

When Visions Become Reality

-

**Urban Living Labs as a Transition Arena
for Sustainable Mobility Culture**

Kumulative Dissertation zur Erlangung des Doktorgrades (Dr. rer. soc.)
des Fachbereichs Sozial- und Kulturwissenschaften
der Justus-Liebig-Universität Giessen

vorgelegt von
Philipp Rollin

aus Köln 2025
[Disputation 30.01.2026]

Acknowledgements

This dissertation exists only because Sebastian Bamberg saw scientific talent in me when I was still far from realising it myself. Thank you very much for your early and emphatic support along the way.

Without Elmar's Schlüters trust and patience, I would probably never have successfully completed this project. Thank you for accepting me as a PhD student without really knowing me. I am looking forward to finally meeting you in person at the disputation. ;-)

A big thank you also goes to Professor Emeritus Peter Schmidt and Professors Jan Häusser and Jochen Mayerl, who agreed to be part of my examination board without much prior knowledge of me or this project. This is by no means a matter of course, so thank you very much for that!

Moreover, Carmen and Stefan, you were the best local partners I could have wished for in my field of research. The world needs courageous visionaries like you!

The constant questions from my family, friends and colleagues were nerve-wracking, but they were also very important for me to keep going. Thank you for never stopping to ask (even when I asked you to stop) and for your warm support over the years. You are the best.

The title - *When Visions Become Reality* - is not just the title of this work. It is also the headline of my very personal PhD journey, from the first idea to this printed work.

I hope that everyone who reads this document will enjoy it. And perhaps, as you read it, ask yourself: what vision do you want to realise? It is obviously possible to make visions come true. Have faith!

Cologne, April 2025

Philipp Rollin

Table of Contents

- Tables.....4
- Figures.....4

- PART 1: THE VISION.....5**
- 1| Initiation of a Socially Accepted Mobility Transition Through Urban Living Labs6
- 2| Transformation of the German Transport Sector 10
- 3| The Complex Path to Socio-Technical System-Change: Mindsets Matter 11
 - 3.1 The Multi-Level Perspective 12
- 4| Transformation Processes as Cultural Projects 14
 - 4.1 Social Norms, Social (Re)order 14
 - 4.2 Mobility Culture 17
 - 4.3 The Importance of Feeling Connected to Transformational Groups 19
- 5| Urban Living Labs: Forward to the Action Research of the 1950s 20
 - 5.1 The Theoretical Deficit: Defining and Determining Urban Living Labs’ Possible Impacts 22
 - 5.2 The Empirical Deficit: Measuring the Impacts of Urban Living Labs 25

- PART 2: THE REALITY 27**
- 6| DOI and citation of the publications associated with the cumulative work..... 28
- 7| Urban Living Labs: From Visions to Reality? 28
 - 7.1 Article Summaries 29
 - 7.1.1 Paper 1: Local mobility culture as injunctive normative beliefs – A theoretical approach and a related measurement instrument..... 31
 - 7.1.2 Paper 2: It’s All Up to My Fellow Citizens. Descriptive Norms as a Decisive Mediator in the Relationship between Infrastructure and Mobility Behaviour 32
 - 7.1.3 Paper 3: Cracks in the Wall of a Car-Oriented Local Mobility System-Results of an Urban Living Lab 34
- 8| Urban Living Labs and the Transformation of the Transport Sector—a Model for Success? 35
 - 8.1 Discussion of the Theoretical Urban Living Lab Deficit..... 36
 - 8.2 Discussion of the Empirical Urban Living Lab Deficit 40
- 9| General Discussion..... 44
- 10| Future Research & Limitations 47
- 11| References..... 50
- 12 | Erklärung..... 59

Tables

| | |
|---|----|
| Table 1. The research objectives, the data and the methods of data analysis of the publications presented in Chapter 7.1.1 to Chapter 7.1.3. | 30 |
|---|----|

Figures

| | |
|--|----|
| Figure 1: The Multi-Level Perspective (Geels & Schot, 2007, p. 401). | 12 |
| Figure 2: Factors influencing mobility culture by Götz & Deffner (2009, p. 41; translation from Klinger & Lanzendorf, 2015). | 17 |
| Figure 3: Stakeholders in an Urban Living Lab, own illustration. | 23 |
| Figure 4: Urban Living Lab in Bielefeld. (1) PR-campaign (here: postcard), (2) public kick-off, (3) public experiments (here: parking lot is used as social space), source: own pictures. | 24 |
| Figure 5: The ULL process, own illustration. | 25 |
| Figure 6: Impacts from Urban Living Labs as Empowered Niche (Rollin et al., 2021, p. 3). | 34 |
| Figure 7: Visible ULL successes in Bad Boll: new bus stop in the village (left) and free cargo bike for residents (right). Photos: Stefan Weiland. | 44 |

PART 1: THE VISION



Interactive event of an Urban Living Lab in Bielefeld, Germany (12/2019).

1| Initiation of a Socially Accepted Mobility Transition Through Urban Living Labs

Access to mobility is an important aspect of social inclusion and therefore also a question of social justice. At the same time, the current transport infrastructure in Germany, which is primarily geared towards the car, generates high external costs such as climate-damaging emissions and immissions or massive land consumption. The resulting demand to ensure socially equitable participation in mobility for all members of society, on the one hand, and to make it more climate-friendly and fairer, on the other, inevitably leads to socio-political challenges. According to Hoor (2021), the reorganisation of social negotiation processes over limited resources is therefore one of the most important challenges facing social science research on transport today. Particularly relevant to these debates is the observation that the external costs of the transport sector are borne primarily by the socially disadvantaged, who in turn cause relatively few of them. In addition, they are more likely to live in close proximity to heavily used transport infrastructure and at the same time are less equipped (e.g., in terms of money, flexibility, social capital or knowledge) to protect themselves against rising prices, emissions and immissions (Frey et al., 2020; Vallée et al., 2021). As a result, a far-reaching transformation of the transport sector is urgently needed. This, however, creates social uncertainty. For many people, travelling in a greener way is not easily contemplated. Changing behaviour patterns that have manifested themselves over many years, such as routinely driving to and from work, is associated with cognitive effort (Aarts & Dijksterhuis, 2000; Ramos et al., 2020). The individual needs to consider all the issues involved in getting to their destination on time using sustainable transport instead of the private car: How often does the train run? How do I get to the station in an environmentally friendly way? Which ticket do I need to get there? This is a significant factor in explaining why mobility behaviour is so difficult to change and why the car's share of the modal split in Germany has remained almost unchanged for years (Nobis et al., 2019, p. 3). So how can this challenge be solved?

Perhaps because of this uncertainty in parts of society about how a change in mobility behaviour could be implemented in everyday practice, policymakers have so far focused primarily on promoting technological innovations to reduce climate-damaging emissions in the transport sector (Matos et al., 2022). The aim is to make the transport sector more climate-neutral without having to fundamentally change people's behaviour (FAZ, 2020; Verkehrsrundschau, 2022). This is an indication of so-called 'transport taboos' at the political level (Gössling & Cohen, 2014). These are urgently needed transport policy measures that are not being implemented because decision-makers believe they cannot

be communicated to society. They stand in the way of more far-reaching changes that also take into account human behaviour, and since the innovation-driven approach has only been moderately successful so far, more far-reaching concepts are needed that overcome transport taboos and also include social innovation and a change in mobility behaviour (Geels, 2002; Nobis et al., 2019).

The term 'transport transformation' refers to this kind of fundamental reform of the sector from two perspectives. On the one hand, there is the 'transition of the engine', which aims to replace fossil fuels with climate-neutral engines, and, on the other, the 'mobility transition', which aims to reduce motorised private transport and to increase the use of eco-mobility (public transport, cycling, walking)—in other words, to change people's behaviour (Hesse, 2018). Such a combined approach to socio-technical transformation is expected to have a particularly significant impact on the modal split and greenhouse gas emissions in the sector. Matos et al. (2022) have calculated that a combination of technological innovation and behavioural change can achieve a reduction in global emissions of almost 76%. By contrast, technological innovation or behavioural change alone could at most halve emissions (Matos et al., 2022, p. 9). A successful transformation of the transport sector is therefore also a social science issue, involving the reorganisation of the social order and strategies to change the mobility behaviour of many people. However, there is still a lack of sufficient knowledge and, above all, comparable empirical data on the decisive drivers and mechanisms of the interplay between innovations and their transfer into mainstream behaviour (Hennicke et al., 2021; Matos et al., 2022; Tiedtke, 2013).

As mobility behaviour is highly dependent on habitual routines and social influences, it is not trivial to change it (Aarts & Dijksterhuis, 2000; Gardner & Abraham, 2007; Javaid et al., 2020). Previous attempts to implement this in Germany also show that social acceptance of a mobility system outside the car is rather low (Zeit, 2019). Monetary approaches to promoting the use of public transport in Germany have hardly had the hoped-for effects. For example, a nationwide low-cost public transport ticket of €9 and then €49 in Germany resulted in only a small shift from car journeys to eco-mobility. In fact, the absolute number of trips made by public transport actually increased, with nearly no substantial reduction in car trips (Kuhlendahl et al., 2022; Rollin & Lutz, 2024). However, there is a growing consensus in the social sciences that the financial aspect is by no means the only factor influencing the use of sustainable transport modes (see review by Javaid et al., 2021). Therefore, other concepts are increasingly coming to the fore as promising ways to influence mobility behaviour. A particularly frequently discussed

concept in the context of transport transition in Germany is that of mobility culture (e.g., Deffner et al., 2017; Klinger & Lanzendorf, 2016; Ruhrort, 2019). This aims to exploit the fact that people strongly base their attitudes and behaviour on social norms—perceived common patterns of behaviour and attitudes in society. According to this assumption, an alternative to the car-dominated status quo will remain unimaginable for most people in Germany until they get the feeling that such an alternative is theoretically and practically a desired wish for other people around them. For these reasons, a change in mobility behaviour is possible if the defining environment changes. A combination of new infrastructure, new technology and, above all, a new, sustainable mobility culture—all in all, a socio-technical transformation (Laa et al., 2021). But how can this vision be realised?

As one approach to implementing this comprehensive transformation of the transport system, a social science method has been increasingly used at the local level since 2015: Urban Living Labs (ULLs) (cf., e.g., Schöpke et al., 2017, p. 29). The aim of this method is to publicly test an alternative, sustainable vision of local mobility, jointly developed by local stakeholders. The aim is to stimulate local discourses and thought-processes that aim to break down cognitive barriers to behavioural change. This, in turn, leads to a change in perceived local mobility culture and thus to a change in the mobility behaviour of the majority (ibid.). The resulting social acceptance of sustainable transport solutions should also increase the willingness of policy makers to change the status quo. The aim is to break down transport taboos and to pave the way for a socio-technical transformation of the transport sector.

So, is a ULL the answer to the question of how a modal shift in Germany can succeed? Theoretical and empirical answers to the question of whether and how ULLs are suitable for this purpose are still lacking. However, there are many examples of ULLs attempting to do just that (Alcántara et al., 2018; Beercroft & Parodi, 2016). One challenge for transformation research in general, and ULL research in particular, is the diverse interpretation and often lacking theoretical categorisation of the hoped-for effects (Parodi et al., 2021; Zolfagharian et al., 2019). A second resulting challenge lies in impact assessment as such. As there is still no consistent understanding of the impact pathways and transformative potential of ULLs, there is also no empirical overview of such ULL impacts. Given extensive funding available for ULL in Germany (BMWK, 2021) and its frequent use, these research gaps are quite surprising. Filling this theoretical and empirical gap is therefore one of the most important challenges for ULL research in order to legitimise this approach. Therefore, this dissertation addresses the following two deficits in social

science research on ULLs: (1) the theoretical deficit of the lack of a generally valid understanding of the definition and transformative potential of ULLs, and (2) the empirical deficit that there is a paucity of data on the transformative potential of ULLs and thus a lack of valid statements about their pathways and effectiveness. In order to address the theoretical deficit, this dissertation categorises the various ULL concepts within transformation theories and identifies the essential factors on the basis of which an impact assessment should be carried out. This, in turn, forms the basis for the initiation and establishment of a ULL in a small German town, which represents the unit of investigation for addressing the empirical deficit. This second deficiency is addressed by the exemplary application of a standardised evaluation concept for mobility-related ULLs developed within the framework of this dissertation. This is essentially based on the assumption that ULLs can positively influence local mobility culture, thereby breaking down transport taboos at the level of decision-makers and overcoming cognitive barriers at the level of civil society that currently stand in the way of more sustainable mainstream mobility behaviour (Rollin et al., 2021).

This framework paper is structured as follows: First, it discusses the conditions under which a transformation of transport in Germany can be realised, based on established theoretical concepts, primarily the concept of local mobility culture. The role that the ULL method can play in the transformation of the transport sector in Germany is then considered. The theoretical and empirical shortcomings of the method are pointed out. This is followed by the three articles on which this cumulative thesis is based. These deal with the following aspects: (1) what a local mobility culture is and how it can be empirically captured; (2) The second paper emphasises that a socio-technical perspective is necessary to achieve a transport transition. It looks more closely at the social construction of mobility norms and whether these can be influenced by ULLs; (3) and finally the third paper presents a proposal to empirically evaluate ULL-impacts. In the concluding general discussion, the challenges, opportunities and limitations of the ULL method for initiating a local transport transition in Germany are presented. Conclusions for social science and policy advice are drawn and open research areas are outlined.

2| Transformation of the German Transport Sector

The transformation of transport in Germany has a central role to play in preventing the climate crisis from worsening: in 2019, the transport sector will still be one of the largest emitters of CO₂ among all sectors defined in the Climate Protection Act (KSG), with 163 million tonnes of CO₂ emissions. It is also the only sector whose emissions have barely decreased since 1990, despite technological progress (Umweltbundesamt, 2020). From a climate policy perspective, CO₂ emissions are the most pressing issue. However, promoting technological innovation is the approach most frequently pursued by policymakers to reduce CO₂ emissions in the transport sector (Brunnengräber & Haas, 2018; Wentland, 2020). The ongoing development of alternative drive technologies and advances in digitalisation and automation are innovations in the transport sector that can actually lead to a reduction in emissions from a technical point of view (Grimm et al., 2020). However, this is counterbalanced by a simultaneous increase in the quantity and distance of trips, as well as the growing number of traditional combustion-engine vehicles on German roads. This results in various problems associated with private motorised individual transport remaining prevalent: traffic congestion, emissions and pollution, and the immense land use by roads and parking spaces (Nobis et al., 2019; Kords, 2022). For example, Nier (2017) estimates that the costs associated with the search for a parking space in Germany (e.g. fuel, emissions, opportunity costs) alone amount to 40 billion euros per year. In Frankfurt am Main, for example, drivers spend an average of 65 hours per year looking for a parking space.

To achieve climate neutrality in Germany's transport sector by 2035, the Wuppertal Institute (2017) suggests in a model calculation that a 24% reduction in car usage is necessary. This reduction is deemed essential regardless of the technological advancements in transportation methods. The starting point for the calculation was the car's modal share in 2008, which was 58% (Rudolph et al., 2017). A change in people's behaviour must therefore be taken into account to a much greater extent in the approach to transport transformation. The transformation of the German transport sector is therefore also a social science question about the change in everyday mobility behaviour and its effects on social life and urban development. Such a change in mobility is accompanied by very specific social consequences. People are well aware that a modal shift will have a very concrete impact on their lives. This is why this project is associated with reserva-

tions and diffuse fears in society, which need to be reduced in order to actually implement a change in behaviour on the scale required. The social acceptance of transport policy measures to organise sustainable mobility is therefore essential.

3| The Complex Path to Socio-Technical System-Change: Mindsets Matter

Innovations, not only technological but also social (e.g., neighbourhood organised car-pooling), are a key prerequisite for a successful transport transition. However, as their uptake is too slow and people are not adapting their behaviour sufficiently to stabilise the climate, a broader view of the transport transition is needed. Central to this is an analysis of how social innovations can be transferred to the mainstream (Matos et al., 2022). This requires a complex process of interaction between technology, regulation, infrastructure and human behaviour (Geels, 2002; Verbong & Geels, 2007; Rip & Kemp, 1998).

This interplay of technological and social conditions for a holistic and successful transport transition can be described as a socio-technical system. This concept plays a central role in social science transformation research (Markard et al., 2012, p. 956). Especially Maja Göpel (2016) describes the need for a major mindset shift, based on the observation that, after 40 years of discussions about sustainability, hardly any trend has been changed to the necessary extent. This perspective calls for a comprehensive transformation of all areas of a system towards greater sustainability. This concerns the economy, technology, politics, but also human thinking and behaviour—in other words, a socio-technical transformation (Göpel, 2016, p. 5). From a social science perspective, the construct of mindsets is central to Göpel's considerations. By this she means orientations and normative beliefs that shape technological, economic and social institutions and systems. Since individual action contributes to transformation, it is necessary to communicate more forcefully that realising socio-technical transformation is a complex, collective task (pp. 53–57). As people orient themselves towards the supposed mainstream mindset and align their own mindset and actions accordingly, social pioneers are needed to demonstrate a sustainable lifestyle and mindset—and thus motivate people to question their own routines (pp. 46–48). Göpel identifies the economic mindset that has prevailed since the 19th century, with its pursuit of unlimited material growth, as the reason for the existence and, above all, the persistence of an unsustainable transport sector (p. 98; VDI nachrichten, 2022). This makes it clear that change in a system can only be initiated

and implemented by people acting with purpose. Change must therefore begin with the awareness of all actors in a complex socio-technical system.

3.1 The Multi-Level Perspective

The Multi-Level Perspective (MLP) (Geels & Schot, 2007) is an appropriate theoretical framework for understanding the interlocking interactions of different actors, interests and resources, and thus for describing possibilities for changing existing socio-technical systems. In a review of recent literature on transformation by Matos et al. (2022), it was identified as one of the most widely used theoretical frameworks in transformative research.

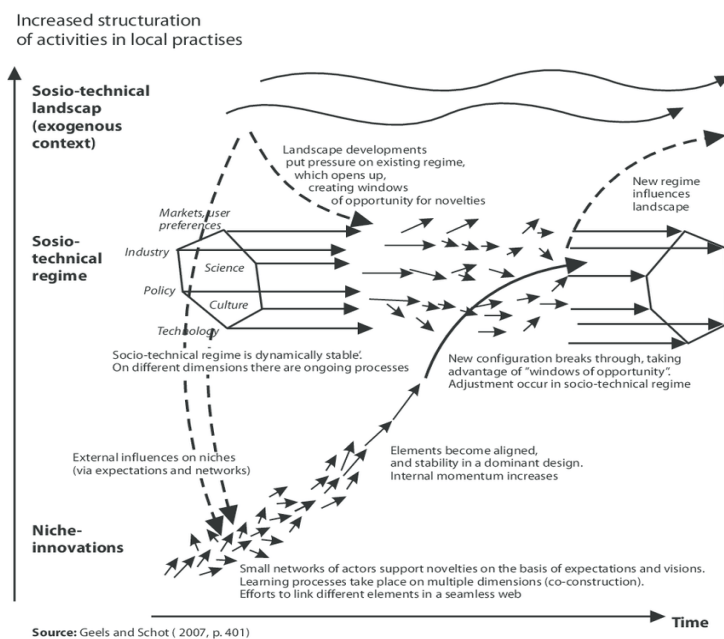


Figure 1: The Multi-Level Perspective (Geels & Schot, 2007, p. 401).

The MLP describes a socio-technical innovation process that takes place on and between three levels (cf. Geels & Schot, 2007, pp. 399–402): (1) the niche, (2) the regime, and (3) the landscape (cf. Figure 1). The ‘niche’ is the site of innovative activity that is directed against the currently prevailing regime. It is a place where different actors act in an initially uncoordinated way and try out alternative visions, practices and models. However, as this usually happens without publicity, niche innovations often have no impact on the existing status quo—they remain the exception rather than the rule. This status quo is called a ‘regime’ and is described as the dominant socio-technical system. It includes current everyday practices, research priorities, economic interests and political processes to maintain the status quo. According to Geels et al. (2017, p. 473), a car-friendly regime currently prevails in the transport sector in all countries of the global North. This is reflected in land use and infrastructure frameworks, but also in the behaviour of the majority. Finally, the term ‘landscape’ describes influencing factors at the macro level. Using

the transport system as an example, these can be climate change, changing attitudes towards climate change mitigation measures, and the dominant mindsets at the heart of Göppel's (2016) considerations.

Arranz (2017, pp. 133–136) has derived the conditions under which niche movements can succeed in changing a regime by analysing 34 regime change projects. He identifies three central factors: (1) niche actors with radical, alternative attitudes, (2) the influence of niche actors on economic capital that can challenge an existing regime, and (3) political actors within the regime who perceive a strong opinion among the civilian population that an alternative to the current regime could gain significant social acceptance and are therefore open to including it in their own political agenda. This underlines the important role of citizens. Only when regime decision-makers perceive a majority opinion in favour of the innovative vision will the necessary social pressure be great enough to open up to far-reaching transformation (Kerkhof & Wieczorek, 2005; Stephens et al., 2008).

According to Geels & Schot (2007), these factors can be complemented by organised coordination of the visions of niche actors in order to exert pressure on the regime from within a group, that is, the opening of a 'window of opportunity' for regime change at the macro level (p. 400). This window opens when macro-trends exert strong pressure on the existing regime, for example, through drastic climate crises, a pandemic or a significant shift in cultural attitudes. As described by Göpel (2016), a mindshift is therefore also central to the MLP. These two aspects expose the regime to pressure from below (niche) and from above (landscape), which can lead to transformation. However, an analysis by Nelson & Allwood (2021) contradicts the hypothesis put forward by Arranz (2017) as the first condition for successful transformation, namely, that niche actors must represent a radical vision. Using a selection of different technological and behavioural measures based on a meta-analysis, they derived several decarbonisation scenarios. These were analysed in terms of their migration potential. It turns out that it is not so much the most blatant measures, but the consensus measures that can bring about effective and long-term change.

Four factors for the successful transformation of socio-technical regimes can thus be derived from these publications:

1. A sustainable niche vision collectively shared by a large number of players, which presents itself as an alternative to the status quo that is suitable for everyday use.
2. Networking the niche movement with regime decision-makers from politics, business and science.
3. Political actors in the regime who react sensitively and openly to changing social moods.
4. Pressure from the landscape level due to changing social mindsets and macro trends.

4| Transformation Processes as Cultural Projects

Mindsets or cultural trends at the macro level therefore play a prominent role in transformation processes as they can break down transport taboos in the dominant regime and lead to behavioural changes among citizens (Geels & Schot, 2007; Göpel, 2015; Schliwa et al., 2015). This is where methods and their impact measurements need to be applied. This is challenging because, in the social sciences, culture and what is associated with it is considered a latent construct (Reckwitz, 2004). In order to obtain the necessary precision of the concept for an empirical examination in the impact measurement of transformation projects, the following section will deal with the norm-related concept of culture in general and a related concept of mobility culture.

4.1 Social Norms, Social (Re)order

The norm-related cultural sociological perspective lends itself to empirically analysing the development of mindsets and cultural trends in the sense of the MLP. It explains the social connections between perceived social beliefs and one's own actions using the easily operationalisable construct of *social norms*. Otte (2018) defines social norms as follows: "Social norms are collectively shared ideas about socially (in)appropriate behaviour in a situation" (p. 90). Durkheim and Parsons are central figures in a norm-oriented social analysis, based on the observation that a society composed of people striving for individual advantage is chaotic and characterised by mistrust, which is why neither cohesion nor order is possible in it. They describe socially appropriate behaviour, or the normative integration into social groups and the structure of society, as the basis for the development of functioning social relationships (Durkheim, 1950; Parsons, 1972). While

Durkheim explains compliance with social norms through the threat of, or fear of, sanctions and perceived immutability, Parsons assumes an implicit process. Following norms is therefore largely unconscious and unquestioned and can therefore serve the purpose of ensuring social order and relationships by reducing the complexity of action decisions: People simply know how to behave in certain situations (Tranow, 2018).

In his definition of social facts in 'The Rules of Sociological Method', Émile Durkheim describes a construct that corresponds to social norms. Social facts are "any more or less fixed mode of behaviour which is capable of exerting an external constraint on the individual; or which occurs generally in the sphere of a given society, so that it has a life of its own independent of its individual manifestations" (Durkheim, 1950, p. 114). These are general ideas about what is accepted as correct behaviour: how to behave towards superiors, or, applied to the transport sector, how to move prototypically, whether, for example, using a bicycle is considered socially acceptable behaviour or not. They are perceived by humans as objective reality ('collective consciousness'). However, it is actually a subjective assessment of expectations that we learn in the course of our lives through observation, socialisation or the experience of positive and negative sanctions, and that we adopt unconsciously and unquestioningly over time. According to Durkheim, social facts become fixed over time, i.e., their existence is manifest and lies outside the individual's sphere of change and influence. They convey social constraints to people and thus fulfil the function of contributing to the order of societies (Durkheim, 1950, p. 125). If these assumptions are now transferred to the MLP, and social facts according to Durkheim are integrated into the model, social facts ensure the continuation of the regime at the landscape level, as they define the social constraints on action corresponding to the current regime. However, if the social facts change diametrically against the existing regime, a window of opportunity opens for the regime to be transformed by a new type of social order.

Since the resulting beliefs about *culture* are anchored in the socially structured knowledge of the actors, the study of culture from this perspective focuses on the collectively shared symbolic orders at the macro level, in line with the definition of landscape in the MLP. Such a shared symbolic order can be expressed in shared systems of normative beliefs and operationalised accordingly (e.g., Bamberg et al., 2020). The perspective thus refers to a complex interweaving of people in social relationships. Through these networks, impulses, affects and spontaneous reactions lose significance due to the habitualised adoption of socio-cultural elements (such as social norms). With its *intersubjective understanding of culture*, social psychology offers further theoretical and empirical

impulses in this regard. In this way of thinking, culture, understood as a commonly shared meaning system, focuses, just like the cultural sociological perspective, on the role of social norms as an organising factor within social networks (e.g., Eom, & Kim, 2015; Fischer et al., 2009; Morris et al., 2015). For example, Sherif (1936) and Asch (1951) were able to empirically demonstrate in experiments that people follow an obviously incorrect answer given by other group members if they are in the majority. The explanations for these observations are that the reactions of people to whom one feels a sense of belonging are an influential source of information (Sherif, 1936) and because people generally try to avoid negative social sanctions from others in order to gain social recognition (Asch, 1956). The intersubjective approach thus also provides a theoretical explanation as to why cultural systems persist unchanged over long periods of time on the one hand and can sometimes change suddenly on the other. The phenomenon of pluralistic ignorance is cited as a reason for this (e.g., Prentice & Miller, 1993). This approach describes the social phenomenon when the majority actually rejects existing social norms personally, but people wrongly assume that they are alone in this opinion and therefore do not communicate any desire for change so as not to jeopardise their social recognition. This can also serve as an explanation for surviving transport taboos in the regime. In order to maintain power, decision-makers also orientate their actions towards the perceived needs of the majority. In other words, a change in social norms is needed in order to break down transport taboos. This is the first hypothesis: Citizen pressure, by changing social norms to become more sustainable, can reduce transport taboos (H1). Of course, this also implies that people's behaviour can be influenced if the perceived social consensus can be transformed and pluralistic ignorance unmasked (Kuran, 1997).

H1: A shift in social norms towards more sustainability leads to a reduction of transport taboos in the regime.

In order to be a recognised member of social networks, avoid sanctions and save resources for costly decision-making processes, people adopt supposedly prototypical attitudes and behaviours. They adapt to a culture and absorb its supposed rules, guiding principles and ideas about correct behaviour. These perceptions of what is considered desirable and socially desirable by the majority are norms that act as the core of society's shared culture (Hoor, 2020).

4.2 Mobility Culture

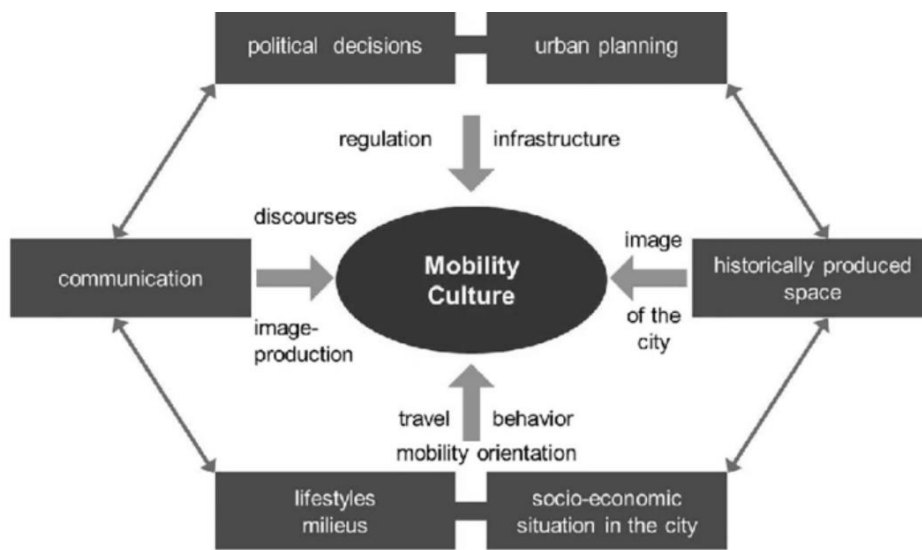


Figure 2: Factors influencing mobility culture by Götz & Deffner (2009, p. 41; translation from Klinger & Lanzendorf, 2015).

The above descriptions make it clear that there is no such thing as *the culture*. Rather, different socio-technical networks each have their own cultures. There is also a cultural concept that is increasingly the focus of everyday discourse and transformative projects, especially in the context of transport and mobility. It is the concept of *mobility culture* (e.g., Deffner et al., 2017; Klinger & Lanzendorf, 2016; Ruhrort, 2019). The scientific debate in the context of transformative goals symbolises the start of a paradigm shift away from a purely technological perspective towards a social perspective on a transport transition (see also Göpel, 2016). Prioritising transport policy thus becomes a civil society decision. Götz and Deffner (2009) have presented a prominent definition of mobility culture that is shown in Figure 2. As can be seen in Fig. 2, Götz and Deffner take a very broad perspective. It includes almost all factors that influence mobility: infrastructure, behaviour, cityscape, public discourses and regulations. On the one hand, this is a strength of the definition, as it is very flexible. On the other hand, however, it makes it unsuitable for an empirical examination of the topic, as such a complex concept makes precise operationalisation difficult. This reflects a frequent debate in the social sciences. On the one hand, there are the proponents of comprehensive concepts who argue in favour of broad considerations in order to be able to draw a holistic picture, and, on the other hand, there is the faction referred to by Hirsch and Levin (1999: 200) as the ‘validity police’, who call for a narrow but very precise examination of social phenomena. Geels (2022) and Sorell (2018) advocate the latter position of the validity police explicitly for the field of sustainable transformation research. Due to the complexity and magnitude of socio-technical

transformation processes, a sharpened focus is necessary in order to understand the underlying processes gradually, but clearly and validly. This work therefore adopts the cultural-sociological perspective on mobility culture in the sense of the intersubjective approach. As a result, mobility culture is conceptualised in a focused and precise manner via perceived social norms. What social norms should refer to in this context was identified in the context of this thesis in discussions with experts on central aspects of perceived, mobility-related social needs of community members (see Bamberg et al., 2020 for a detailed description of the development of the measurement instrument). As a second hypothesis, this thesis therefore investigates whether individual mobility behaviour is more sustainable the more sustainable the local mobility culture is perceived to be (H2).

H2: The more sustainable a person considers the local mobility culture to be, the more ecologically sustainable their individual mobility behaviour is.

A key objective of mobility-related transformation processes should therefore be to positively influence society's assessment of its local mobility culture. However, a norm-based understanding of local mobility culture presents it as a thing and thus as a given social fact (cf. König, 1950, p. 61). But how can something tangible be changed in order to open the window of opportunity for regime transformation? According to Durkheim, social facts are created by people themselves, in that several individuals carry out a certain activity in the same way and thereby create and exemplify a certain social order. Durkheim discusses the question of how a social system can change when this is beyond the possibilities of individuals by referring to states of social disintegration (*anomie*). By this he means new social differentiations caused by extensive processes of social change, which result in the dissolution of collective order and create a momentum in which new social systems guiding behaviour must be established (König, 1950, pp. 57–69). At this point, too, it becomes clear that Durkheim's considerations fit well into the theoretical assumptions on the transformation of socio-technical regimes of the MLP. The momentum described by Durkheim and König (1950) is associated with the opening of a window of opportunity at the landscape level and a strong niche movement networked with the regime.

Thus, according to Durkheim and the MLP, it would be possible to replace a car-oriented local mobility culture with a more sustainable local mobility culture if, firstly, a process

of social change begins (e.g., growing acceptance of the need for a traffic transition), secondly, a group of people translates this into their daily actions (e.g., cycling more often) and, thirdly, compliance or non-compliance is framed with positive or negative social sanctions (e.g., (lack of) social recognition).

4.3 The Importance of Feeling Connected to Transformational Groups

In order to change existing mindsets, perceived social norms and thus mobility culture, moments of anomie are needed. These are generated by social actors who consciously and visibly oppose existing norms and thus open up space for alternative thinking. There is a need for niche social actors who live out an alternative to the existing system in a publicly effective way, thereby making it tangible and making deviant behaviour visible—the pluralistic ignorance can thus be dissolved, and attitudes can be attributed to the majority that correspond to their own. However, in order for the social norms assigned to this group to really influence one's own behaviour as an action-guiding expectation, it must be perceived as a majority and ideally, there must be a pronounced feeling of solidarity with this majority (Abrams & Hogg, 1988; Tajfel & Turner, 1979). Several experimental studies that have manipulated in-group norms and measured their effects on the behaviour and attitudes of test subjects have demonstrated the importance of attachment to social groups (cf., e.g., Hogg & Turner, 1987; Hogg & Smith, 2007; Hornsey, 2008).

Here, a challenge emerges that may explain why niche movements often find it difficult to transfer the more sustainable vision of social life that they exemplify to the mainstream, i.e., to grow out of the in-group significance of certain norms (Schulte et al., 2020). The 'Transition Town' movement is an illustrative example. Transition Towns are organised groups of people who consciously implement a sustainable lifestyle in their everyday lives, with the aim of getting as many people as possible to join them. However, their membership in Germany is stagnating in a relatively small, highly educated milieu (Maschkowski & Wanner, 2014). A study of 280 Transition Town initiatives also concludes that the movement is mostly focused on internal networking and rarely manages to make significant contributions to the socio-technical transformation of society as a whole. However, the more heterogeneous such an initiative was, the more successful it was in its external impact (Feola & Nunes, 2013). In order for perceived social norms to have a real impact on people's attitudes and behaviour beyond an initiative, these social norms need to be associated with groups with which one feels a certain affinity. For example, because one's own milieu is represented in the group, or because people participate with whom one feels connected, trusts, or hopes for social recognition. According to

these observations, a group consisting only of niche players has little chance of success. What is needed is a combination of actors that represent as much of society as possible. Urban Living Labs (ULLs) are a method that can be used to initiate such diverse groups. These are online and offline formats for discussing, developing and testing alternative, more sustainable visions for everyday life. They deliberately involve as many stakeholders as possible to ensure that the group is connected to the wider society. According to the studies mentioned above, the more diverse a ULL is, the more connected people feel to it. This in turn substantially increases the transformative power of a ULL. The third hypothesis of this dissertation describes this phenomenon based on the assumption that a ULL is suitable for bringing together a diverse group of many different stakeholders and building consensus around a jointly identified problem. The theoretical idea behind this is that a heterogeneously staffed ULL represents a cross-section of society, so that more people identify with its goals and the ULL actually has transformative potential to change social norms.

H3: The more stakeholders from different societal groups are involved in an Urban Living Lab (ULL), the more citizens identify with the ULL and its goals.

5| Urban Living Labs: Forward to the Action Research of the 1950s

Urban Living Labs (ULL) refer to action research, a theoretical orientation developed in the USA in the 1950s. Kurt Lewin (1953) saw overcoming the hard boundary between research object and research subject as a method for resolving social conflicts. The aim was to allow scientific knowledge and reality to learn together and from each other. Sociological knowledge was to be generated under real conditions and thus have a targeted effect. Projects were concerned, for example, with collective approaches to urban renewal, the reduction of discrimination or the improvement of working conditions (Adelman, 1993). This made social science normative and its projects directly political and emancipatory. Science actively helped to shape society. In Germany, the approach also found resonance from around the 1970s in the context of a socially and scientifically critical mood at German universities. At that time, the approach was positioned as a counter-proposal to the rigid and supposedly unrealistic theoretical debates in the humanities, which were criticised in some social groups (Haag, 1972; Horn, 1979).

After a few years, however, the method itself began to attract criticism. This mainly concerned the lack of objectivity and neutrality of the projects. In addition, the causal assumptions about the effectiveness of the chosen theoretical and methodological concepts proved to be a major challenge, as action research was used to solve complex, real social problems. This made it very difficult to control for other influencing variables and to compare projects. It was almost impossible to judge when an action research project had been successful. Coupled with all this was the problem of the lack of a unified scientific-theoretical and strategic orientation. All this ultimately led to purely descriptive findings, but hardly to an understanding analysis of the causes in general, e.g., precarious working conditions, or concrete solutions to them (Schneider, 1980). As a result, the action research projects provided little knowledge of transformative processes for research, but rather acted as moderators of social processes (Heinze, 1987). There were also reports of failed social mobilisation, communication problems in the transdisciplinary project groups, power or interest conflicts, and action researchers who were overwhelmed by the complexity of a completely different working day (Köberer & Horn, 1979; Moser, 1975). These reasons led to a steady decline in the number of projects from the end of the 1990s (von Unger et al., 2007).

Since 2005, however, this approach has experienced a renaissance in the European Union and in Germany in particular (Hossain et al., 2019; Schuurmann, 2015; Pascu & Van Lieshout, 2009). The logic of action research was taken up once again under the name of 'real-world laboratory'. In the German state of Baden-Württemberg alone, €20 million have been spent on real-world laboratory projects since 2015 (MWK, 2021). One concrete example is the 'Future City Lab Stuttgart'. Initiated by the University of Stuttgart, visionary locations for sustainable mobility were designed by students, prioritised in workshops with civil society and political actors, and implemented as a real-life experiment. For example, a car park was converted into a meeting place with a kiosk. What began as a temporary experiment has now existed for six years, in 2024. It has continued to be maintained on a voluntary basis. A new normality was created, initiated by a real-world laboratory (Alcántara et al., 2018). As a result of such success stories, the state government of Baden-Württemberg increased the funding guideline again in 2021, with possible funding amounts of up to €25 million per real-world laboratory (BMWK, 2021). A first indication that transport taboos are being lifted? The German government for the 2021–2025 legislative period has also explicitly announced further funding for real-world laboratory in its Federal Report on Research and Innovation 2022: "In addition, the Federal Ministry of Transport, Building and Urban Affairs will promote the interdis-

ciplinary and transdisciplinary development of sustainable mobility and logistics concepts at the municipal level and their testing and implementation within the framework of real-world laboratories (see also, III 4.1 Framework conditions for the promotion of innovation)" (Deutscher Bundestag 2022, p. 90).

But how has this method regained strength in political and scientific discourse? Are the lack of objectivity and neutrality as well as the difficulty of making causal assumptions no longer perceived as a problem today? A 2018 documentation by the Scientific Service of the German Bundestag justifies the high political funding sums by stating that "(...) not only technological innovations, but (...) also social innovations that have arisen or could arise as a result of technological upheavals [should be analysed] in order to develop measures that are necessary to solve the resulting social challenges." (WD, p. 4). This can be realised using the real-world laboratory method. Defila and Di Giulio (2019) also derive a twofold potential from the observation of various real-world laboratories between 2015 and 2019: (1) Working on concrete everyday problems in real contexts makes the topics tangible for all actors involved and makes working on a joint solution attractive. (2) The role and significance of science in overcoming real problems is re-evaluated by society—and in a positive way (Defila & Di Giulio, 2019, p. 1). ULLs are therefore seen as an opportunity to develop complex socio-technical solutions.

Schäpke et al. (2017) emphasises that real-world laboratories should contribute both to the transformation as such and to the further development of transformation research. On the one hand, the real-life experiments ensure that potential solutions to the identified challenges are experienced. On the other hand, it must also be a goal to generate knowledge about the robustness, scalability and transferability of the solutions through the process. However, the method's weak point remains a twofold deficit, which action research was already exposed to. Firstly, a theoretical deficit becomes apparent. The term is currently used for many, sometimes very different processes and projects. There is no universally valid definition of the method and concrete impact expectations (Schneidewind, 2014; Beecroft & Parodi, 2016). Secondly, this leads to an empirical deficit resulting from the lack of impact analyses. The claim formulated by Schäpke et al. (2017) is therefore currently being missed.

5.1 The Theoretical Deficit: Defining and Determining Urban Living Labs' Possible Impacts

The term 'real-world laboratory' is a very general one. It covers many different approaches to action research, including the one that is the focus of this research, namely Urban Living Labs (ULL). In order to answer the questions of what a ULL is and what

impacts can be expected, it is necessary to look at the context of use and the associated objectives, as the term is used in many different ways. The term living lab is also often used. Although the two concepts differ only slightly in terminology, they represent two completely different understandings of the design and purpose of the action research. This can be seen as a major source of misunderstanding. The two concepts will therefore be explained and distinguished below.

Living Labs (LL) refer to co-creation processes of technological innovations by potential end-users, usually initiated by companies. Success or failure can be determined relatively easily based on economic analyses of the final product (Leminen, 2015; Schuurman et al., 2015; Veeckman et al., 2013). This is in line with the Council of the European Union, which in a 2020 conclusion on the future use of LLs called for them to be used as a framework for testing innovations “where appropriate in a real-world environment” (p. 4). There are also numerous LLs in the mobility sector that focus on providing and testing technological innovations in real-life conditions (e.g., the RMV-Easy project, which is testing an autonomous e-shuttle on-demand service, see: <https://www.probefahrt-zukunft.de/>). An LL can therefore provide a suitable framework for accelerating the transition of the engine.

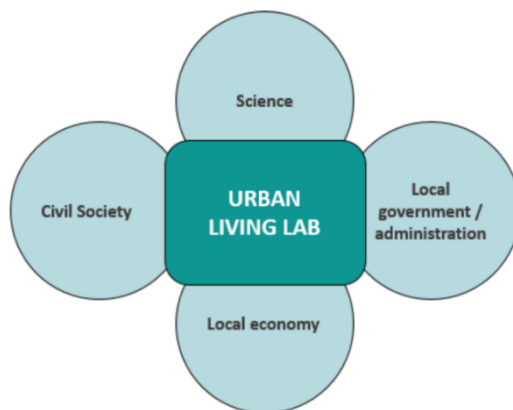


Figure 3: Stakeholders in an Urban Living Lab, own illustration.

In contrast to an LL, ULLs extend the scope of impact to problems that affect society as a whole and require close collaboration between numerous stakeholders to solve (Chronéer et al., 2019; Stehen & van Bueren, 2017). They are therefore more closely related to action research. The core aspect here is the integration of as many stakeholders as possible affected by the alternative vision into the real-world laboratory: civil

society, politics and administration. But science itself is also part of ULLs. On the one hand, this means that the classical separation between research subject and research object is dissolved, and that cooperation takes place together rather than alone in a scientific-social structure. On the other hand, it also ensures that many social groups and milieus are part of the ULL. This is seen as an important aspect of a ULL to ensure that as many people as possible in a location can identify with the ULL actors and that the ULL

innovations are widely accepted by society (see Chapter 4.3; Burbridge, 2017; Oldenhof et al., 2020). This is a first literature-based confirmation of H3 (p. 16).

Due to their constellation, ULLs thus integrate all levels of the socio-technical regime, together with actors in the niche. They thus represent an arena in which socio-technical transformation processes can be constituted. Five universal key characteristics of ULLS identified by McCormick and Hartmann (2017, p. 6) are suitable for a clear definition. These are (1) Geographical embedding: ULLs are located or embedded in geographical areas and they are predominantly not virtual platforms. (2) Experimentation and learning: ULLs test new technologies, solutions and strategies in real-life conditions and in a highly visible way. (3) User participation and involvement: Stakeholder co-design and involvement is often found in all phases of the ULL approach. (4) Leadership and ownership: It seems that a clear leader or owner is crucial for ULLs, although there is a delicate balance between steering and control. (5) Evaluation of actions and impact: Evaluation underpins the ability of ULLs to facilitate formalised learning.



Figure 4: Urban Living Lab in Bielefeld. (1) PR-campaign (here: postcard), (2) public kick-off, (3) public experiments (here: parking lot is used as social space), source: own pictures.

In practical terms, the work of ULLs can be described as follows: a group of stakeholders identifies a common problem and then organises an initial, public kick-off meeting to further differentiate the ULL line-up. The core objective is to identify a common vision as a group and then make this visible to everyone, including those beyond the ULL activists, through real-life experiments in public spaces. This is where the transformative potential of a ULL unfolds: the aim is to initiate social thought processes and agenda-setting within the regime. We also take this goal as further support for H1, namely that this can break down transport taboos in the regime (cf. H1, p. 12) and gradually change local culture and behaviour patterns. This should ultimately lead to a regime transformation. Figure 4 shows these steps using photos of a ULL and Figure 5 shows the process as a diagram.

An impact assessment of ULLs can therefore be well conceptualised based on the MLP. Schliwa et al. (2015) suggest measuring ULL impacts on three levels, which are based on the MLP levels of niche, regime and landscape. They suggest locating direct impacts at

the niche level. These are directly visible or tangible things, such as changing behaviour patterns (e.g., more sustainable mobility routines). Indirect impacts are the second level to be assessed, primarily located in the regime and reflect changing political regulations or prioritisation. Finally, diffuse impacts reflect changing cultural trends and normative values in society at the landscape level. As explained in Chapter 4, these cultural changes are the most important door opener for a socio-technical transformation process. Schliwa et al. (2015, p. 4) also share this opinion.

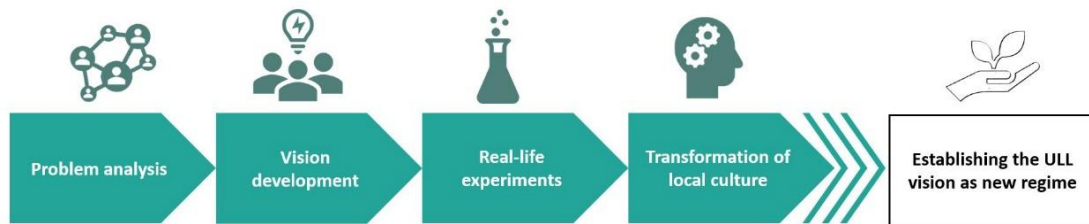


Figure 5: The ULL process, own illustration.

5.2 The Empirical Deficit: Measuring the Impacts of Urban Living Labs

The aim of ULLs is therefore to make concrete contributions to a more sustainable future. For a method such as ULLs, which has sustainable community development as its guiding principle, measuring transformative success is essential to legitimise the method. Accordingly, empirical impact assessment is an important part of ULL research (Parodi et al., 2021). However, it is not possible to judge whether previous ULLs really achieved their goals based on the data available to date (Beecroft & Parodi, 2016). This is because there is a lack of empirical data on their impact pathways and effects. Even the example of the successful Future City Lab in Stuttgart from an output perspective does not provide any accompanying empirical evaluation of how the successes can be explained. It remains unclear what specific impacts the ULL activities had on the city's residents, politicians and other stakeholders and how these are related to the successful implementation of their niche innovations, like the kiosk on a previous car park (see p. 17). The reasons for this are manifold. On the one hand, there is a lack of recognised empirically measurable evaluation criteria (Luederitz et al., 2017). On the other hand, ULLs are confronted with the same challenges that action research once faced. Firstly, because ULLs are embedded in complex real-world contexts, it is complicated to provide evidence of causality (Geels, 2022). Secondly, researchers are intensively involved in organisational and moderation processes that prevent parallel evaluation for resource reasons (Parodi et al., 2021; Schneidewind & Rehm, 2019).

One of the few empirical studies claiming to measure ULL impacts was conducted by Schecke et al. (2021). It uses the continuation of 28 real-world laboratories of the same funding guideline as an assessment of the transformative potential. The researchers analysed documents and conducted quantitative and qualitative interviews with researchers involved in the real-world laboratories. The results paint a very heterogeneous picture. While on the one hand eight real-world laboratories existed over the duration of the project, the feedback regarding the format and perceived success from a researcher's perspective is divided. For example, the scientific output is critically assessed and justified on the one hand with a lack of empirical findings and on the other hand with researchers being overloaded with coordinative and organisational tasks (pp. 418–420). Nevertheless, the transformative potential of real-world laboratories is rated as high by the majority of respondents. In addition, over 90% of respondents were involved in follow-up applications for the continuation of real-world laboratories (p. 415). This study does provide evidence of positive ULL impacts. However, it does so solely on the basis of an assessment of indirect impacts at the regime level, which includes scientists. This evaluation concept therefore fails to holistically assess the transformative potential within the socio-technical system. In particular, the lack of consideration of diffuse effects on cultural mind-sets negates what Schliwa et al. (2015) consider to be the most important aspect in assessing the impacts of socio-technical transformation processes. To address this gap, the fourth hypothesis is that ULLs lead to a change in the local mobility culture (H4). The fifth and final hypothesis is that ULLs, mediated by a change in local mobility culture, also lead to more sustainable mobility behaviour among people in the ULL neighbourhood (H5).

H4: Urban Living Labs lead to a change in the local mobility culture.

H5: By changing the local mobility culture, Urban Living Labs lead to more sustainable behaviour among citizens.

From vision to reality—are ULLs suitable for organising a socio-technical transformation process to implement a transport transition? In the following second part of the dissertation, this question will be further analysed empirically.

PART 2: THE REALITY



Illustration: mobilista / Johannes Schwer

6| DOI and citation of the publications associated with the cumulative work

Bamberg, S., Rollin, P., & Schulte, M. (2020). Local mobility culture as injunctive normative beliefs—A theoretical approach and a related measurement instrument. *Journal of Environmental Psychology*, 71, 101465.

<https://doi.org/10.1016/j.jenvp.2020.101465>

Rollin, P., & Bamberg, S. (2021). It's all up to my fellow citizens. Descriptive norms as a decisive mediator in the relationship between infrastructure and mobility behavior. *Frontiers in psychology*, 11, 610343.

<https://doi.org/10.3389/fpsyg.2020.610343>

Rollin, P., Bamberg, S., Ketterl, C., & Weiland, S. (2021). Cracks in the wall of a car-oriented local mobility system—Results of an urban living lab. *Journal of Environmental Psychology*, 77, 101678.

<https://doi.org/10.1016/j.jenvp.2021.101678>

7| Urban Living Labs: From Visions to Reality?

Urban Living Labs (ULLs) are increasingly being used as a method to realise a socially accepted traffic transition (e.g., in Stuttgart (Alcántara et al., 2018), Munich (Mück et al., 2019) or Bielefeld (Sennestadt GmbH, 2024)). However, so far this is more assumption than fact, as there is a lack of empirical data on the effectiveness of the method. As a result, this dissertation is based on five hypotheses that deal theoretically and empirically with the transformative potential of ULLs in the context of a traffic transition. At its core is the identified twofold deficit of ULL research. Firstly, a theoretical deficit of a lack of agreement on what a ULL is and how it can have an impact on mainstream behaviour in society. Secondly, an empirical deficit consisting of missing data sets on change processes through ULLs. The hypotheses formulated in the first part of this dissertation can be assigned to these two deficits. The following three publications form the basis of the discussion of these hypotheses. The research objectives, data used and methods of data analysis are summarised in Table 1, while Chapter 7.1 lists the corresponding Digital Object Identifier (DOI) of the articles and provides brief summaries of their content. This is

followed by the discussion section of this dissertation, before open research questions are identified and finally the limitations of this work are summarised.

7.1 Article Summaries

The three articles summarised below are the publications associated with this cumulative dissertation. Firstly, an operationalisation of the concept of 'local mobility culture' in the sense of a norm-based understanding of culture is presented. This measuring instrument is the basis for the impact assessment of ULLs, applied here as an example in the third article. In an intermediate step, however, the second article presents experimental studies in order to analyse in a comprehensible way how people generate their assessment of mobility-related social norms.

Table 1. The research objectives, the data and the methods of data analysis of the publications presented in Chapter 7.1.1 to Chapter 7.1.3.

| Article (Chapter) | Research Aims | Data | Methods |
|-------------------|--|--|---|
| 7.1.1 | <p>How can local mobility culture be operationalised as a social science phenomenon using quantitative measurement tools?</p> <p>How does local mobility culture influence mobility decisions?</p> | <p><u>Study 1:</u> convenience sample, composed of students from two different universities and visitors attending an Open University Day.</p> <p><u>Study 2:</u> Sample generated by the return of a survey sent to all households in a small German town (approx. 2.200 households).</p> <p><u>Study 3:</u> Stratified random sample, generated in 12 German cities, using an online access panel.</p> | <p>Descriptive analyses; exploratory factor analysis (EFA); confirmatory factor analysis (CFA); t-tests; correlation analyses; structural equation modeling (SEM); analysis of variances (ANOVA); hierarchical regression analysis.</p> |
| 7.1.2 | <p>How are descriptive social norms formed, and how do they influence mobility behavior?</p> <p>What activates a certain descriptive social norm?</p> | <p><u>Study 1:</u> Stratified random sample, generated in 12 German cities, using an online access panel.</p> <p><u>Study 2 & 3:</u> Experimental online studies with random samples generated using an online access panel.</p> | <p>Descriptive analyses; correlation analyses; hierarchical regression analysis; mediation analyses; qualitative text analysis; t-tests; analysis of variances (ANOVA).</p> |
| 7.1.3 | <p>Can an Urban Living Lab (ULL) support the sustainable transformation of a local mobility system?</p> <p>Development of a concept for the evaluation of mobility-related ULLs and its application in a case study.</p> | <p>Objective operational data and the results of a company survey of a major employer; a guided qualitative interview with a mayor; two samples generated by the responses to a survey addressed to all households in a small German town (approx. 2.200 households).</p> | <p>Descriptive analyses; one-sample t-tests; qualitative text analysis; confirmatory factor analysis (CFA); structural equation model (SEM).</p> |

7.1.1 Paper 1: Local mobility culture as injunctive normative beliefs – A theoretical approach and a related measurement instrument

DOI: <https://doi.org/10.1016/j.jenvp.2020.101465>

The article discusses the concept of *local mobility culture* as an explanation of different, locally typical mobility patterns. The focus is on two questions. Firstly, how local mobility culture can be operationalised as a social science phenomenon, and, secondly, how it is related to mobility decisions.

For practical research and theoretical reasons, a norm-based understanding of culture is presented as the basis for the operationalisation of the construct. Specifically, the operationalisation is based on injunctive and descriptive normative beliefs and reflects a local, commonly shared meaning system about socially accepted mobility behaviour and attitudes. It is inspired by the findings that people base their thoughts and actions on their assessment of their environment, e.g., the neighbourhood (see Chapter 4 and, e.g., Asch, 1956; Kashima et al., 2013; Sherif, 1936).

The 22-item measurement instrument has a structure of seven first-order factors that reflect the influence of two latent second-order factors, which reflect the perceived support for either a multimodal or a car-orientated transport policy. In the article, we also explore the assumption that these factors of injunctive normative beliefs influence individual mobility decisions only indirectly, mediated by descriptive normative beliefs. Three studies with different samples and survey methods serve as the empirical basis for the analyses. Exploratory factor analysis (EFA) and Confirmatory Factor Analysis (CFA) confirm the structure, validity and reliability of the newly developed measurement instrument in all three studies. However, the latent factors of injunctive normative beliefs also have a direct influence on self-reported mobility behaviour. Their influence is only partially mediated by descriptive normative beliefs. Together they make a significant contribution to the variance explanation of self-reported car use of 16 to 47%, depending on the study.

Another aspect of the investigation was to consider whether local mobility culture is purely a subjective phenomenon or also reflected in the objective infrastructure available. To explore this, a sample of 725 individuals was selected, each assigned to a specific city category (e.g., car cities or bicycle cities). These city categories represented distinct, locally dominant transport infrastructures, as identified in a study by Klinger et al. (2013). In a hierarchical regression analysis to explain self-reported car and bicycle use, the infrastructure indicators were first included as dummy variables. The regression

model was then extended to include the factors measuring local mobility culture to test their additional explanatory power. First, it was shown that the infrastructure indicators alone can explain 5 to 7% of the variance in car and bicycle use. Secondly, however, it is equally clear that the inclusion of the latent factors of injunctive normative beliefs and descriptive normative beliefs significantly increases the predictive power of the model to 19% and 22% respectively.

According to these analyses, providing sustainable transport infrastructure is not sufficient to achieve modal shift. There is a need for further action aimed at influencing social interaction processes which develop a local mobility culture. These results thus confirm the importance of socio-technical transformation processes. They also provide initial indications of the effectiveness of ULLs. This is because their activities are aimed precisely at influencing social debates through public experimentation with and promotion of sustainable means of transport in order to achieve strong local social support and consensus for sustainable mobility.

Despite the validity of the items, the content of the measuring instrument for measuring local mobility culture can be discussed. So far, the items do not contain much information about public transport. However, initial adaptations of the measurement instrument with greater consideration of public transport are already underway in this regard (Rollin, 2023).

7.1.2 Paper 2: It's All Up to My Fellow Citizens. Descriptive Norms as a Decisive Mediator in the Relationship between Infrastructure and Mobility Behaviour

DOI: <https://doi.org/10.3389/fpsyg.2020.610343>

The motivation for this paper is based on the direct connection between descriptive norms and personal mobility behaviour identified in the first paper (Bamberg et al., 2020). We therefore investigated how people derive their descriptive social norms. We used an interesting observation in Berlin as an application example. There, two temporary cycle paths (so-called “pop-up” bike lanes) were used in completely different ways. While bicycle use multiplied in the area of one pop-up bike lane, it was simultaneously used as an additional car parking area in the other district. Using this phenomenon as an example, the article takes a closer look at descriptive social norms, their influence on behaviour and how they arise. Does a certain behaviour replicate itself because it is seen

as the usual behaviour? And what activates a certain descriptive social norm? Is it the visible behaviour of others, or is the sight of traffic infrastructure enough?

The first hypothesis, that people make their own mobility behaviour dependent on the descriptive social norms of a place as well as on the local transport infrastructure, was confirmed on the basis of a correlative study and thus coincides with the findings of the first article of this dissertation mentioned above. This inevitably leads to the question of whether it is sufficient to find certain infrastructural framework conditions in order to form a clear opinion about the descriptive norms prevailing there, or whether it is also necessary to be able to observe adequate behaviour. As a second hypothesis, it was therefore initially investigated whether people systematically derive certain descriptive social norms from visible transport infrastructure. This was realised through an online vignette experiment with photomontages. The test subjects were randomly assigned to a photomontage showing either a view of a road with or without a pop-up bicycle lane. Prior to this, a cover story was used to put them in the position of having just moved to a previously unknown location and not knowing anyone there. The results show that people with a view of a pop-up bicycle lane assigned a significantly higher descriptive norm for sustainable mobility to this location, while photos without a pop-up bicycle lane were expected to have a higher descriptive norm for car use.

A second experimental vignette study was extended to include the factor of visible behaviour. The test subjects were now randomly assigned to one of four photomontages. Behaviour corresponding to the infrastructure was either visible or not. The results show that subjects who saw a pop-up bicycle lane and its use rated the highest of all sustainable descriptive norms. Seeing sustainable infrastructure and sustainable mobility behaviour appears to have a stronger influence on the development of a descriptive norm than seeing transport infrastructure alone.

These findings empower ULL actors. Their public and highly visible use and support of sustainable means of transport in the context of real-life experiments can apparently increase the expression of a place's sustainable descriptive norms. The fact that the studies also showed that there is no significant correlation between self-reported car use and the descriptive norm of perceived car use also disproves the hypothesis that descriptive norms only represent personal mobility patterns. So, even if previously completely convinced frequent car drivers arrive at a new location to which they immediately assign a descriptive norm for the use of environmentally friendly means of transport, this study provides empirical support for the assumption, that this person will adapt their own mobility behaviour accordingly.

7.1.3 Paper 3: Cracks in the Wall of a Car-Oriented Local Mobility System-Results of an Urban Living Lab

DOI: <https://doi.org/10.1016/j.jenvp.2021.101678>

Finally, this article uses the findings of the first two papers to operationalise and exemplify an evaluation concept for mobility-related real-world laboratories based on a theoretical proposal by Schliwa et al. (2015). This is based on a combination of the MLP and the Transition Management Approach (TM) (Loorbach, 2007). The latter is suitable as a governance model for designing a ULL. The MLP serves as a theoretical framework for categorising how ULLs can generate transformative impact. The integration of the TM into the MLP was adopted from Schliwa et al. (2015), and ULLs were accordingly located between niche and regime. In doing so, we give them the concept of an "empowered niche". This represents niche movements that have the competence and influence to actually challenge the regime. We also supplement this model with citizens as a separate, relevant influencing factor. With their behaviour and the mobility culture attributed to them, they determine whether the vision of the empowered niche or the existing status quo of the regime receives the vote of the majority. Also based on the MLP, we measure ULL impacts on three levels: a direct (niche / citizens), indirect (regime) and diffuse (landscape) level (see Fig. 6). The diffuse impacts (changes at the cultural and normative

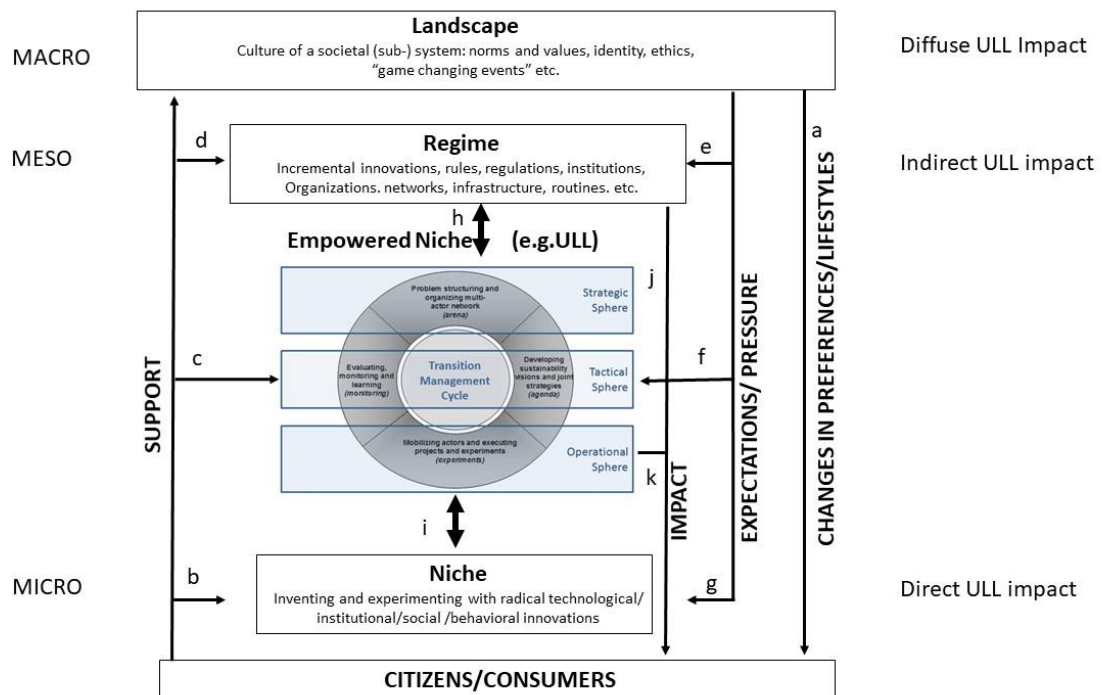


Figure 6: Impacts from Urban Living Labs as Empowered Niche (Rollin et al., 2021, p. 3).

level) are described in the literature as the most important but have not yet been operationalised. We answer this open research question on the operationalisation of diffuse effects using the items for measuring local mobility culture presented in Paper 1.

The direct, indirect and diffuse effects of a ULL were analysed for this article using the ULL "getting ahead together" in the small German town of Bad Boll as an example. The ULL analysed was established in 2018 and began public campaigns in spring 2019. In the first public year alone, more than 80 real-life experiments were carried out on site. For example, competitions were held to motivate people to use public transport, and car parks were temporarily converted into ice cream parlours. At first glance, a lot was achieved. For example, a new bus stop and a bicycle car park were built in the town at the instigation of the ULL stakeholders. Direct impacts can also be seen in the overall increased sustainable mobility behaviour of people in the town. Indirect impacts, measured by a qualitative interview with the mayor involved in the ULL, indicate increased political support for sustainable transport infrastructure. In addition, diffuse impacts indicate that the local mobility culture in the town has developed positively, at least in part. These results are interpreted as the first cracks in the wall of the car-dominating status quo. Due to the study design, however, the observations cannot be causally attributed to the impact of the ULL.

8| Urban Living Labs and the Transformation of the Transport Sector—a Model for Success?

60.6% of transport-related CO₂ emissions come from private motorised transport (European Environmental Agency, 2022). There is therefore a clear need for a holistic transport transition that goes hand in hand with a socially accepted change towards more ecological mobility behaviour. The starting point of this dissertation project was the question of whether a traffic transition that completely covers the socio-technical system can be realised in a socially acceptable way through a ULL. To date, the goal of reducing emissions in the transport sector has mostly been pursued through top-down approaches. The idea is that policy frameworks and initiatives, as well as advanced technology and a successful innovation culture, are the most important aspects on the path to climate neutrality in the transport sector. One explanation for the persistence of this approach, despite the lack of success with the necessary clarity, is the existence of

transport taboos. These prevent political decision-makers from pursuing transport policies that go against the perceived social consensus of the current car-centred mainstream behaviour. Political action against this status quo is associated with the fear of losing power. Therefore, the focus is on solutions for a transport transition that do not involve fundamental changes in mainstream behaviour. To this end, the focus is on innovations that aim to reduce the sector's climate-damaging emissions without making it necessary to travel less or differently (Deutschlandfunk, 2023; Gössling & Cohen, 2014). However, this perspective obscures an important debate, namely the role of changing practices and social dynamics. Matos et al. (2022) show that global emissions could be reduced by almost 76% through a combination of technological innovation and adaptation of mainstream behaviour. In contrast, relying on technological innovation alone could only halve emissions at most. A key explanation for this lower value for purely technological solutions is rebound effects (Matos et al., 2022, p. 9). In the transport sector, these describe the offsetting of CO₂ savings by more frequent or longer journeys with more environmentally friendly means of transport. For example, if a person buys a hybrid car, he or she may drive it more often, feeling that this is now possible in an environmentally friendly way. This negates the savings made possible by the technological innovation, and the sector as a whole does not become more climate-friendly (de Haan et al., 2015). This also makes the goal of decarbonising the transport sector a social issue of individual behavioural choices by all members of society. These debates can be conceptualised in terms of socio-technical transformation processes. These describe the complex path dependencies that take place between technological, political, infrastructural and social levels with the aim of changing the world as we perceive it as 'normal'. In order to address the question of whether a ULL is suitable for lending structure to such socio-technical transformation processes, the following section addresses the identified twofold deficit of the ULL method (cf. Chap. 7.1 & Chap. 7.2) and uses it to discuss the hypotheses formulated in Part 1 "THE VISION" of this dissertation.

8.1 Discussion of the Theoretical Urban Living Lab Deficit

The theoretical question of how and where a ULL can be effective has been addressed from a cultural sociological perspective. It makes use of the observations that people orient their individual behaviour strongly towards social norms and that this also applies to their mobility behaviour (cf., e.g., Javaid et al., 2021; Ramos et al., 2020). Integrated into the transformation-theoretical model of the Multi-Level Perspective (MLP) (see Chapter 3.1), transformation processes are considered successful if social norms change. But are social norms a suitable unit of analysis for assessing the impacts of a ULL?

First of all, the conceptualisation of local mobility culture as a normatively shared system of meaning has proven to be suitable for explaining mobility behaviour (cf. Bamberg et al., 2020). Using the newly operationalised measurement instrument, the social embedding in the choice of means of transport is emphasised. Based on the given infrastructural environment, mobility culture is socially constructed and ultimately has an impact on one's own mobility behaviour. It remains an independent and influential predictor of transport mode choice, even when including classic control variables in inferential statistical models, such as habit or car ownership (Bamberg et al., 2020, p. 8). According to this information, changing social norms can therefore also lead to a change in people's mobility behaviour. Various preliminary studies have already been carried out on the transformation of social norms in general. This dissertation adopts Sherif's (1936) perspective that social norms develop through everyday interaction in social groups.

Following these findings, initiating and organising a public discourse on the design of the local mobility system can have an impact on the local acceptance of an alternative transport policy that promotes eco-mobility (pull measures) on the one hand and reduces car attractiveness (push measures) on the other. In transformation-oriented transport policy research, such a combination of push and pull measures is considered a promising way to achieve an effective mobility transition (Sommer et al., 2022; Wang et al., 2020). This dissertation confirms H1 (see p. 12) that a change in social majority opinion can reduce transport taboos towards an alternative, sustainable transport policy. This is because the surveys at the ULL in Bad Boll revealed that pluralistic ignorance is present in the regime. It was already clear from the first survey that the local citizens also perceived a mood in favour of sustainable means of transport. However, the local mayor's commitment to the project goals increased over time in parallel with a likewise steadily increasing social mood regarding the promotion of sustainable transport policy (Rollin et al., 2021, p. 6). The fact that a ULL has the transformative power to initiate cultural changes at the landscape or meta-level and that these in turn have an impact on the political regime at the meso-level was thus at least partially evident in Rollin et al. (2021). The steadily increasing commitment of the local mayor in Bad Boll can also be interpreted as a slight confirmation of H1 (cf. p. 12), namely, that changing social norms result in a change in political prioritisation of actors in the political regime.

The observation that the role and importance of support from the local political regime has grown over the course of ULL activities is also in line with H3 (cf. p. 16). In addition, it should be noted that a ULL should be as heterogeneous as possible in order to have a transformative effect, as the more people feel connected to the social group of the ULL,

the more important this has indeed proven to be. H3 is supported overall, firstly because such a group was found in Bad Boll and secondly because it was able to agree on a common goal. Local niche activists (so-called 'sustainability managers') are active in the ULL, as well as all of the town's major employers and the mayor. The latter is very popular in the town and has been consistently confirmed in office in every election since 1996—most recently with 96.6% (Staatsanzeiger, 2020). The "ULL" label has given the group a conceptual framework that has made it possible to work together in the first place. The fact that the group is still operating in the same composition for the fifth year in a row (cf. gemeinsam-weiterkomme.de) can also be seen as confirmation of H3. Further activities are also planned for 2024 and beyond, for example, to support the reactivation efforts of the local railway connection and car park management. The ULL stakeholders are also consulted by neighbouring municipalities as speakers on their best-practice experiences of a local traffic transition (EmK, 2023). This provides evidence that a successful, established local ULL can also have an impact beyond its own regional target. These developments stimulate the important branch of research to address the questions of what role such a ULL can actually play for a fundamental traffic transition that is not just focused on one district or location. It also makes it clear that the definition of a ULL as an arena for joint visioning and experimentation by many different stakeholders cited in Chapter 6 is a suitable conceptual approach for bringing about changes in the mindsets of the people in the region and thus forcing a local traffic transition.

These considerations also show that the theoretical deficit of ULL research can be resolved with a standards-based assessment of effectiveness. Impact measurement on the three levels of direct, indirect and diffuse effects has proven to be practicable and, in particular, the operationalisation of diffuse effects using the measuring instrument for measuring local mobility culture has proven to be useful (cf. Rollin et al., 2021; Schliwa et al., 2015). Consequently, it is recommended to analyse any changes within local social networks (e.g., extended family, circles of friends, colleagues and acquaintances) as a reference group for assessing social ULL impacts. This approach is based on the proposal by Kashima, Wilson, Lusher et al. (2013), but also Klinger, Kenworthy and Lanzendorf (2013), namely, to use community-based networks as units when assessing local mobility culture or cultural transformation projects. For these reasons and with regard to H3 (p. 16), we have adopted this suggestion and evaluate the local mobility culture as normative beliefs at the neighbourhood level (e.g., "The people in my neighbourhood..."). In the exemplary evaluation of the ULL in Bad Boll, the connection with the local people generally increased over the course of the project (Mean 2019 = 2.85; Mean 2020 = 2.94; Mean 2021 = 3.13). The evaluation of the goals of the ULL stakeholders also developed

positively (Mean 2020 = 3.20; Mean 2021 = 3.33) as well as the perceived social support of some factors of the measurement instrument for measuring sustainable mobility culture (cf. Rollin, 2023, pp. 6–7; Rollin et al., 2021, p. 24). I also see these findings as a confirmation of H3 (p. 16), namely the importance of a heterogeneous but united ULL group for the social acceptance of ULL goals and their transformative potential.

The fact that changes at a cultural level could be measured after just one year of ULL activities is also a surprising and empowering observation. ULLs can therefore also pave the way in the short term for making local people's mobility behaviour more environmentally friendly in the medium term. This is surprising because it is otherwise considered an extremely lengthy process to be able to significantly change the mobility behaviour of a larger group (Aarts & Dijksterhuis, 2000; Ramos et al., 2020).

This work has also addressed the question of how the assessment of local mobility-related norms is formed. In the experimental paper by Rollin and Bamberg (2021), it was shown that it is partly fed by local transport infrastructure. However, it also became clear that visible behaviour is extremely important for the assessment of sustainable mobility norms (Rollin & Bamberg, 2021, pp. 10–12). Sustainable mobility norms are attributed to a place all the more strongly if you can observe people there who themselves travel sustainably. In other words, the majority explicitly behave contrary to the supposed mainstream norms. A qualitative survey on what people would do if they were visiting a place that was previously unknown to them, presented with a photo also revealed the impact of such norm attributions: in a place where a cycle lane is visible, 21.8% of the test subjects would cycle as their first activity. At another place where, in addition to the cycle lane, people riding bicycles were also presented in the photo, the proportion of test subjects who also want to ride a bicycle themselves as their first activity increases to 23.1%. In photos of places without cycle lanes, zero test subjects stated that they themselves wanted to cycle on site (cf. Rollin & Bamberg, 2021, p. 10). Offering a safe and environmentally friendly transport infrastructure therefore has very concrete effects on individual mobility decisions. However, seeing other local people using this infrastructure adequately further reinforces this effect. Using other residents of one's own neighbourhood or town as a reference group for measuring ULL impacts is confirmed by these results as a suitable approach. At the same time, in this experimental design, self-reported car use is not significantly related to the assessment of the descriptive norm. It is therefore refuted that the descriptive norm attributed to a place simply reflects one's own mobility behaviour (Rollin & Bamberg, 2021, p. 9). These are all results that rein-

force the sense of a socio-technical perspective on transformation processes. Infrastructural adjustments alone have less positive impact on ecologically sustainable mobility than approaches that also strive for social innovation and, for example, demonstrate an adequate use of infrastructure for ecological travel through public action.

People therefore use the observation of local mobility patterns to interpret what is considered adequate mobility behaviour in the location. According to the findings of this study, there is a high probability that people will adapt to this observed "normality". This is because mobility-related social norms are independent, predictive factors of individual mobility decisions. Most transport planners and politicians probably do not realise how strongly they can influence the descriptive social norms perceived by people. However, utilising psychological and design knowledge for the redesign of public spaces in a way that leads to the formation or activation of ecomobility-related descriptive social norms can apparently significantly simplify a traffic transition. This is because the demonstration of a certain mobility behaviour can influence the choice of means of transport that is considered appropriate. This also provides evidence that consciously breaking with the supposed social consensus that driving is the most accepted mobility behaviour can have a positive impact on a more sustainable assessment of the local mobility culture. Accordingly, the fifth hypothesis (see p. 22) that ULLs that feature the public testing of alternative behaviour patterns have a transformative effect on the local mobility culture can be evaluated positively. Measuring corresponding ULL impacts at these levels therefore proves to be a suitable theoretical framework for ULL evaluation. The theoretical deficit could be resolved in this way.

8.2 Discussion of the Empirical Urban Living Lab Deficit

These findings automatically raise the question of how this cultural level can be operationalised and measured in order to assess the effectiveness of a ULL. In response to these questions, this dissertation has operationalised the concept of local mobility culture as a social science phenomenon. The use of this operationalisation to empirically measure the cultural level of local change processes in the course of a mobility-related ULL is a central achievement of this thesis. The validation of the instrument and the determination of its predictive power with regard to individual mode choice underline the importance of this perspective for social science transport research. The challenge, but also the central goal of a successful transport transition, should be to change mainstream mobility behaviour. According to the theoretical groundwork presented in part one, the perceived social consensus on the prioritisation of the socio-technical regime in transport policy and on the appropriate choice of means of transport is a promising lever

for a socially accepted transport transition. But can this be demonstrated empirically? Is mobility behaviour social behaviour and embedded in social interaction processes?

Based on the given transport infrastructure, the assessment of the local mobility culture is actually socially constructed and in turn has an impact on people's own mobility behaviour. This is shown by the experimental results in Rollin & Bamberg (2021) and the structural equation modelling in Bamberg et al. (2021). This is a clear confirmation of H2 (see p. 14), namely that mobility behaviour is related to local mobility culture. The operationalisation of local mobility culture has been confirmed several times as an independent, strong predictor of car use, even in models including central control variables (Bamberg et al., 2020, p. 8). This applies to both the social norms included in the concept, namely both the injunctive and the descriptive norms. In the following, these findings are discussed with a view to clarifying the empirical ULL deficit (cf. Section 6.2).

In order to address this empirical deficit in ULL research, Rollin et al. (2021) evaluated one ULL as an example. To this end, a qualitative interview was conducted to assess direct and indirect impacts, and quantitative trend data was collected over three survey periods to assess diffuse impacts. The samples for the quantitative study were drawn from paper questionnaires that were returned to all households and employees in the town. The core of the questionnaires were the items measuring the local mobility culture (cf. Bamberg et al., 2020).

In the ULLs analysed as examples, the trend studies measured changes at the cultural level after one year of ULL activities, which is a clear confirmation of H4 (see p. 22). On average, the surveyed citizens and employees in Bad Boll perceived significantly lower social support for local transport policies that prioritise the needs of car users and lower social support for policies that aim to develop existing infrastructure for car use for this purpose. In line with these findings, there is also a trend towards greater support for transport policies that aim to reduce local car use infrastructure. The transformative relevance of these findings lies in the chance to implement alternative ideas that are more likely to meet with societal acceptance during an open window of opportunity (Geels and Schot, 2007). Such momentum should be utilised immediately by politicians, as windows of opportunity can close again quickly. But they can also remain open due to specific dynamics in the socio-technical system. Windows of opportunity are kept open by maintaining pressure on the regime through ongoing real-world experiments, or through direct political intervention. But it is not a straightforward process. The influence of powerful regime actors opposed to change also has the potential to quickly close such a win-

dow (Graham-Nye et al., 2024). Tongur and Engwall (2017), for example, use the example of a transport infrastructure project. The latter can be prevented by a structured composition and consensus-based process design within a ULL. In Bad Boll, it was possible to integrate the most important stakeholders on the political, economic and civil society side into the ULL and have them commit to a common vision. Once a window of opportunity has been opened, it should remain open more reliably under these conditions. As a policy, knowing the timing of a window of opportunity on the basis of ULL-accompanying studies is accordingly very valuable information for deciding the perfect time to implement or communicate a future transport policy vision. This is another argument in favour of collecting empirical data during a ULL process, especially in cooperation with local political actors.

Despite the methodological problem associated with an impossible causal interpretation of the results from Bad Boll due to the trend design of the data, I see them as empirical evidence that ULL activities have caused at least some cracks in the wall of the car-dominated local mobility system. The evaluation of a third survey also continues to show clear effects on the behavioural dimensions: Rollin (2022, p. 3) shows that the car is actually used less frequently at the official end of the project in 2021 than in 2019 before the start of ULL activities (Mean 2019: 3.98; Mean 2021: 3.63), but cycling (Mean 2019: 2.53; Mean 2021: 2.77) and walking (Mean 2019: 2.86; Mean 2021: 3.09) are used more frequently. These are indications of a confirmation of H4 (cf. p. 22) that ULLs can influence people's mobility behaviour by changing the local mobility culture (cf. p. 35). Due to the methodological design of this study, however, this connection remains hypothetical, as it cannot be assessed causally. Nevertheless, analyses of variance have shown that these mean differences are statistically significant. Only the initially positive development of more frequent bus use in the middle of the project in 2020 fell back to the 2019 level at the end of the project. Here, however, the increased proportion of people working from home and the nationwide decline in public transport use due to fear of infection in the context of the current Covid-19 pandemic are plausible explanations, incidentally, for all changes found on the behavioural dimension. It would be interesting to see whether bus use has increased again in the meantime. Discussions are currently underway with the local ULL stakeholders as to whether a fourth study will be conducted in 2026 to analyse such medium-term developments.

In principle, the exemplary application of a ULL in Bad Boll has raised the question of whether the ULL should be judged as successful or not. It is worth taking another look at

the transition management approach (see Schliwa et al., 2015). According to its assumptions, a ULL has only completed a first transition cycle after one year. After a period of reflection, the next cycle begins, then a new one, and so on. Apparently, the first three cycles between 2019 and 2021 had the desired impact on mobility in Bad Boll. This is because mobility behaviour has developed in a more sustainable direction, and the factors of local mobility culture that reflect the perceived social support for sustainable means of transport have also increased (cf. Rollin, 2022). With an even longer time lag and further transition cycles, even clearer developments would be measurable according to this theoretical logic. Empirical answers need to be generated based on new surveys. Until then, however, the first three transition cycles between 2019 and 2021 can be considered successful. There is empirical evidence of changes at the cultural level, which is particularly relevant for transformation processes.

The exemplary evaluation of the ULL also shows that it is fundamentally possible to initiate a local transport transition through ULLs—provided that they fulfil the conditions for successful transformation processes set out at the end of Chapter 4. These are: (1) a niche vision collectively shared by a large number of actors, (2) networking of the niche movement with regime decision-makers from politics, business and science, (3) political actors in the regime who react sensitively and openly to changing social moods, and (4) pressure from the landscape level due to changing social mindsets and macro trends. All of the aspects mentioned here were fulfilled by the analysed ULL in Bad Boll. The empirical deficit was thus addressed in two ways: (1) The dissertation offers a suitable operationalisation to empirically measure ULL impacts. (2) The dissertation provides the first empirical data sets for the impact analysis of a ULL. However, the fact that the quantitative data collected at three points in time to analyse diffuse ULL-impacts is a trend design, and not data sets linked as a panel, reduces its informative value and clarity. The changes measured are also relatively small and have only been analysed in one case study. However, it does at least provide numerous indications of the suitability of the proposed evaluation instrument on the one hand and the effectiveness of mobility-related ULLs on the other. The empirical deficit now requires intensive further studies in order to strengthen the evidence for these findings.

9| General Discussion



Figure 7: Visible ULL successes in Bad Boll: new bus stop in the village (left) and free cargo bike for residents (right). Photos: Stefan Weiland.

The dissertation project has provided answers to the question of whether ULLs are a way to foster a transport transition with broad social acceptance and to solve the social and environmental challenges of the current car-dominated system. The ULL in Bad Boll has demonstrated successes that support this general assumption. The mobility behaviour of local people, the local mobility culture and the attitudes of representatives of the regime have changed positively. The empowered niche has also continued to operate since the end of the ULL-funding-phase. Two actors who are currently coordinating the ULL on-site are now being paid by funding from local companies involved in the ULL, which is a clear commitment to the project. The ULL has been regularly visible in the cityscape with real-life experiments since mid-2019 and into 2024, and ULL stakeholders are valued as transformation consultants in neighbouring municipalities (EmK, 2023; gemeinsam-weiterkommen.de). The goals of the ULL have even become an integral part of the town's sustainability strategy, in which it is also a declared goal to attach great importance to a "cross-local integrated transport concept for the needs of all road users" (Gemeinde Bad Boll, 2024). The framework created by the method to institutionalise themselves as a group and impose a common label has thus had an effect, at least in this case study.

In addition to the outlined involvement of a diverse number of different stakeholders and important local figures in the ULL, the diligent realisation of real-life experiments could be essential. The ULL in Bad Boll presented here has realised over 80 real-world experiments in the first three years of the project, some of them quite radical (e.g., using car parking spaces as an ice cream parlour for five weeks; Rollin et al., 2021, p. 5). This figure of experiments is higher than many comparable ULLs in Germany (Karlsruher Institute of Technology, 2024). In order for the transformative processes to become the

new 'normality' in the long term, openness to the niche vision in the dominant regime is also necessary (Göpel, 2015; Mulgan & Leadbeater, 2013). The interviewed mayor from the location of the analysed ULL was impressed by the initiative, especially by the commitment of the ULL actors known and networked in the location (Rollin et al., 2021, p. 6). The analyses presented here also provide empirical evidence for the assumption that support from the political regime is particularly reliable when recognised local actors are involved in the ULL and citizens identify with these goals. Support for the project and its objectives is indeed very clear in Bad Boll in the third survey. Over 80% of respondents support the ULL initiative (Rollin, 2022, p. 5). Information campaigns about these high approval ratings of the project goals could open doors to dissolve the pluralistic ignorance of the population and transport taboos of transport politicians, shift the perceived mobility-related norms and thus further motivate the use of eco-mobility. The sheer quantity of the composition and equipment of a ULL is therefore not the decisive factor. Instead, the group primarily needs motivated, locally popular players with decision-making power. Political anchoring of local transformation processes is therefore a necessary condition for successful change (see also Parodi et al., 2021; Turnhout et al., 2020).

This dissertation does not explicitly address the question of a socially equitable transport transition. However, experiments in Bad Boll and the experimental studies by Rollin & Bamberg (2021) have shown that street space can be organised differently without this necessarily leading to social conflicts. Despite the use of car parks for other purposes (e.g. as a cycle lane or ice cream parlour) with the aim of causing anomie (cf. Durkheim, 1950 & Ch. 4.2) and initiating a cultural transformation, the ULL in Bad Boll has met with great approval from residents. It also became clear in the experiment on the effect of more cycling infrastructure that it actually motivates people to use their bikes more (cf. Rollin & Bamberg, 2021, p. 8). According to the findings presented here, I consider this visible turning away from supposed mainstream behaviour by people in their own locality to be an essential key to creating anomie and motivating people in general to change their mobility behaviour. It also became clear in this work that even relatively small things, such as using a car lane as a cycle lane by painting it a different colour, can have a big impact. The aim here is to encourage local initiatives and politicians to turn visions of ecologically sustainable mobility into reality, to invite people to experience and try things out, and thereby to challenge or even dissolve rigid socio-technical systems. A favourable combination of real-life experiments that are popular in society at large, carried out by locally recognised actors, developments at the landscape level and openness in

the current regime can result in a local traffic transition. Organising and coordinating such processes through a ULL seems to be a working method.

These findings, as well as the social ambivalence identified in all studies to promote eco-mobility on the one hand, but without giving up car-orientation in return, and the indications of pluralistic ignorance, also have important political implications. In such a situation of anomie, clear and convincing political leadership for a transformative policy can succeed in forcing a traffic transition without losing power. It can resolve the ambivalence of civil society and increase acceptance for a transformative transport policy. At such a time, a ULL and the involvement of politicians in it can play an important role in multiplying the eco vision directly across society. The ULL in Bad Boll provides evidence to support this assumption. The mayor there backed the ULL goals early on and personally campaigned for them. The positive developments that can be observed, both in the injunctive and descriptive normative convictions of the community members and in the self-reported mobility behaviour (Rollin, 2022), can therefore certainly be attributed to the ULL and the transformation-oriented political leadership. In terms of transport policy, this implies that a policy that aims to make the transport sector climate-neutral would be well advised to support initiatives for sustainable mobility that are supported by society, or to organise official events for people to try out and experience sustainable mobility on their own initiative. In addition to ULLs and their real-life experiments, the Critical Mass movement is another suitable example. This is an initiative that meets regularly in an organised manner in order to use the public road space, which is designed to be car-friendly, for sustainable cycling. As a group, they deliberately cycle in such a way that the road space can only be used for cycling for this period and cars have to queue patiently at the back. This makes it clear how much space is reserved for relatively few cars on the one hand and how many more cyclists could be travelling safely on the other.

The continuation of existing funding programmes for ULLs is therefore to be welcomed. However, parts of the funds should be reserved for comprehensive evaluation, particularly of developments in diffuse impacts, and measurements should be made possible over periods of several years. The initiative launched in 2023 by the Federal Ministry for Economic Affairs and Climate Action for a "real-world laboratory law" is a welcome and exciting step by the 24th Federal Government in Germany (Federal Ministry for Economic Affairs and Climate Action, 2023a). Based on the results of the work presented here, it is strongly recommended that, in addition to testing technological innovations, the focus of the law should also be on social innovations. The claim formulated so far in initial public documents, "To test change on a small scale in order to realise it later on a

large scale" (ibid.), is an equally immensely important task in order to make traffic transition a nationwide reality. However, whether a ULL succeeds in this can only be answered by accompanying evaluations. For this reason, the second recommendation for the intended law is to stipulate the evaluation of ULL-impacts as a funding condition.

Nevertheless, there are some aspects that limit the results of this work. In addition, some questions remain unanswered and new research tasks have arisen. These points will be addressed in the following final chapter.

10| Future Research & Limitations

ULLs work in public spaces under real conditions. There are therefore many external influencing factors, also because it is a fundamentally trans- and interdisciplinary format. It is therefore an important aspect of ULL research to recognise that every action on the ground can have a direct and long-term impact on the local people. As active co-creators on site, the initiating researchers take on a great responsibility for the place or neighbourhood in which a ULL works. However, as we repeatedly read about researchers involved in ULLs being overwhelmed by taking on a completely unfamiliar organising and normative role, this is a key risk factor for ULL success. In particular, the unknown expectations and self-evidence in a transdisciplinary transition arena are seen as a challenge (Parodi & Steglich, 2021). To solve these, inspiration could be drawn from debates on science communication in the field of public sociology. It addresses issues related to communicating with a wider audience and actively involving them in the research process (Bogusz, 2020; Bösch, 2020; von Unger, 2020).

In general, the ULL method continues to enjoy sustained popularity. The federal and state governments are still launching well- equipped funding programmes to this end (e.g., Federal Ministry for Economic Affairs and Climate Action, 2023b; Senate Department for Economic Affairs, Energy and Public Enterprises, 2023). However, the lack of evaluation reports to date reflects a challenge that action research has also faced: initiating, maintaining and evaluating a ULL demands a great deal from all stakeholders involved. Especially for the scientists involved, most of their immediate tasks in keeping a ULL running often have little to do with their learned profession; it is about organising, empowering and being present in their own field of research. This unfamiliar role of science to organise and coordinate has so far meant that the generation of scientific, empirical findings during the ULL processes has often not been successful (Defila & Di Giulio, 2019; Schecke

et al., 2021). This is a major burden for the future legitimisation of the format. Here, processes must be standardised, with clear role models and, if necessary, interdisciplinary teams at the research institutes to fulfil the tasks of initiation, coordination, support and organisation, as well as to meet the demands of knowledge generation and dissemination. Only in this way can ULLs maintain their place in the methodological diversity of the social sciences. This dissertation has provided evidence that this place is indeed justified. However, the empirical ULL deficit could only be addressed here on the basis of a case study. Of course, this approach needs to be replicated and, ideally, validated. The more ULL projects are initiated and evaluated in different contexts using a measurement concept established as consensus, the more valid the resulting knowledge will be (Parodi, 2019). All of these are also exciting starting points for thinking about the action research of the future and its role in the social sciences. Is it generally worth being more present in the field and dissolving the strict separation between ‘researched’ and ‘researcher’?

The possible areas of application of a ULL are also as diverse as the complexity of socio-political challenges. In addition to initiating a socially accepted traffic transition, it can also be about topics such as the joint organisation of climate-neutral neighbourhoods, cultural and social spaces or, more generally, the strengthening of a common identity. Apart from the measurement concept of local mobility culture developed specifically for mobility issues, the evaluation concept (Rollin et al., 2021) is generally applicable. Operationalising culture or mind sets at the makro level as injunctive and descriptive normative beliefs has proven its worth and could be transferred to all the application examples mentioned above. It would also be exciting to examine the extent to which the evaluation concept and measurement instrument developed by experts from Germany can be transferred to other nations. There is also a need for policy field analyses that take into account the influence of different political systems and local dynamics.

Overall, the design of the empirical questionnaire studies at the ULL in Bad Boll has two weaknesses. Firstly, no panel data set was collected, but rather trend studies. Secondly, there was no control group. It therefore remains unclear whether the changes identified in the on-site surveys can actually be attributed to the ULL. However, this methodological approach was the only consensus that could be negotiated with limited project resources.

As mobility behaviour is something that takes time to really change in the long term, the results so far should only be seen as the short-term transformative potential of ULLs. Whether this method can also transform mobility culture and mobility behaviour in the

medium and even long term remains unanswered by this work. The results that attribute transformative potential to a ULL need to be validated all the more urgently in future studies. A transformation process is not usually successfully completed after three years of project funding. It is advisable to be able to carry out empirical observations over more than three years by providing funding for even longer periods. This would undoubtedly generate information with significant implications for transport policy and society.

11 | References

- Aarts, H., & Dijksterhuis, A. P. (2000). The automatic activation of goal-directed behaviour: The case of travel habit. *Journal of environmental psychology*, 20(1), 75-82.
- Abrams, D., & Hogg, M. A. (1988). Comments on the motivational status of self-esteem in social identity and intergroup discrimination. *European journal of social psychology*, 18(4), 317-334.
- Adelman, C. (1993). Kurt Lewin and the origins of action research. *Educational action research*, 1(1), 7-24.
- Alcántara, S., Lindner, D., Löwe, C., Kuhn, R., Puttowitz, E. (2018): *The culture of experimentation. Creating sustainability together in real-world laboratories*. Online document: <http://www.r-n-m.net/wp-content/uploads/2018/03/Forschen-mit-Realexperimenten.pdf> (last accessed: 16/02/2023).
- Arranz, A. M. (2017). Lessons from the past for sustainability transitions? A meta-analysis of socio-technical studies. *Global Environmental Change*, 44, 125-143.
- Asch, S. E. (1951). Effects of group pressure upon the modification and distortion of judgements. *Groups, leadership, and men*, 177-190.
- Asch, S. E. (1956). Studies of independence and conformity: I. A minority of one against a unanimous majority. *Psychological monographs: General and applied*, 70(9), 1-70.
- Bamberg, S., Rollin, P (2018). Warum es so schwer ist, weniger Auto zu fahren. Erklärungen aus der Verkehrspsychologie. In: *ADAC Gute Wege zur guten Arbeit*, p. 18-24.
- Bamberg, S., Rollin, P., & Schulte, M. (2020). Local mobility culture as injunctive normative beliefs-A theoretical approach and a related measurement instrument. *Journal of Environmental Psychology*, 71, 101465.
- Beecroft, R., & Parodi, O. (2016). Real-world laboratories as sites of sustainability research and transformation: Introduction to the focus. *TATuP-Zeitschrift Für Technikfolgenabschätzung in Theorie Und Praxis*, 25(3), 4-8.
- BMWK, Federal Ministry of Economics and Climate Protection (2021). *Further development of the "Real-world laboratories of the energy transition": Now even more practical*. Online document: <https://www.bmwk.de/Redaktion/DE/Pressemitteilungen/2021/07/20210701-weiterentwicklung-der-reallabore-der-energie-wende.html> (last accessed: 16/02/2023).
- Bogusz, T. (2020). Collaborative research. In: Selke, S., Neun, O., Jende, R., Lessenich, S., Bude, H. (eds) *Handbook of Public Sociology. Public science and social change*. Springer VS, Wiesbaden.
- Böschen, S. (2020). Real-world laboratories - transformation spaces of public sociology. In: Selke, S., Neun, O., Jende, R., Lessenich, S., Bude, H. (eds) *Handbook of Public Sociology. Public science and social change*. Springer VS, Wiesbaden.

- Brunnengräber, A., & Haas, T. (2018). Out of the frying pan into the fire: the socio-ecological downsides of e-mobility. *GAIA-Ecological Perspectives for Science and Society*, 27(3), 273-276.
- Burbridge, M. (2017). If living labs are the answer-what's the question? A review of the literature. *Procedia engineering*, 180, 1725-1732.
- Chronéer, D., Ståhlbröst, A., & Habibipour, A. (2019). Urban living labs: Towards an integrated understanding of their key components. *Technology Innovation Management Review*, 9(3).
- Deffner, J., Götz, K., Stete, G., Bracher, T., Stein, M., & Bülow, S. (2017). *Shaping a sustainable mobility culture in Hesse. Concept for a mobility strategy*.
- Defila, R., & Di Giulio, A. (2019). How real-world laboratories sensitise to challenges and expertise in the design of transdisciplinary and transformative research-an introduction. *Transdisciplinary and transformative research, Volume 2: A collection of methods*, 1-30.
- Deutscher Bundestag (2022). Printed matter 20/2400. briefing by the Federal Government. *Federal Report on Research and Innovation 2022*.
- Deutschlandfunk (2023). *Combustion engines and e-fuels. Volker Wissing (FDP): "We must allow every form of climate-neutral mobility"*. Online document: <https://www.deutschlandfunk.de/volker-wissing-e-fuels-verbrennermotor-100.html> (last accessed: 25/12/2023).
- Durkheim, E. (1950). The rules of the sociological method. Pp. 103-218 in: König, R. (ed.): *Emile Durkheim. The rules of the sociological method*. Neuwied, suhrkamp.
- EmK (2023). *Environmental commitment to imitate. Invitation to imitate*. Online document: <https://www.emk.de/meldung/einladung-zum-mitmachen> (last accessed: 29/01/2024).
- Eom, K., & Kim, H. S. (2015). Intersubjective norms: Cultural and interpersonal perspective. *Journal of Cross-Cultural Psychology*, 46(10), 1313-1316.
- European Environmental Agency (2022). *Decarbonising Road Transport-The Role of Vehicles, Fuels and Transport Demand*. Online document: <https://www.europarl.europa.eu/news/de/headlines/society/20190313STO31218/co2-emissionen-von-pkw-zahlen-und-fakten-infografik> (last accessed: 20/01/2024).
- FAZ (2020). *Transport Minister Scheuer: "I am in favour of freedom of mobility without unnecessary bans"*. Online document: <https://www.faz.net/aktuell/technik-motor/motor/andreas-scheuer-freiheit-der-mobilitaet-ohne-unnuetze-verbote-16622509.html> (last accessed: 21/07/2023).
- Federal Ministry for Economic Affairs and Climate Action (2023a). *New opportunities for testing innovations: BMWK launches consultation on the Reallabore Act*. Online document:

ment: <https://www.bmwk.de/Redaktion/DE/Pressemitteilungen/2023/07/20230710-bmwk-konsultation-reallabore-gesetz.html> (last accessed: 29/01/2024).

Federal Ministry for Economic Affairs and Climate Action (2023b). *Funding concept for real-world laboratories of the energy transition*. Online document: <https://www.energieforschung.de/foerderkonzept-reallabore> (last accessed: 20/01/2024).

Feola, G., & Nunes, R. (2014). Success and failure of grassroots innovations for addressing climate change: The case of the Transition Movement. *Global Environmental Change*, 24, 232-250.

Fischer, R., Ferreira, M. C., Assmar, E., Redford, P., Harb, C., Glazer, S., ... & Achoui, M. (2009). Individualism-collectivism as descriptive norms: Development of a subjective norm approach to culture measurement. *Journal of Cross-Cultural Psychology*, 40(2), 187-213.

Frey, K., Burger, A., Dziekan, K., Bunge, C., & Lünenbürger, B. (2020). *Transport transition for ALL: how to achieve more socially just and environmentally friendly mobility*. Federal Environment Agency.

Geels, F. W. (2002). *Understanding the dynamics of technological transitions. A co-evolutionary and socio-technical analysis*.

Geels, F. W. (2022). Causality and explanation in socio-technical transitions research: Mobilising epistemological insights from the wider social sciences. *Research policy*, 51(6), 104537.

Geels, F. W., & Schot, J. (2007). Typology of sociotechnical transition pathways. *Research policy*, 36(3), 399-417.

Geels, F. W., Sovacool, B. K., Schwanen, T., & Sorrell, S. (2017). The socio-technical dynamics of low-carbon transitions. *Joule*, 1(3), 463-479.

Municipality of Bad Boll (2024). *Mission statement*. Online document: <https://www.bad-boll.de/seite/629620/leitbild.html> (last accessed: 22/01/2024).

Göpel, M. (2016). *The great mindshift: how a new economic paradigm and sustainability transformations go hand in hand*. Springer Nature.

Gössling, S., & Cohen, S. (2014). Why sustainable transport policies will fail: EU climate policy in the light of transport taboos. *Journal of Transport Geography*, 39, 197-207.

Götz, K., & Deffner, J. (2009). A new mobility culture in the city-practical steps towards change. *Federal Ministry of Transport, Building and Urban Development (ed) Urban Mobility. Federal transport research for municipal practice, direct*, 65, 39-52.

Graham-Nye, J., Florin, N., & Retamal, M. (2024). Windows of opportunity: The power dynamics in the disposable nappy regime and opportunities for niche innovations. *Cleaner and Responsible Consumption*, 100169.

- Grimm, Anna; Doll, Claus; Hacker, Florian; Minnich, Lukas (2020). *Sustainable automotive industry: Strategies for a successful transformation, Working Paper Sustainability and Innovation, No. S19/2020*, Fraunhofer Institute for Systems and Innovation Research ISI, Karlsruhe, <https://nbn-resolving.de/urn:nbn:de:0011-n-6154090>.
- Haag, F. (1972). Social research as action research. In: Haag, F., Krüger, H., Schwärzel, J., & Wildt, J. A. (eds.). *Action research: Research strategies, research fields and research plans*. Munich, 22-55.
- de Haan, P., Peters, A., Semmling, E., Marth, H., & Kahlenborn, W. (2015). Rebound effects: Their relevance for environmental policy. *UBA-Texts: Berlin, Germany*, 31.
- Heinze, T., & Heinze, T. (1987). Programme and practice of socio-critical action research. *Qualitative Social Research: Experiences, Problems and Perspectives*, 29-59.
- Hennicke, P., Koska, T., Rasch, J., Reutter, O., & Seifried, D. (2021). *Sustainable mobility for all: a plea for more transport justice*. Oekom publishing house.
- Hesse, M. (2018). 25 years of transport transition. A look back to the future. *Ecological Economy*, 22(3), 16-18.
- Hogg, M. A., & Smith, J. R. (2007). Attitudes in social context: A social identity perspective. *European Review of Social Psychology*, 18(1), 89-131.
- Hogg, M. A., & Turner, J. C. (1987). Social identity and conformity: A theory of referent informational influence. In W. Doise & S. Moscovici (Eds.), *Current issues in European social psychology* (Vol. 2, pp. 139-182). Cambridge, England: Cambridge University Press.
- Hoor, M. (2020). *Mobility Cultures: On the Need for a Cultural Perspective of Integrated Transport Planning (No. 2020 (1))*. IVP Discussion Paper.
- Hoor, M. (2021). *Public mobility and a new mobility culture-foundations, developments and paths to cultural mobility*.
- Horn, K. (1979). Action research: Balancing act without a net. Methodological comments. Frankfurt (Syndikat), *Psyche - Zeitschrift für Psychoanalyse* 36:957-959.
- Hornsey, M. J. (2008). Social identity theory and self-categorization theory: A historical review. *Social and personality psychology compass*, 2(1), 204-222.
- Hossain, M., Leminen, S., & Westerlund, M. (2019). A systematic review of living lab literature. *Journal of cleaner production*, 213, 976-988.
- Javaid, A., Creutzig, F., & Bamberg, S. (2020). Determinants of low-carbon transport mode adoption: systematic review of reviews. *Environmental Research Letters*, 15(10), 103002.
- Karlsruhe Institute of Technology (2024). *Real-world laboratories of sustainability. List of members*. Online document: <https://www.reallabor-netzwerk.de/mitglieder.php> (last accessed: 28/01/2024).

- Kashima, Y., Wilson, S., Lusher, D., Pearson, L. J., & Pearson, C. (2013). The acquisition of perceived descriptive norms as social category learning in social networks. *Social Networks*, 35(4), 711-719.
- Klinger, T., & Lanzendorf, M. (2016). Moving between mobility cultures: what affects the travel behaviour of new residents? *Transportation*, 43, 243-271.
- Klinger, T., Kenworthy, J. R., & Lanzendorf, M. (2013). Dimensions of urban mobility cultures-a comparison of German cities. *Journal of Transport Geography*, 31, 18-29.
- König, R. (1950). Introduction by René König. Pp. 21-102 in: König, R. (ed.): *Emile Durkheim. The rules of the sociological method*. Neuwied, suhrkamp.
- Kords, Martin (2022). *Stock of registered cars in Germany in 2022*. Online document: <https://de.statista.com/statistik/daten/studie/12131/umfrage/pkw-bestand-in-deutschland/> (last accessed: 16/02/2023).
- Kuhlendahl, L., Rollin, P., Weber, R. (2022). Event documentation. *Accompanying research on the 9-euro ticket*. Symposium of the DZSF on 04 November 2022. Online document: https://www.dzsf.bund.de/SharedDocs/Downloads/DZSF/Veroeffentlichungen/Fachtagung-9-Euro-Ticket_Dokumentation.pdf?__blob=publicationFile&v=5 (last accessed: 31/01/2024).
- Kuran, T. (1997). *Private truths, public lies: The social consequences of preference falsification*. Harvard University Press.
- Laa, B., Frey, H., Haselsteiner, E., Danzer, L., Biegelbauer, P., & Friessnegg, T. (2021). Mobilitätswende in den Köpfen-interdisziplinäre Analyse zur Einleitung von Transformationsprozessen im Verkehrssystem. In *CITIES 20.50-Creating Habitats for the 3rd Millennium: Smart-Sustainable-Climat e Neutral. Proceedings of REAL CORP 2021, 26th International Conference on Urban Development, Regional Planning and Information Society* (pp. 509-516). CORP-Competence Centre of Urban and Regional Planning.
- Leminen, S. (2015). Q&A What are living labs? *Technology Innovation Management Review*. 5. 29-35. 10.22215/timreview/928.
- Lewin, K. (1953). *The solution of social conflicts*. Bad Nauheim: Christian-Verlag.
- Loorbach, D. (2007). *Transition Management: New Mode of Governance for Sustainable Development*. North. 193.
- Luederitz, C., Schöpke, N., Wiek, A., Lang, D. J., Bergmann, M., Bos, J. J., ... & Westley, F. R. (2017). Learning through evaluation-A tentative evaluative scheme for sustainability transition experiments. *Journal of Cleaner Production*, 169, 61-76.
- Markard, J., Raven, R., & Truffer, B. (2012). Sustainability transitions: An emerging field of research and its prospects. *Research policy*, 41(6), 955-967.
- Maschkowski, G., Wanner, M. (2014). The Transition Town Movement - Empowerment for the Great Transformation? *PND-Online*. 2. 60-71.

- Matos, S., Viardot, E., Sovacool, B. K., Geels, F. W., & Xiong, Y. (2022). Innovation and climate change: A review and introduction to the special issue. *Technovation*, 102612.
- Mccormick, K., & Hartmann, C. (2017). *The Emerging Landscape of Urban Living Labs: Characteristics, Practices and Examples*. Lund University.
- Morris, M. W., Hong, Y. Y., Chiu, C. Y., & Liu, Z. (2015). Normology: Integrating insights about social norms to understand cultural dynamics. *Organizational behaviour and human decision processes*, 129, 1-13.
- Moser, H. (1975). *Action research as a critical theory of the social sciences*. Kösel.
- Mück, M., Helf, C., & Lindenau, M. (2019). Urban living labs fostering sustainable mobility planning in Munich. *Transportation Research Procedia*, 41, 741-744.
- Mulgan, G., & Leadbeater, C. (2013). *Systems innovation*. London: Nesta.
- MWK, Ministry of Science, Research and the Arts Baden-Württemberg (2021): *Baden-Württemberg promotes real-world laboratories*. Online document: <https://mwk.baden-wuerttemberg.de/de/forschung/forschungspolitik/wissenschaft-fuer-nachhaltigkeit/reallabore/> (last accessed: 16/02/2023).
- Nelson, S., & Allwood, J. M. (2021). Technology or behaviour? Balanced disruption in the race to net zero emissions. *Energy Research & Social Science*, 78, 102124.
- Nier, H. (2017). *How long Germans spend looking for a parking space*. Online document: <https://de.statista.com/infografik/10532/so-lange-sind-die-deutschen-auf-parkplatzsuche/> (last accessed: 16/02/2023).
- Nobis, C., Kuhnimhof, T., Follmer, R., Bäumer, M. (2019). *Mobility in Germany - Time Series Report 2002 - 2008 - 2017*. Study by infas, DLR, IVT and infas 360 on behalf of the Federal Ministry of Transport and Digital Infrastructure (FE No. 70.904/15). Bonn, Berlin.
- Oldenhof, L., Rahmawan-Huizenga, S., van de Bovenkamp, H., & Bal, R. (2020). The Governance Challenge of Urban Living Laboratories: Using Liminal 'In-Between' Space to Create Livable Cities. *Partnerships for Livable Cities*, 293-315.
- Otte, G. (2018). What is culture and how should we analyse it? Draft of a sociological social structure and cultural analysis. On the relationship between empiricism and cultural sociological theorising. *Status and perspectives*, 74-104.
- Parodi, O., & Steglich, A. (2021). Real-world laboratory. In Schmol, T.; Philipp, T. (Eds.): *Handbook of transdisciplinary didactics* (pp. 255-265), Bielefeld, transcript.
- Parodi, O., Ober, S., Lah, O., Steglich, A., Wagner, F., & Podann, A. (2021). Challenge real-world laboratory: Workshop report on real-world laboratory research. *GAIA-Ecological Perspectives for Science and Society*, 30(4), 286-288.
- Parsons, T. (1972). Culture and social system revisited. *Social Science Quarterly*, 253-266.

Pascu, C., & van Lieshout, M. (2009). User-led, citizen innovation at the interface of services. *info*, 11(6), 82-96.

Ramos, É. M. S., Bergstad, C. J., & Nässén, J. (2020). Understanding daily car use: Driving habits, motives, attitudes, and norms across trip purposes. *Transportation research part F: traffic psychology and behaviour*, 68, 306-315.

Reckwitz, A. (2004). The development of the vocabulary of action theories: From purpose- and norm-orientated models to theories of culture and practice. *Paradigms of actor-centred sociology*, 1, 303-328.

Rollin, P. (2022). *Accompanying social science research of the project Gemeinsam Weiterkommen - Eine Initiative aus Bad Boll. Final evaluation*. Online document: http://daten.verwaltungsportal.de/dateien/news/7/2/4/8/4/7/Auswertung_20220322.pdf (last accessed: 09/08/2023).

Rollin, P. (2023). Mobility behaviour is social behaviour. On norms, infrastructure and the use of public transport. pp. 11-26, in: Institute of Transport at the University of Kassel (ed.). *Local Transport Days 2023. Transport turnaround and public transport: How do we get everyone on board before the train leaves the station? Transport series*. Issue 36, University press, Kassel.

Rollin, P., & Bamberg, S. (2021). It's All Up to My Fellow Citizens. Descriptive Norms as a Decisive Mediator in the Relationship Between Infrastructure and Mobility Behaviour. *Frontiers in psychology*, 11, 610343.

Rollin, P., Bamberg, S., Ketterl, C., & Weiland, S. (2021). Cracks in the wall of a car-oriented local mobility system-Results of an urban living lab. *Journal of Environmental Psychology*, 77, 101678.

Rollin, P., Lutz, C. (2024). Event documentation. *Happy Birthday Deutschlandticket?! Symposium of the DZSF on 07 June 2024*. Online document: https://www.dzsf.bund.de/SharedDocs/Downloads/DZSF/Veroeffentlichungen/Fachtagung-D-Ticket_Zusammenfassung.pdf?__blob=publicationFile&v=2 (last accessed: 02/04/2025).

Rudolph, F., Koska, T., & Schneider, C. (2017). *Transport transition for Germany: the path to CO2-free mobility by 2035*.

Ruhrort, L. (2019). Gesellschaftliche Voraussetzungen für einen Modal Shift: Theoretische Anhaltspunkte aus Soziologie und Transformationsforschung. In *Transformation im Verkehr: Erfolgsbedingungen für verkehrspolitische Schlüsselmaßnahmen*, 49-79.

Schäpke, N., Stelzer, F., Bergmann, M., Singer-Brodowski, M., Wanner, M., Caniglia, G., & Lang, D. J. (2017). *Real-world laboratories in the context of transformative research: Starting points for conceptualisation and embedding in the international state of research*. *IETSR discussion papers in transdisciplinary sustainability research*.

Schecke, N., Abdulnabi Ali, A., Bönisch, A., & Schweiger, S. (2021). The stabilisation of real-world laboratories in the field of tension between theoretical conception and practical implementation: An empirical study. *Raumforschung und Raumordnung/Spatial Research and Planning*, 79(4), 411-423.

Schliwa, G., Evans, J., McCormick, K., & Voytenko, Y. (2015). Living labs and sustainability transitions-Assessing the impact of urban experimentation. In *Proceedings of the IN-OGOV Workshop: Climate Change Policy and Governance: Initiation, Experimentation, Evaluation*, Helsinki, Finland (pp. 12-13).

Schneider, U. (1980). *Social science methodological crisis and action research*. Campus-Verlag.

Schneidewind, U., & Rehm, A. (2019). From inside-out to outside-in: Changing perspectives on impact measurement of transformative research. *GAIA-Ecological Perspectives for Science and Society*, 28/2: 168-17

Schneidewind, U., (2014). Urban real-world laboratories - a look at the current research workshop. In: *pnd online* (III), pp. 1-7.

Schulte, M., Bamberg, S., Rees, J., & Rollin, P. (2020). Social identity as a key concept for connecting transformative societal change with individual environmental activism. *Journal of Environmental Psychology*, 72, 101525.

Schuurman, D., De Marez, L., & Ballon, P. (2015). *Living Labs: a systematic literature review*. Open Living Lab Days 2015.

Senate Department for Economic Affairs, Energy and Public Enterprises (2023). *Bringing innovations into use faster: Berlin launches funding programme for real-world laboratories*. Online document: <https://www.berlin.de/sen/web/presse/pressemitteilungen/2023/pressemitteilung.1376517.php> (last accessed: 20/01/2024).

Sennestadt GmbH (2024). *MobiliSta. mobility spaces away from the car-friendly city*. Online document: <https://mobilista.sennestadt.de/> (last accessed: 27/01/2024).

Sherif, M. (1936). *The psychology of social norms*. Oxford, England: Harper.

Sommer, C., Briegel, R., Harz, J., & Reiserer, M. (2022). Strategies for meeting climate protection targets in transport- Status quo: Target missed so far. *Local Transport*, 40(5).

Staatsanzeiger (2020). *Hans-Rudi Bührle. Mayor of Bad Boll*. Online document: <https://www.staatsanzeiger.de/person/hans-rudi-buehrle/> (last accessed: 31/01/2024).

Tajfel, H., Turner, J. (1979). An integrative theory of intergroup conflict. In: C., Austin, W. G., & Worchel, S, *Organisational identity: A reader*, 56(65), 9780203505984-16.

Tiedtke, Benjamin (2013). *External costs of transport and social justice*. IVP Discussion Paper 02/2013. Berlin. DOI: 10.26128/2023.43

Tongur, S., & Engwall, M. (2017). Exploring window of opportunity dynamics in infrastructure transformation. *Environmental Innovation and Societal Transitions*, 25, 82-93.

- Tranow, U. (2018). Norm, social. In: Kopp, J., Steinbach, A. (eds) *Basic concepts of sociology*. Springer VS, Wiesbaden. https://doi.org/10.1007/978-3-658-20978-0_66
- Turnhout, E., Metze, T., Wyborn, C., Klenk, N., & Louder, E. (2020). The politics of co-production: participation, power, and transformation. *Current Opinion in Environmental Sustainability*, 42, 15-21.
- Vallée, D., & Gertz, C. (2021). Integration of transport into urban planning. *Urban Transport Planning Volume 1: Fundamentals, Goals and Perspectives*, 47-69.
- VDI Nachrichten (2022). Maja Göpel: "An increasingly fast-paced economy is not necessarily progress". Online document: <https://www.vdi-nachrichten.com/technik/forschung/maja-goepel-eine-immer-schneller-rasende-wirtschaft-ist-nicht-unbedingt-fortschritt> (last accessed: 30/08/2023)
- Veeckman, C., Schuurman, D., Leminen, S., & Westerlund, M. (2013). Linking living lab characteristics and their outcomes: Towards a conceptual framework. *Technology Innovation Management Review*, 3(12 December), 6-15.
- Verkehrsrundschau (2022). Federal Transport Minister calls for transformation of the transport sector by 2045. Online document: <https://www.verkehrsrundschau.de/nachrichten/recht-geld/bundesverkehrsminister-plaedierte-fuer-transformation-des-verkehrssektors-bis-2045-3169892> (last accessed: 21/07/2023).
- von Unger, H. (2020). Participatory research. In: Selke, S., Neun, O., Jende, R., Lessenich, S., Bude, H. (eds) *Handbook of Public Sociology. Public science and social change*. Springer VS, Wiesbaden
- von Unger, H., Block, M., & Wright, M. T. (2007). *Action research in German-speaking countries: on the history and topicality of a controversial approach from a public health perspective (No. SP I 2007-303)*. WZB Discussion Paper.
- Wang, S., Wang, J., & Yang, F. (2020). From willingness to action: Do push-pull-mooring factors matter for shifting to green transportation? *Transportation Research Part D: Transport and Environment*, 79, 102242.
- WD, Scientific Services (2018). *Real-world laboratories, living labs and citizen science projects in Europe*. Online document: <https://www.bundestag.de/resource/blob/563290/9d6da7676c82fe6777e6df85c7a7d573/wd-8-020-18-pdf-data.pdf> (last accessed: 16/02/2023).
- Wentland, A. (2020). Why electric utopias are stuck: The imaginary automobility as a limit to the transport transition using the example of electric mobility in Germany. *BEHEMOTH-A Journal on Civilisation*, 13(1), 70-82.
- Zeit (2019). Survey. Almost two thirds don't want to give up their car. Online-Dokument: <https://www.zeit.de/news/2019-02/04/fast-zwei-drittel-wollen-nicht-auf-auto-verzichten-190204-99-844069> (last accessed: 16/02/2023).
- Zolfagharian, M., Walrave, B., Raven, R., & Romme, A. G. L. (2019). Studying transitions: Past, present, and future. *Research Policy*, 48(9), 103788.

12 | Erklärung

„Ich erkläre: Ich habe die vorgelegte Dissertation selbständig, ohne unerlaubte fremde Hilfe und nur mit den Hilfen angefertigt, die ich in der Dissertation angegeben habe. Alle Textstellen, die wörtlich oder sinngemäß aus veröffentlichten Schriften entnommen sind, und alle Angaben, die auf mündlichen Auskünften beruhen, sind als solche kenntlich gemacht. Bei den von mir durchgeführten und in der Dissertation erwähnten Untersuchungen habe ich die Grundsätze guter wissenschaftlicher Praxis, wie sie in der ‚Satzung der Justus-Liebig-Universität Gießen zur Sicherung guter wissenschaftlicher Praxis‘ niedergelegt sind, eingehalten.“

Köln, 02. April 2025, Philipp Rollin