we elaborate on these concepts.

As indicated in Table 3, we approached everyday mobility through people's accounts of their performances of it. As Røpke (2009, p. 2490) elaborated, 'if asked about their everyday life, [people] will usually describe the practices they are engaged in'. We expected that through such accounts, we gain insights into the material artefacts, skills, experiences, understandings, etc. on which people draw in their performances of everyday mobility and which hence constitute their practices (for conceptualisations of the elements which constitute practices, see Røpke, 2009; Shove et al., 2012).

With the meaning of everyday mobility, we refer to Schatzki's notion of teleo-affectivity. This notion is reflected in Røpke's definition of the component of meanings, which, in her words, 'is about making sense of the activities' and 'includes the ideas of what the activities are good for (or why they are considered problematic), the emotions related to the activities, the beliefs and understandings' (Røpke, 2009, p. 2492). We expected that through accounts of meanings, we gain insights into what matters to commuters regarding everyday mobility, how they experience it, and what goals they pursue through it. This can shed light on what motivates their use of a given transport mode.

With social order, we refer to Schatzki's argument that practices are interconnected and that these interdependencies constitute the social order (Schatzki, 2002, p. 70). We examine how everyday mobility is embedded in the organisation of everyday life. Watson (2012, p. 493) emphasises the importance of 'understanding the practices which surround and make sense of patterns of mobility' and looking at how shifts in mobility practices coincide with changes in the other practices with which they are bundled together in space and time. We expect that looking at the social order of practices provides insights into how the interconnectedness of practices places constraints on performing everyday mobility with different transport modes.

Lastly, including prefigurations of everyday mobilities in our operationalisation allowed us to extend beyond a reconstruction of commuters' current everyday mobility practice. Schatzki (2002) described prefigurations as those practices that people consider desirable and feasible, given the purpose they ascribe to the practice and the existing material infrastructure, social norms, or individual abilities. We expected that accounts of prefigurations of everyday mobility shed light on the transport modes commuters can imagine using, given their current circumstances.

3.3. Analytical approach

We analysed the interview data in a three-step procedure, which we outline in Fig. 1.

In the first step, we mainly followed a deductive approach and coded the interview data using the concepts outlined in Table 3. We looked for narratives of changes in any of these elements (performances, meanings, embeddedness in the social order and prefigurations). This allowed us to gain insights into what characterised interviewee's performances of everyday mobility, as well as how they changed.

In the second step, we focused on the narratives of modal shifts and analysed how they related to characteristics of and changes in everyday mobility identified in the previous step. We inductively identified three stages in modal shifts; each characterised by different processes: 1)

Table 2
Description of the interview sample used for this study (N = 21).

ID	Gender	Age	Commuting dist. [km]	Children at home	Modal shift
Basel					
B01	m	60–70	10–14	2	Motorbike → bicycle
B02	f	50–60	10–14	0	Car → public transportation → bicycle
B03	f	50–60	10–14	2	Car → bicycle
B04	m	50–60	< 5	0	Car → public transportation
B05	f	50–60	5–9	0	Public transportation → bicycle
B06	f	40–50	≥ 15	2	Bicycle → car
B07	m	40–50	≥ 15	2	Car → public transportation → car
B08	f	40–50	10–14	2	Public transportation → car
B09	m	40–50	≥ 15	2	Car → public transportation
Lausanne					
L01	f	50–60	< 5	0	Public transportation → walking & public transportation
L02	f	30–40	< 5	0	Public transportation → car
L03	f	40–50	< 5	1	Public transportation → walking & bicycle
L04	m	30–40	< 5	2	Bicycle → public transportation
Geneva					
G01	m	50–60	≥ 15	0	Car → bicycle
G02	f	50–60	10–14	0	Car → public transportation
G03	m	50–60	≥ 15	0	Car → public transportation
G04	m	30–40	5–9	1	Motorbike → bicycle
G05	f	40–50	10–14	3	Bicycle → car
G06	f	40–50	variable	2	Car → electric bicycle
G07	m	50–60	10–14	0	Car → bicycle
G08	f	50–60	≥ 15	0	Car → Car & bicycle → electric bicycle

Table 3
Operationalisation of practice theories for empirically studying modal shifts in everyday mobility.

Concept	Empirical application
Performances of everyday mobility	Accounts of the trips which belong to everyday mobility, how they are carried out, and what is made use of in carrying them out
Meaning of everyday mobility	Accounts of how everyday mobility is experienced, how it is made sense of, and the purposes associated with it
Embeddedness of everyday mobility in the social order	Accounts of how everyday mobility is embedded in the coordination of the spatio-temporality of everyday life and the many practices of which it consists
Prefigurations of everyday mobilities	Accounts of how social or material configurations and individual abilities facilitate or complicate different ways of performing everyday mobility and/or the use of different transport modes

abandoning the established transport mode; 2) adopting a new transport mode; and 3) establishing an everyday mobility routine with the new transport mode (see Fig. 2). The concept model allowed us to re-structure the coded interview data and to produce structured and synthesised representations of modal shifts.

In the third step, we reflected on these structured and synthesised representations of modal shifts. We inductively developed categories of dynamics that can give rise to modal shifts as well as a typology of ways in which new transport modes are integrated into performances of everyday mobility. In the next section, we present the insights which we gained in this last step.

4. Findings

Firstly, we present our findings on how modal shifts arise from and are shaped by how everyday mobility is embedded in everyday life. Secondly, we show our findings on the implications of modal shifts on how everyday mobility is performed, experienced and embedded in everyday life.

4.1. Changing to a different mode: Dynamics playing into modal shifts

Our findings show that on the one hand, modal shifts can emerge from and be shaped by dynamics related to contextual elements that play a role in performing everyday mobility, such as available modal infrastructure and its condition, the coordination of everyday mobility with other people, and the management of limited resources between everyday mobility and other daily practices. On the other hand, modal

shifts can emerge from and be shaped by intrinsic motivations regarding the time spent commuting or the use of a specific transport mode. Table 4 provides an overview of the dynamics playing into modal shifts. In the remainder of this section, we elaborate on them in greater detail.

4.1.1. Modal shifts related to the conditions of use of different modes

Modal shifts can coincide with shifts in how different transport modes compare regarding their conditions of use. Our findings show that dynamics taking place at different scales and which concern different domains can play a role therein: Macro-social developments such as increasing road traffic or ecological awareness, work-related developments such as increasing parking costs, urban policies such as public transportation subsidies, and biographical developments such as a move of the home or workplace. Furthermore, we observed that how changes in the relative conditions of use of different transport modes affect commuters' modal choices cannot be dissociated from how they make sense of everyday mobility. For instance, B09 uses whichever mode is fastest. For L02, however, who changed from the train to the car when her workplace moved from Geneva to her home city of Lausanne, it is more important how she can spend the time of the commute, and she makes sense of the conditions of use of different transport modes in this sense:

B09: Since I've started working here, I commute by train. In my previous company, I commuted by car [...] because it would have been more complicated and taken more time to get there by train. But here, it almost takes me longer by car than by train. It's very convenient here, of course.

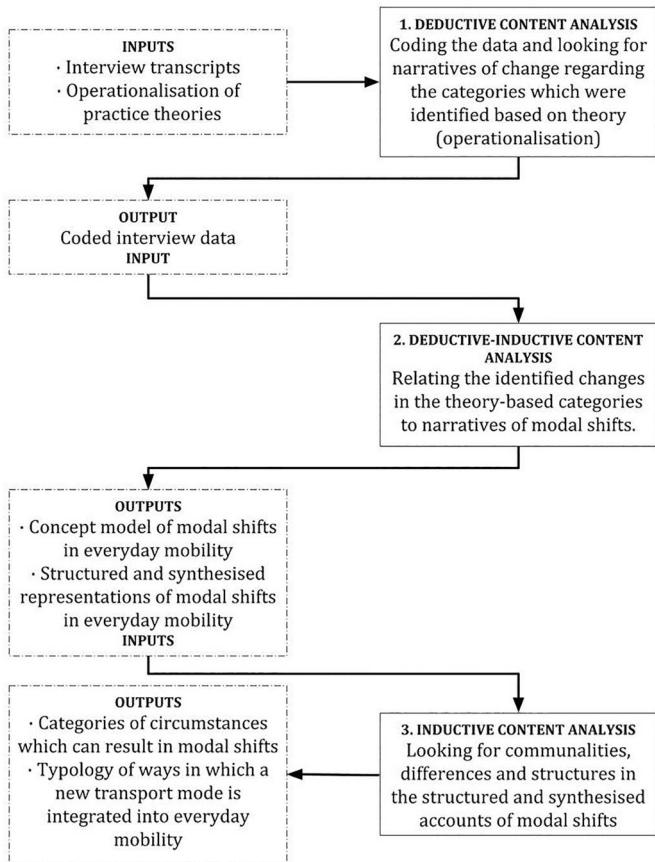


Fig. 1. Three-step analytical approach for analysing the interview data.

L02: When I worked in Geneva I had time, I could use the time to do certain things like reading a book or a magazine, etc., and now that I work more in Lausanne, sometimes I miss this hour of commuting during which I could read [...] If I could leave my home and take a bus in my neighbourhood [...] I think I'd take it even if it took 40 minutes. It's having to change buses three times that annoys me, because in the end, I don't have time to read.

In addition to triggering the abandonment of the present transport mode, the conditions of use of different transport modes can also shape which transport mode is adopted as a replacement:

G02: I was fed up with being in this car, all by myself, polluting, stupidly waiting around [in traffic]. In my view, there was something illogical about it [...] I had tried the bicycle, I cycled for a while, but I've, it stinks, it doesn't smell nice; what other options can

I find, and so I've adopted the bus. But I had to find the travel pass first; it's quite pricey actually [...] the company actually reimburses 200 francs and the municipality 50 more. So at 250, I don't think there's another means of transportation that can beat this price.

Which transport mode is adopted can also be shaped by intrinsic motivations specific to that transport mode, even when what originally triggered the modal shift was a change in the conditions of use of the previous mode:

G08: We had to change to the Opera parking, and that quadrupled the price I was paying at the time, and so I seized that opportunity to change. And commuting by bicycle, it's really, I work full time. And if I don't cycle enough, I clearly don't do enough sports.

These findings indicate that modal shifts in many cases result from different and interconnected dynamics.

4.1.2. Modal shifts related to the coordination of one's everyday mobility with the one of other people

Modal shifts related to the coordination of one's mobility needs with those of other people can result from the coordination of the use of a means of transportation with other people or the need to chauffeur other people. The experience of B07 illustrates the first case:

B07: We were young, and with our financial situation, we thought we can ill afford two cars. I'll take the train, it's convenient [...] for me, it was obvious one and then two children, she's more in need of the car than I, I'm sitting in the office the whole day. It was obvious to me that it won't be her who takes public transportation.

His statement that his wife needed the car following the birth of their children mirrors the experience of several female interviewees who began using cars following childbirth. We observed that in some cases, having to navigate everyday mobility in a context of interconnected everyday lives creates situations in which commuters have to compromise and cannot use their preferred mode:

B06: If it weren't for the children, I'd never do that to myself, every morning and evening with the car on the freeway. Because it's horribly stressful. It's brutal [...] I wish it was different, but I can't, I don't manage to do it differently [...] for my husband it's much easier, he goes to work in the morning and leaves in the evening and comes home. And I have to get 100'000 things done throughout the day [...] for him, it's much more relaxed, go to work, by bicycle, you go there in the morning, put it there, stay there the whole day, 10, 12 hours in the hospital and then you come home in the evening.

These findings indicate that to understand modal shifts, it must be accounted for how the organisation of everyday life and the mobility needs which derive therefrom are coordinated between household members.

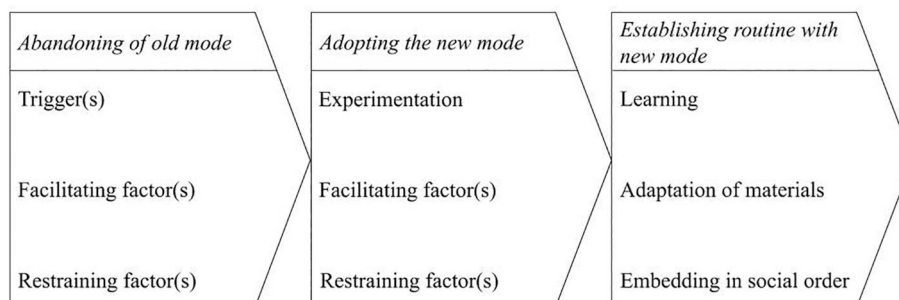


Fig. 2. Inductively developed concept model of modal shifts in everyday mobility practices.

Table 4
Dynamics playing into modal shifts.

Dynamics related to the...	Description
Conditions of use of different transport modes	Comparative availability and conditions of use of different transport modes
Coordination of one's everyday mobility with other people's mobility needs	Coordination of one's everyday mobility with the mobility needs of other people (e.g. accompanying or picking up people, sharing means of transportation with other people)
Coordination of available resources between everyday mobility and other daily practices	Allocation and management of resources such as time, money, mental or physical energy, etc. between everyday practices
Intrinsic motivation of everyday mobility	Intrinsic motivations regarding or intended purposes of everyday mobility, which impose the use of a specific transport mode

4.1.3. Modal shifts related to the coordination of available resources between everyday practices

Modal shifts related to how limited resources are allocated and managed between daily activities can involve different resources. B07 illustrates a case in which limited financial resources played a role in triggering the modal shift:

B07: Before having children, we always had two cars. Only once we had children, we thought that we had better use that money differently; I'll take the train.

The experience of B02, who started cycling, illustrates a modal shift resulting from how time is managed between different daily activities:

B02: Before, [I worked out] in the gym, at least twice per week, and so I was away three evenings per week. At some point I cancelled that, because I didn't have any more evenings where I could just chill. And now at least in summer I can integrate that with my commute, and have some kind of workout.

Her experience shows that having to manage limited resources between daily practices can require compromises:

B02: I don't actually like cycling [laughs] So, for me it's not leisure [...] it's really, combining the useful with the convenient, I mean, combining two useful things.

Also G05, who changed from the bicycle to the car due to limited personal resources, had to compromise:

G05: I'm quite tired, because since I also do physical work now, and I still have 3 children and I don't always sleep well at night, it's true that the bicycle has become a burden. Which it wasn't for many years, it was my freedom, my love, and I really loved it. But right now I have to admit that it's not working out well [...] I tried to not always take the car, but at some point I had to say no, I was too exhausted.

These findings indicate that also everyday practices that do not per se create specific mobility needs can shape and trigger modal shifts.

4.1.4. Modal shifts related to intrinsic motivations

Modal shifts can further be related to how everyday mobility is intrinsically valued. Our findings show that everyday mobility can be

intrinsically valued in many ways. Often, intrinsic motivations regarding everyday mobility reflect the desire to experience it as a pleasurable activity:

B07: [The car] is of course a luxury but it's also very comfortable [...] Of course, then I'm stuck in traffic. But at the same time, for me, traffic is a time out [laughs] [...] it's half an hour where I can listen to music, have some peace and quiet, and then I get home and can deal with the children [...] I'm relaxed again, rooted.

G06: It's easily 3 hours a day that I'm travelling, and it wasn't just very exhausting, it wasn't satisfactory at all. It was really a negative aspect of my job, all this travelling, and I told myself that I have to find a way to make this travelling agreeable. And now I really see, for me the bicycle is really a gain, it doesn't take me longer than the car, and in addition it's good for me; I get some air, I, and it's like, transforming something that is tiresome into something that is agreeable.

Changes onto active transport modes were often motivated by their sportive or health-related benefits. However, these aspects could also deter commuters who did not associate everyday mobility with sports:

L04: Since now two years, more than two years, I've lived in the Montchoisi neighbourhood, which is situated in the lower parts of the city, and it's too much by bicycle [...] for me [commuting] isn't leisure time, it's just getting from one place to another [...] I saw the altitude difference, and although we have showers here, that's nice, but I didn't feel like taking extra clothes to change, it's just making life complicated.

Our findings also show that even when commuters had a strong intrinsic motivation to adopt a specific transport mode, sometimes they only shifted once extrinsic triggers fell in place or a barrier disappeared:

G07: It's gonna be 29 years that I work at [company]. In the beginning, I always came by car. And then little by little, I started to come by bicycle, because, just to do sports [...] I wasn't yet in that approach, in the 100% bicycle mindset, the bicycle for me was just a little extra to get around and contribute to my fitness [...] I decided, when the parking became too expensive [...] come on, let's go, it's like a challenge, let's go, every day by bicycle.

Table 5
Different patterns of modal shifts.

Pattern	Description
Same performance and experience of everyday mobility	This pattern describes cases in which the adoption of the new transport mode does not require an adaptation of the performance of everyday mobility and in which everyday mobility with the new mode is experienced in the same way as with the old mode.
Relearning everyday mobility	This pattern describes cases in which the adoption of the new transport mode requires some adaptation of the performance of everyday mobility. Following the modal shift, everyday mobility must be relearned and a new routine must be built around the new transport mode.
Embedding everyday mobility in a new lifestyle	This pattern describes cases in which not only must everyday mobility be relearned. The modal shift further coincides with a larger process of redefining life priorities, with implications regarding what is valued or matters regarding performances and experiences of everyday mobility.

G06: I've had [the electric bicycle] mainly since maybe four years, because I don't have to transport the children anymore, before, it's true, I had to bring my children to the daycare, often I had to transport the children, so I had to take the car.

These findings indicate that to understand modal shifts, an understanding of the different ways in which everyday mobility can intrinsically motivated is necessary. Furthermore, they again highlight that modal shifts must be understood as the result of different and interconnected dynamics.

4.2. Implications of modal shifts on everyday mobility: Different forms of modal shifts

We identified three patterns in how modal shifts are integrated into everyday mobility (see Table 5). We elaborate on them in the remainder of this section.

4.2.1. Same performance and experience of everyday mobility

Modal shifts that follow this pattern do not have a significant impact on how everyday mobility is performed or experienced, and do not require a relearning of everyday mobility. As the following excerpt illustrates, they coincide with a certain indifference between transport modes:

B09: Well I don't really care whether I commute by car or by train, I couldn't say which one I like better, both are fine [...] I've usually gotten used to it quite quickly.

Our findings show that different factors can facilitate such smooth shifts between transport modes. These include the facility of use and adequacy of modal infrastructure, formal or informal rules, or previous experience with the new mode:

G01: [Cycling] was never difficult, but I've never not cycled at all! I didn't start from zero, so yeah! Quite quickly, it went quite well!

B09: We're somewhat flexible with the working hours, somewhat, of course at seven we have to check in, but if you're five minutes early or late, depending on the train, it's not like we have to strictly be, somehow, that would be annoying, because then you'd have to get here way too early to be on time, but like that it's fine.

This pattern thus describes modal shifts which mainly ensure that everyday mobility can be performed as smoothly as possible in a context of evolving circumstances. Transport modes are interchangeable and shifts between them do not challenge any other aspect of performing everyday mobility.

4.2.2. Relearning everyday mobility

This pattern describes modal shifts which are, at least initially, perceived as challenging and which require learning and adapting. This can imply learning new skills, acquiring supporting materials, adapting the organisation of the day or building a new pleasurable routine. B07's experiences illustrates this last aspect. He encountered no practical difficulties when adopting the train:

B07: We have really good connections in the morning, there's a train almost every 10 minutes [...] I have my app, I see when the train departs, I see when it's late, we can quickly let the people in the company know, when I go to the Chleibasel neighbourhood, on the way to the tramway station I've already bought my ticket; no I don't think that there's any reason to pretend that it's complicated!

Nonetheless, he struggled to establish a new routine with this mode:

B07: It was a huge change! So in the beginning I took a newspaper with me, and used the time to read, read the newspaper [...] I like to read, at least, to put the time in the train to use, but sometimes I

really went for the replacement trains, which are for sure older, maybe no A/C, but with less people, and you get your peace and quiet.

Once past this initial phase of learning and adaptation, the new routine could be appreciated:

G04: You need to get there, lock [the bicycle], anticipate when you'll leave, so in the beginning I mainly saw that, I didn't yet see the pleasure that came with it. But I think I really started enjoying it when I felt that I got better, and physically I was maybe less out of breath, and I also had a bicycle which I thought was lighter, which was nice to pedal [...] no honestly, with time, it really became more of a pleasure than a burden. And now I feel the pleasure and that it's good for me, as well.

But in some cases, the performance of everyday mobility with the new mode remained tedious and challenging even after the period of adaptation and relearning:

B02: When I go by bicycle, I have to think about the weather, what will the weather be like when I get back, do I have to take rain gear or not, I don't always take it [...] I also have to think about what I'll wear at work [...] it requires more planning, because I can only double-check in the mirror once I'm here. And when then I notice that the blouse doesn't match it's simply too late [...] and the whole getting changed, I actually get changed entirely twice per day.

In such cases and when the modal shift resulted from a reason other than an intrinsic transport mode-specific motivation, a change in the conditions which had initially motivated the modal shift could result in the new routine being questioned again. For example, B07, who had switched from the car to the train because his family could no longer afford two cars, changed back as soon as their financial situation improved:

B07: The freedom which you gain [with the car], which you can use differently at home [...] me too I'm part of the affluent society,⁶ I'm allowed that luxury again!

This pattern thus illustrates modal shifts that at least initially present a challenge and are followed by a period of adaptation and relearning, during which a new everyday mobility routine is built. Whereas in some cases, this routine represents an improved experience of everyday mobility, it represents a deterioration in others.

4.2.3. Embedding everyday mobility in a new lifestyle

This pattern describes modal shifts that are part of a larger process of redefining priorities in life which has implications for how everyday mobility with different transport modes is experienced and made sense of. This process of redefining life priorities can precede and be part of what triggers the modal shift, or it can take place in the aftermath of the modal shift. In some cases, it can even be triggered by the modal shift.

The case of B06 illustrates a modal shift which can be understood as part of a wider process of shifting from an urban to a suburban lifestyle:

B06: In the beginning with the first child we still lived in Basel, we didn't have a car at that time [...] we wanted an apartment or a house [...] and then you're quickly in the suburbs, aren't you, the prices there are simply much much lower [...] I don't think that we'll get rid of the two cars. I see that with all our neighbours [...] they all have two cars. You're simply more independent then!

And she was unhappy with the new mobility routine which this lifestyle imposed:

B06: The bicycle is like some kind of life quality, you can combine it with, like, some sports, enjoy nature, experience the surroundings,

⁶ German original: Wohlstandsgesellschaft

take care of yourself and all that, whereas the car, that's just because I have to go to work, and it's a duty. It's not a pleasure and nothing that's good for me [...] the stress on the freeway and red lights and in this city and it's just, well, everything, for me it's really not enjoyable at all. I don't like doing it. But I have to.

G02 illustrates a case in which the process of redefining priorities in life takes place in the aftermath of the modal shift and is facilitated by it. She was forced to use the bus after an accident. Through using it, she experienced a different way of being mobile, which opened her eyes to a more relaxed and holistic approach to life:

G02: I've come to realise that [using the bus] is not as disagreeable as I thought, that I could read a book, arrive at work calmly, without getting all worked up in traffic [...] you just have to take your time. Learning to take your time, and that's what I didn't, I was always, I have to hurry. It's the entire approach to life which you have to change [...] having the smallest possible footprint, being invisible, not polluting, eating locally, taking care that the food isn't from Brazil or wherever, and well, a mindset, trying to relax, to meditate, to do yoga, it's the whole lifestyle which is changing a bit. Not getting all worked up about some problems, some insignificant problems.

In the course of this process of redefining priorities in life and adapting to a new transport mode, the way in which the previous mode is made sense of can change. As a result, the previous way of performing everyday mobility might no longer be considered tenable:

G02: I used to love driving, but not anymore [...] that feeling of going to war, in the car [...] traffic, road rage, rights of way which aren't respected, huge SUVs that don't respect rights of way [...] In the bus, people can be whichever way they like, that's none of my concern, I'm not confronted with it, so I'm a spectator. In the car, I'm more a protagonist.

This pattern thus describes modal shifts that are embedded in a wider process of establishing a new lifestyle, including shifting priorities.

5. Concluding discussion

With this study, we aimed to shed light on two questions: Firstly, how modal shifts in everyday mobility arise from the embeddedness of everyday mobility in the interplay between individual and structural dynamics in everyday life. And secondly, how the new transport mode is integrated into everyday mobility. To explore these questions, we analysed modal shifts in everyday mobility from a practice-theoretical stance, all while adopting a bottom-up approach and thus making sense of everyday mobility and modal shifts through commuters' subjective understandings thereof. This approach proved purposeful for shedding light on the above questions. On the one hand, it allowed us to disentangle the different dynamics that can give rise to modal shifts; notably because we were able to complement the practice-theoretical focus on the embeddedness of practices such as everyday mobility in structural dynamics with a focus on how everyday mobility is intertwined with dynamics at the individual level. On the other hand, it allowed us to identify different patterns in how modal shifts affect everyday mobility; notably because we looked at modal shifts not as punctual events, but as processes consisting of different stages. This latter aspect allowed us to usefully complement existing research on modal shifts, which for the most part focuses on the moment of the modal shift, rather than on how it affects commuting.

In Section 5.1, we discuss in how far our findings on the dynamics from which modal shifts arise reflect those of existing research on this topic. In doing so, we elaborate on how our approach allowed us to address some of the questions left open by previous studies. We also discuss the implications of our findings for studying modal shifts. In

Section 5.2, we discuss the implications of our findings for understanding in how far modal shifts result in lasting changes in the transport mode in use. And in Section 5.3, we discuss the perspectives that our findings open with regard to the decarbonisation of everyday mobility.

5.1. Exploring the dynamics giving rise to modal shifts: Between practice and practitioner, habit and intent

Several aspects of our findings regarding the dynamics giving rise to and shaping modal shifts reflect those of studies exploring the impact of life events or policy interventions on modal shifts. However, our focus on how these dynamics are intertwined in modal shifts allowed us to understand why specific life events or policy interventions can result in many different patterns of modal shifts. This addresses questions left open by previous studies in this domain and provides avenues for studying modal shifts. We elaborate on the latter after briefly discussing the aspects of our findings mirrored by previous studies.

Firstly, our findings reflect those of studies looking at the impact of childbirth on modal shifts. Similar to other studies (e.g. Janke and Handy, 2019; McCarthy et al., 2019; Oakil, 2016; Scheiner, 2014), we found that in how far parenthood results in a car-based everyday mobility is gendered and mainly concerns women, due to an unequal distribution of care work in families (e.g. De Haas et al., 2018; McCarthy et al., 2019). Our findings thus emphasise that to understand the different ways in which life events such as childbirth affect modal shifts, it should be accounted for how they are intertwined with social and institutional dynamics such as those which shape the distribution of care work in families.

Secondly, our findings reflect those of studies looking at the impact of relocations on modal shifts. We also found that a relocation of the home or the workplace often coincides with a modal shift (e.g. Gerber et al., 2017; Rau and Manton, 2016; Scheiner and Holz-Rau, 2013; Yang et al., 2017) and that this tends to be in reaction to the resulting changes in the comparative quality of use of different transport modes (see Scheiner and Holz-Rau, 2013). Our study extends on the findings of such studies by showing that not all commuters value the same aspects regarding the use of different transport modes. This highlights that to understand the impact of relocations on modal shifts, differences in what commuters value regarding everyday mobility and the use of different transport modes should be accounted for.

Thirdly, our findings affirm approaches to mobility that conceive of it not only a means to an end, but also an intrinsically valuable activity (see, for instance, Cresswell, 2010; Mokhtarian et al., 2001; Rigal, 2018). Our focus on how different dynamics are intertwined in modal shifts allowed us to shed light on how these two aspects of everyday mobility interplay in modal shifts. Our findings showed that situational constraints, constraints related to the coordination of everyday mobility with other people and resource constraints delimit the field of possible ways in which it can be performed. To understand the role of intrinsic motivations in modal shifts, it is important to account for such constraints. This implies focusing on how everyday mobility is embedded in social, interpersonal and infrastructural dynamics.

Fourthly, our findings are in agreement with approaches to everyday mobility which insist that it must be understood as a practice that is embedded in shared lives (e.g. Rau and Sattlegger, 2018). Our findings further indicate that everyday mobility becomes embedded in shared lives through interconnected daily practices, rather than through parental socialisation. This reflects the findings of Döring et al. (2019), who studied the impact of parental socialisation on modal shifts, and affirms Rau and Sattlegger (2018, p. 17)'s statement that everyday mobility must be considered as embedded in shared lives due to the mobility needs created by the interconnectedness of household members.

Lastly, our findings point to a structural factor which plays into modal shifts which, to our knowledge, is rarely discussed in other

studies. This concerns traffic. Many interviewees mentioned it as a deciding factor when comparing the conditions of use of different transport modes. This finding highlights the importance of research on the endogenous dynamics of transport infrastructure. Such research could usefully complement existing studies that analyse the impact that policy interventions on transport infrastructure have on modal shifts (e.g. Fuller et al., 2013; Heinen et al., 2017; Martin and Shaheen, 2014; Nkurunziza et al., 2012; Shaheen et al., 2013; Song et al., 2017; Uttley and Lovelace, 2016).

Overall, our findings have implications for studying modal shifts in everyday mobility. Firstly, they emphasise that to understand how modal shifts arise, it is not enough to look either at dynamics at the individual or at the structural level. Their entanglement must be accounted for. Practice theories, with their focus on the embeddedness of everyday mobility, are useful for capturing structural dynamics. However, they carry the risk of losing the practitioner from sight, due to their tendency to focus exclusively on the practice. As Watson (2012, p. 490) put it: 'Theories of practice decentralise the individual, instead placing the practices which constitute individual lives at the centre of analysis'. Our experience, as well as the one by Laakso (2017), shows that practice theories can be operationalised in such a way that they account for life course dynamics, in addition to structural dynamics. And experiences by Chatterjee et al. (2013) and Sattlegger and Rau (2016) show that mobility biographies can be operationalised in such a way that they account also for structural dynamics, in addition to those of the life course. Yet other authors have successfully integrated both approaches in this endeavour (see Greene and Rau, 2016; Kent et al., 2017; Rau and Sattlegger, 2018; Uteng et al., 2019). Therefore, we conclude that both practice theories and mobility biography research are suitable approaches for capturing the complex dynamics from which modal shifts arise; what matters is that the interrelations between structural and individual-level dynamics are explicitly accounted for.

Secondly, our findings emphasise that approaches to practice theories which focus on the habitual nature of practices might fall short of capturing the full complexity of the dynamics giving rise to modal shifts. Such approaches are close to Bourdieu's original conception of practices as being rooted in the *habitus*. In this conception, practices change as the result of *hysteresis*, meaning a discrepancy between the conditions in which a person is used to act, and how they experience their current situation (Bourdieu, 1972). As Gronow (2008, p. 253f.) argued: 'Action normally proceeds through habitual ways of acting but the ever-changing nature of the world, i.e., the environment of action, forces us to ponder upon our responses and to change our habits'. Whereas such an approach to practice theories is useful for understanding modal shifts as a strategy to adapt to life events or situational dynamics, it overlooks modal shifts that originate from the intention of infusing everyday mobility with a specific intrinsic purpose. When arguing from such approaches, a dichotomy is drawn between 'conscious projects of action' and 'habitual modes of acting' (Gronow, 2008, p. 254), which are thought to follow different dynamics. We argue that to study modal shifts, everyday mobility must be understood as simultaneously embodying both. Modal shifts can then be understood as resulting from the interplay between these dynamics.

5.2. Modal shifts and practice change: Different transport modes or different mobilities?

Our focus on modal shifts as a process which unfolds in different stages allowed us to identify patterns in how new transport modes become embedded in everyday mobility. We were able to trace in how far modal shifts challenged aspects of everyday mobility others than the transport mode, and hence in how far they disrupted performances of everyday mobility. Our findings indicate that a modal shift can, but not necessarily does, result in a change in how commuters perform, experience and make sense of their everyday mobility. If we define

practices as being meaningful to people (Røpke, 2009, p. 2490), this implies that a modal shift can, but does not have to, result in a practice change. As illustrated in section 4.2.1, in some cases, modal shifts simply consist in adapting the material artefact which is used to perform everyday mobility. No new competences have to be acquired and the experience of everyday mobility and how it makes sense to commuters remain unchanged. This indicates that in multi-modal environments such as those we studied, everyday mobility can exist as a mode-independent practice, meaning as a practice which can be performed with different transport modes, without this challenging the practice as it makes sense to and is experienced by commuters. In such cases, modal shifts do not disrupt everyday mobility practices. Their habitual performance continues with a different transport mode without there being a need for learning or adaptation. Such ease in adopting a different transport mode might facilitate more frequent modal shifts: The transport mode can be fluidly adapted to shifting circumstances.

Our findings further showed that also in such multi-modal environments, modal shift can be followed by a period of learning and adaptation during which a new everyday mobility routine is built. In such cases, modal shifts challenge habitual performances of everyday mobility and the way in which they are experienced. This indicates that also in multi-modal environments, everyday mobility can exist as a mode-specific practice. This reflects the conclusion by Cass and Faulconbridge (2016, p. 6), who state that 'bus-, car-, and cycle-commuting are each associated with particular materials, competences and meanings [...] [and that] commuting by a particular mode involves materials, competences and meanings generic to the use of that mode'. Given that such modal shifts imply building new habits, although initially more challenging, they might also be more stable: It has been found that habits are difficult to challenge (see Sahakian and Wilhite, 2014).

Lastly, we observed cases in which modal shifts were embedded in lifestyle changes or processes of redefining priorities in life. In such cases, commuters often could no longer imagine their previous way of performing everyday mobility. This indicates that the modal shift might not be reversible. Rather than lying dormant, the previous way of performing everyday mobility vanishes.⁷

5.3. Decarbonising everyday mobility: Concluding reflections

The scope of our findings remains limited to our study context. They are further limited to the demographics of our sample, which is not representative of the population of the cities we studied: Whereas sampling through big employers allowed us to constitute a very precise sample, it introduced a sampling bias. All companies mostly offer jobs that require at least some level of further education and pay accordingly. Our sample reflects the demographics of these companies. Thus, whereas we were able to identify different dynamics which can play into modal shifts, and patterns in how they play out, we cannot make any statements regarding the dynamics or patterns that might prevail in a differently chosen sample. Nonetheless, our insights open up perspectives for reflections on the decarbonisation of everyday mobility.

Firstly, our finding that modal shifts arise from different and intertwined dynamics indicates that policies which address them separately might fail to produce the expected results. Political reflection on modal shifts should go beyond its purely material aspects and account for how everyday mobility is intertwined with dynamics such as social and institutional norms regarding the distribution of care work, the

⁷ Shove et al. (2012, p. 34f.) state that as practices change and some of the elements which were mobilised in their performance are no longer used, these elements can still lie dormant and potentially be reintegrated into the same or a different practice. However, the elements might also vanish, in the sense that they or their use are forgotten.

spatio-temporal organisation of everyday life, as well as for the many ways in which everyday mobility can be intrinsically valued. Therefore, we agree with researchers who highlight ‘the importance of configurations of policy that address the elements [of practices] and time-space issues [...] in an *integrated way*’ (Cass and Faulconbridge, 2016, p. 10 f.) (see also Shove, 2010; Watson, 2012).

Secondly, our finding that modal shifts arise from dynamics which operate at different scales indicates that policies with the aim of achieving a modal shift onto low-carbon transport modes should also operate on these different scales. This indicates that actors operating on all scales have a role to play therein. We saw that in many cases, policies decided at the level of municipalities and interviewees' workplaces interacted in shaping their modal shifts. Fostering cooperation between such actors in the aim of deploying policies which act in a coordinated manner on different scales could, thus, be a promising avenue for fostering modal shifts onto low-carbon modes.

Thirdly, our perspective on modal shifts as a process which unfolds in different stages (abandoning the old mode, adopting a new mode, integrating the new mode into an everyday mobility routine) indicates that it could be of interest to design policies specifically for each stage. In particular when modal shifts involve a period of learning and adaptation, new elements can gain importance in performances and experiences of everyday mobility. This indicates that different policies might be needed to discourage the use of one transport mode and to encourage the use of another one. Correspondingly, transport policy should be thought dynamically. Hence, whereas dynamic adaptive transport policy tends to be thought of as a policy approach which is adaptable to long-term developments and new insights (see Marchau et al., 2010), we advocate for dynamic transport policies which are adaptive with regard to the process of modal shifts, and comprise measures targeting different stages of the process.

Fourthly, our finding that how commuters make sense of the conditions of use of different transport modes depends on how they intrinsically value everyday mobility indicates that policy interventions should account for the many ways in which transport modes can be intrinsically valued. On the one hand, this leads us to advocate for an environmentally sustainable pluralism (see Foundational Economy Collective, 2019) in transport policy. This implies that policies reflect the variety of ways in which low-carbon transport modes are intrinsically valued by commuters and thus allow for using them in different ways. On the other hand, this leads us to agree with researchers who call for more research on the different ways in which everyday mobility becomes meaningful to commuters and on how this affects their mobility practices (e.g. Cass and Faulconbridge, 2017; Heisserer and Rau, 2017; Laakso, 2017; Sattlegger and Rau, 2016). Together with studies that explore how the dynamics we identified interplay in modal shifts in other study contexts, such research on how everyday mobility becomes meaningful presents a useful direction for future research.

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References

- BAFU, 2017. Kenngrößen zur Entwicklung der Treibhausgasemissionen in der Schweiz: 1990–2015. Bundesamt für Umwelt, Bern.
- BFS, 2018a. Motorfahrzeuge, 2016 / Effectif des véhicules à moteur, en 2016. Bundesamt für Statistik, Neuchâtel.
- BFS, 2018b. Pendlermobilität in der Schweiz 2016. Bundesamt für Statistik, Neuchâtel.
- BFS, 2019. Unfall-, Umwelt- und Gesundheitskosten des motorisierten Verkehrs, 2015. Bundesamt für Statistik, Neuchâtel.
- Bourdieu, P., 1972. Esquisse d'une théorie de la pratique: précédé de trois études d'ethnologie kabyle. Editions du Seuil.
- Brod, M., Tesler, L.E., Christensen, T.L., 2009. Qualitative research and content validity: developing best practices based on science and experience. *Qual. Life Res.* 18, 1263.
- Cass, N., Faulconbridge, J., 2016. Commuting practices: new insights into modal shift from theories of social practice. *Transp. Policy* 45, 1–14.
- Cass, N., Faulconbridge, J., 2017. Satisfying everyday mobility. *Mobilities* 12, 97–115.
- Chatterjee, K., Sherwin, H., Jain, J., 2013. Triggers for changes in cycling: the role of life events and modifications to the external environment. *J. Transp. Geogr.* 30, 183–193.
- Corsini, F., Laurenti, R., Meinherz, F., Appio, F.P., Mora, L., 2019. The advent of practice theories in research on sustainable consumption: past, current and future directions of the field. *Sustainability* 11, 341.
- Cresswell, T., 2010. Towards a politics of mobility. *Environment and Planning D: Society and Space* 28, 17–31.
- De Haas, M., Scheepers, C., Harms, L., Kroesen, M., 2018. Travel pattern transitions: applying latent transition analysis within the mobility biographies framework. *Transp. Res. A Policy Pract.* 107, 140–151.
- DETA, 2014. Les transports genevois en chiffres. Département de l'environnement, des transports et de l'agriculture, Genève.
- Döring, L., Kroesen, M., Holz-Rau, C., 2019. The role of parents' mobility behavior for dynamics in car availability and commute mode use. *Transportation* 46, 957–994.
- Dubois, Y., 2019. Frontières et mobilité au quotidien: Modes de vie dans l'agglomération trinationale de Bâle. Editions Alphil-Presses Universitaires Suisses.
- EEA, 2013. Environmental Pressures from European Consumption and Production. A Study in Integrated Environmental and Economic Analysis. European Environment Agency, Copenhagen.
- Foundational Economy Collective, 2019. Die Ökonomie des Alltagslebens - Für eine neue Infrastrukturpolitik. edition suhrkamp.
- Fuller, D., Gauvin, L., Kestens, Y., Morency, P., Drouin, L., 2013. The potential modal shift and health benefits of implementing a public bicycle share program in Montreal, Canada. *Int. J. Behav. Nutr. Phys. Act.* 10, 66.
- Gerber, P., Ma, T.Y., Klein, O., Schiebel, J., Carpentier-Postel, S., 2017. Cross-border residential mobility, quality of life and modal shift: a Luxembourg case study. *Transp. Res. A Policy Pract.* 104, 238–254.
- Giddens, A., 1984. *The Constitution of Society*. Polity Press, Cambridge.
- Gram-Hanssen, K., 2011. Understanding change and continuity in residential energy consumption. *J. Consum. Cult.* 11, 61–78.
- Graneheim, U.H., Lundman, B., 2004. Qualitative content analysis in nursing research: concepts, procedures and measures to achieve trustworthiness. *Nurse Educ. Today* 24, 105–112.
- Greene, M., Rau, H., 2016. Moving across the life course: a biographic approach to researching dynamics of everyday mobility practices. *J. Consum. Cult.* 18, 60–82.
- Gronow, A., 2008. The over- or the undersocialized conception of man? Practice theory and the problem of intersubjectivity. *Sociology* 42, 243–259.
- Heinen, E., Harshfield, A., Panter, J., Mackett, R., Ogilvie, D., 2017. Does exposure to new transport infrastructure result in modal shifts? Patterns of change in commute mode choices in a four-year quasi-experimental cohort study. *J. Transp. Health* 6, 396–410.
- Heisserer, B., Rau, H., 2017. Capturing the consumption of distance? A practice-theoretical investigation of everyday travel. *J. Consum. Cult.* 17, 579–599.
- Hu, L., Schneider, R.J., 2015. Shifts between automobile, bus, and bicycle commuting in an urban setting. *Journal of Urban Planning and Development* 141, 04014025.
- Janke, J., Handy, S., 2019. How life course events trigger changes in bicycling attitudes and behavior: insights into causality. *Travel Behav. Soc.* 16, 31–41.
- Kaufmann, V., 2008. Les paradoxes de la mobilité: bouger, s'enraciner. Presses Polytechniques Universitaires Romandes, Lausanne.
- Kent, J., Dowling, R., Maalsen, S., 2017. Catalysts for transport transitions: bridging the gap between disruptions and change. *J. Transp. Geogr.* 60, 200–207.
- Laakso, S., 2017. Giving up cars—the impact of a mobility experiment on carbon emissions and everyday routines. *J. Clean. Prod.* 169, 135–142.
- Lanzendorf, M., 2010. Key events and their effect on mobility biographies: the case of childbirth. *Int. J. Sustain. Transp.* 4, 272–292.
- Marchau, V.A., Walker, W.E., Van Wee, G., 2010. Dynamic adaptive transport policies for handling deep uncertainty. *Technol. Forecast. Soc. Chang.* 77, 940–950.
- Martin, E.W., Shaheen, S.A., 2014. Evaluating public transit modal shift dynamics in response to bikesharing: a tale of two us cities. *J. Transp. Geogr.* 41, 315–324.
- Mayring, P., 2000. Qualitative content analysis. *Forum Qual. Soc. Res.* 1.
- Mayring, P., 2015. Qualitative Inhaltsanalyse: Grundlagen und Techniken. 12. überarbeitete Auflage. Julius Beltz.
- McCarthy, L., Delbosc, A., Currie, G., Molloy, A., 2019. Trajectories and transitions: mobility after parenthood. *Transportation* 1–18.
- Meinherz, F., 2019. [Dataset] Pratiques de mobilité en Suisse: Une étude qualitative sur les choix modaux des pendulaires urbains et la mobilité au quotidien. FORSbase. <https://doi.org/10.23662/FORS-DS-1021-1>.
- Mokhtarian, P.L., Salomon, I., Redmond, L.S., 2001. Understanding the demand for travel: It's not purely 'derived' Innovation: *The European Journal of Social Science Research* 14, 355–380.
- Nkurunziza, A., Zuidgeest, M., Brussel, M., Van Maarseveen, M., 2012. Examining the potential for modal change: motivators and barriers for bicycle commuting in Dar-Es-Salaam. *Transp. Policy* 24, 249–259.
- Oakil, A., Ettema, D., Arentze, T., Timmermans, H., 2011. A longitudinal analysis of the dependence of the commute mode switching decision on mobility decisions and life cycle events. In: *Transport Dynamics: Proceedings of 16th International Conference*

- of Hong Kong Society for Transportation Studies (HKSTS). Hong Kong Society for Transportation Studies, Hong Kong.
- Oakil, A.T.M., 2016. Securing or sacrificing access to a car: gender difference in the effects of life events. *Travel Behav. Soc.* 3, 1–7.
- Oakil, A.T.M., Ettema, D., Arentze, T., Timmermans, H., 2016. Bicycle commuting in the Netherlands: an analysis of modal shift and its dependence on life cycle and mobility events. *Int. J. Sustain. Transp.* 10, 376–384.
- Rau, H., Manton, R., 2016. Life events and mobility milestones: advances in mobility biography theory and research. *J. Transp. Geogr.* 52, 51–60.
- Rau, H., Sattlegger, L., 2018. Shared journeys, linked lives: a relational-biographical approach to mobility practices. *Mobilities* 13, 45–63.
- Reckwitz, A., 2002. Toward a theory of social practices: a development in culturalist theorizing. *Eur. J. Soc. Theory* 5, 243–263.
- Rigal, A.A.R., 2018. Changer le mode de vie, changer la mobilité: voiture et sobriété Ph.D. thesis. Ecole Polytechnique Fédérale de Lausanne.
- Røpke, I., 2009. Theories of practice. New inspiration for ecological economic studies on consumption. *Ecol. Econ.* 68, 2490–2497.
- Sahakian, M., Wilhite, H., 2014. Making practice theory practicable: towards more sustainable forms of consumption. *J. Consum. Cult.* 14, 25–44.
- Sattlegger, L., Rau, H., 2016. Carlessness in a car-centric world: a reconstructive approach to qualitative mobility biographies research. *J. Transp. Geogr.* 53, 22–31.
- Schatzki, T.R., 1997. Practices and actions a Wittgensteinian critique of Bourdieu and Giddens. *Philos. Soc. Sci.* 27, 283–308.
- Schatzki, T.R., 2002. *The Site of the Social: A Philosophical Account of the Constitution of Social Life and Change*. Penn State Press.
- Schatzki, T.R., Cetina, K.K., Von Savigny, E., 2001. *The Practice Turn in Contemporary Theory*. Routledge.
- Scheiner, J., 2014. Gendered key events in the life course: effects on changes in travel mode choice over time. *J. Transp. Geogr.* 37, 47–60.
- Scheiner, J., Holz-Rau, C., 2013. Changes in travel mode use after residential relocation: a contribution to mobility biographies. *Transportation* 40, 431–458.
- Schweiz, Pro Velo, 2014. *PRIX Velostädte 2016*. Pro Velo Schweiz.
- Shaheen, S., Martin, E., Cohen, A., 2013. Public bikesharing and modal shift behavior: a comparative study of early bikesharing systems in North America. *International Journal of Transportation* 1.
- Shove, E., 2003. Converging conventions of comfort, cleanliness and convenience. *J. Consum. Policy* 26, 395–418.
- Shove, E., 2010. Beyond the ABC: climate change policy and theories of social change. *Environ. Plan. A* 42, 1273–1285.
- Shove, E., Pantzar, M., Watson, M., 2012. *The Dynamics of Social Practice. Everyday Life and how it Changes*. SAGE.
- Song, Y., Preston, J., Ogilvie, D., Consortium, iconnect, et al., 2017. New walking and cycling infrastructure and modal shift in the UK: a quasi-experimental panel study. *Transp. Res. A Policy Pract.* 95, 320–333.
- Stadt, Basel, Bern, Stadt, Luzern, Stadt, Gällen, Stadt St., Winterthur, Stadt, Zürich, Stadt, 2017. *Städtevergleich Mobilität. Vergleichende Betrachtung der Städte Basel, Bern, Luzern, St. Gallen, Winterthur und Zürich im Jahr*. Basel Stadt, Mobilität, Stadt Bern, Verkehrsplanung, Stadt Luzern, Tiefbauamt, Stadt St. Gallen, Tiefbauamt, Stadt Winterthur, Tiefbauamt, Stadt Zürich, Tiefbauamt, pp. 2015.
- Uteng, T.P., Julsrud, T.E., George, C., 2019. The role of life events and context in type of car share uptake: comparing users of peer-to-peer and cooperative programs in Oslo, Norway. *Transp. Res. Part D: Transp. Environ.* 71, 186–206.
- Uttley, J., Lovelace, R., 2016. Cycling promotion schemes and long-term behavioural change: a case study from the university of Sheffield. *Case studies on transport policy* 4, 133–142.
- Watson, M., 2012. How theories of practice can inform transition to a decarbonised transport system. *J. Transp. Geogr.* 24, 488–496.
- Yang, M., Wu, J., Rasouli, S., Cirillo, C., Li, D., 2017. Exploring the impact of residential relocation on modal shift in commute trips: evidence from a quasi-longitudinal analysis. *Transp. Policy* 59, 142–152.