Connective Mobility

Changes in Mobility Behavior through Changes in the Socio-cultural and Physical Environment

A Psychological Perspective

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Although the need for more sustainable transport has been discussed for decades, our transport systems are still far from sustainable. Greenhouse gas emissions from transport increased by 20 percent in the EU between 1990 and 2018 (EEA 2020). City dwellers still suffer from local air and noise pollution and private cars occupy space that is missing for recreation, walking, and cycling (Creutzig et al. 2020). Residents of rural areas often depend on a car to fulfil their mobility needs, leaving carless people behind (Ahern and Hine 2012; Mattioli 2014). Road traffic dominated by motorized transport additionally poses a safety threat, with road injuries being a leading cause of death globally (Chen et al. 2019).

More sustainable transport requires a change in mobility behavior as technological advancements alone are not sufficient (Schwanen et al. 2011; Skippon et al. 2012) and may lead to rebound effects (Millonig and Haustein 2020). To identify effective behavior change measures, it is relevant to understand under what circumstances people change their mobility behavior and what mental mechanisms are involved in these behavior change processes. This chapter provides an overview on most relevant psychological theories of behavior change in transport and how change mechanisms are linked to the sociocultural and physical environment. It raises questions of cause and effect and how they can be addressed in future studies combining advanced technologies of data collection and analysis with qualitative methods, utilizing the advances of interdisciplinary research.

Understanding the Process of Behavior Change

During recent decades, our understanding of mobility behavior and the various related factors has increased substantially. However, the question of which environmental factors and societal processes lead to a change in mobility behavior has still only been answered rudimentarily (Haustein 2021a). The mobility biographies approach (Lanzendorf 2003) offers a useful framework to explain changes in mobility behavior. Key events in the course of a life are considered to be the main drivers of behavior change. These events can interrupt people's established travel habits, which are reconsidered and eventually changed. Müggenburg et al. (2015) distinguish between three types of key events that determine everyday mobility decisions: life events (e.g., childbirth, retirement), adaptations in long-term mobility decisions (e.g., residential relocation, car purchase/disposal), and exogenous interventions (e.g., new infrastructure, changes in urban design). According to the mobility biographies approach, these key events influence each other and are influenced by long-term processes (that is ageing and socialization, period and cohort effects). Long-term and everyday mobility decisions are assumed to mutually affect each other. Based on retrospective interviews, Janke and Handy (2019) explored how life events changed cycling attitudes and behavior and pointed to a bidirectional relationship between both variables. Initiating a deliberation process was identified as one of several ways through which life events trigger behavior change.

Deliberate processes of behavior change are described in stage models of behavior change, perhaps in most detail in the stage model of self-regulated behavioral change (SSBC; Bamberg 2013a, 2013b). The model specifies which psychological factors and processes trigger stage progression, starting with an unspecific goal to change behavior over more specific steps and actions, which can finally lead to the establishment of a new behavior, which may then form a new habit. SSBC integrates assumptions of static action models, in particular the theory of planned behavior (TPB; Ajzen 1991) and the norm-activation model (NAM; Schwartz 1977; Schwartz and Howard 1981) and previous stage models.

TPB is probably the most frequently applied theoretical framework when explaining transport behavior. According to TPB, intention is the main predictor of behavior. Intention is influenced by attitude toward the behavior, which is the evaluation of the positive and negative consequences of the behavior, and the subjective norm, which is the perception of social approval of the behavior. Subjective norm has later been supplemented by descriptive norm—the behavior that is observed in others and found to be a relevant addition to

explain transport behavior (Eriksson and Forward 2011; Møller and Haustein 2014).

A third predictor of both intention and behavior is perceived behavioral control (PBC), which describes how easy or difficult a person perceives the conduction of a target behavior (such as cycling to work). While it may be completely determined by actual behavioral control, PBC typically differs from actual behavioral control because different people perceive the same situations or environments as more or less supportive for a behavior (such as cycling). In the context of mode choice, PBC mostly relates to the perception of the transport infrastructure. To explicitly account for perceived requirements and constraints resulting from the personal living situation, TPB was extended by the construct of perceived mobility necessities (PMN), capturing demands from family and work that require a high level of mobility, hampering car use reduction (Haustein and Hunecke 2007). A recent study in Copenhagen indicates that the effect of PMN on cycling is context-specific: in a supportive cycling environment, PMN do not only encourage car use but also cycling (Thorhauge et al. 2020). PMN have also been identified as a relevant determinant of car sharing adoption (Jain et al. 2021) and are related to an increase in car ownership over time (Jain et al. 2020; Haustein 2021b).

While the standard attitude measure in TPB is often reduced to the positive versus negative evaluation of the behavior or to functional and instrumental aspects of the behavior, such as convenience, saved travel time and money, attitude has been exchanged or complemented by symbolic and affective motives (Hunecke et al. 2007).

In case of mode choice, this includes to what extent the use of a specific transport mode is related to fun and passion (enjoyment), status and prestige, or freedom and autonomy (Haustein et al. 2009; Steg 2005; Zhao and Zhao 2020). Indeed, it has been demonstrated that more than half of the value of car-ownership comprises non-use value (Moody et al. 2021).

While TPB assumes that people aim to maximize their own benefits, the norm-activation model focuses on the moral obligation to engage in a behavior (Schwartz and Howard 1981). The model views proenvironmental behavior as the consequence of the activation of personal norm—the perceived obligation to act according to own moral values. Many proenvironmental actions are associated with behavioral costs, which may prohibit the activation of personal norm. Indeed, several conditions need to be fulfilled before it is activated. First, people must be aware that a given behavior (e.g., car use) has negative consequences for the environment (awareness of need). Second, people need to be aware that their own behavior contributes to the problem and thus feel responsible for the consequences of their behavior (ascription of responsibility). Third, people need to believe that their behavior will help solving the problem (outcome efficacy). Here it is important that people expect others to act in an environmentally friendly way as well; otherwise, others' behaviors can be used to justify one's own unsustainable behavior, similar to the denial of consequences and the denial of responsibility. Finally, people must perceive the ability to act according to their personal norm (e.g., they must be able to avoid car trips).

While the norm-activation model focuses on acting in accordance with one's own moral standards and the TPB focuses on optimizing one's own benefits, Lindenberg and Steg (2007) integrated both approaches in the goal-framing theory. Apart from the normative goal (e.g., protecting the environment) and the gain goal (e.g., saving time and money), the goal-framing theory additionally considers hedonic goals (e.g., enjoying the trip) to determine a behavioral choice. All three goals are assumed to frame the way people process information and how they act in a given situation. What goals are predominant depends both on people's underlying values and situational factors and may thus vary for the same person in different contexts.

More specific action models that combine assumptions of the TPB and the norm-activation model have been suggested by Klöckner and Blöbaum (2010) and Zavareh et al. (2020), adding habits and self-identity, respectively.

Sociocultural and Spatial Context: Mobility Cultures

Besides the natural and built environment (Christiansen et al. 2016; Hillnhütter 2021; Nielsen et al. 2018; Susilo and Maat 2007), a supportive environment for the use of alternative transport modes also includes nonmaterial aspects. How the use of specific transport modes is perceived in a city or in a broader cultural context, and what symbolic meanings are connected with its use, has been found to play a relevant role for mode choice (Ashmore et al. 2020; Sovacool and Axsen 2018). Objective and subjective elements as well as the interaction of actors, stakeholders, and infrastructures are considered jointly when describing the mobility culture of a city or region (Deffner et al. 2006; Haustein, Koglin et al. 2020). A city may be described as a »transit metropolis« (Klinger et al. 2013), while several cycling (sub)cultures can be differentiated within the same city (Hoor 2020a). This also illustrates how differently the concept of mobility culture is understood, operationalized, and examined. On the one hand, it is argued that only a joint consideration of all elements of mobility cultures based on qualitative methods is adequate and meaningful since a quantitative assessment and comparison of mobility cultures may neglect the negotiation processes through which mobility cultures are in the first place created, consolidated, and changed (Hoor 2020b). On the other hand, it is argued that a definition that includes nearly all aspects of urban mobility may become a »superficial fashion term« and along this line of argumentation an empirical operationalization of mobility culture as injunctive normative beliefs is suggested (Bamberg et al. 2020). Similarly, Basaran et al. (2021) suggested a cycling norm index that measures how cycling is perceived in a region as a proxy for the predominant cycling culture. An alternative way of measuring mobility culture could be an application of a stated preference approach as used in Moody et al. (2021), where a low value of car ownership, in particular a low non-use value, would indicate a more sustainable mobility culture that has decoupled car ownership from well-being and social inclusion (Haustein 2021c).

Another way of studying the effect of different mobility cultures is to examine people's travel behavior adaption when moving to a different city. Examining people who recently moved, Klinger and Lanzendorf (2016) found that cycling—as compared to other modes—is more affected by citywide sociocultural attributes, such as the perceived acceptance of cyclists, than by specific local/neighborhood characteristics. However, the specific process of how and under which circumstances the experience of a new mobility culture changes attitudes, norms, and travel behavior is far from being understood and needs further investigation.

Causality in Behavior Change

Causality patterns in long-term mobility decisions are complex and do not necessarily follow a simple cause-and-effect logic. Challenges arise particularly from endogeneity, which occurs when a relevant variable is omitted in a causal model or when the dependent variable is (also) a predictor or the independent variable, in case of multidirectional causality (Avramovska 2020). The latter has for example been examined in the context of residential self-selection (Kroesen 2019). Residential relocation is among the most examined long-term mobility decisions. Moving to suburban locations is typically followed by an increase in car use, while the opposite is the case for moving into the city (Scheiner and Holz-Rau 2013). Research around residential self-selection indicates that residential choice is influenced by travel attitudes, which need to be accounted for to avoid an overestimation of environmental effects on mode choice (Cao et al. 2009). However, increasing evidence is found for the »reversed causal relation,« meaning that the new location changes travel attitudes (De Vos et al. 2018; van de Coevering et al. 2021). Additionally, multidirectional causality is at play in the relationship between car use and car attitudes (Moody and Zhao 2020), meaning that car use is not only influenced by attitudes but also that there is a strong path back, which also applies for other travel modes (Kroesen et al. 2017). Although the reciprocal relationship between attitude and behavior in mode choice was demonstrated four decades ago (Dobson et al. 1978), it has rarely been

considered in the empirical application of psychological models, especially not in the frequently applied TPB, with few exceptions (Thøgersen 2006).

Yet, TPB also assumes that feedback from one's own behavior is likely to affect one's own beliefs and thereby also future intentions and actions (Fishbein and Ajzen 2010). Recently, empirical evidence that intention affects subjective norms and attitudes in a reverse-causal direction has also been provided (Sussman and Gifford 2019), demonstrating a need to consider the reciprocal relationships between all TPB-components, not only the attitude-behavior relationship, in future research.

Several transport studies (De Vos and Singleton 2020) use Festinger's theory of cognitive dissonance (1957) to explain the alignment of attitudes and behavior over time. According to Festinger, incongruence in attitude and behavior leads to mental discomfort, which causes an adaption of behavior and/or attitudes. Similarly, the norm-activation model suggests that not acting according to personal or social norms leads to unpleasant feelings of guilt or shame, respectively. To avoid this mental discomfort, people practice different strategies, such as denying the need for action or their own responsibility (Møller et al. 2018; Kroesen 2013; Lamb et al. 2020). While there is empirical evidence for the relationship between the involved sociopsychological factors, the involved mental processes, and, in particular, the context in which a given attitude or norm does or does not lead to action, has rarely been examined in longitudinal studies, and thus the basis for causal conclusions is generally limited.

Context-conditionality is indeed another causality challenge. There are several examples of transport choices where a cause-effect relationship depends on the sociocultural and/or spatial context. Immigrant background, for example, increases the likelihood of cycling in low-cycling countries (Smart 2010) but decreases it in high-cycling countries (Haustein, Kroesen et al. 2020). Similarly, age and gender play a role for the uptake of cycling in low- but not in high-cycling countries, suggesting that the provision of safe infrastructure and travel socialization plays a relevant role (Aldred et al. 2016; Haustein, Koglin et al. 2020).

Future Perspectives

Advancements in data collection and analysis can be named as factors that are expected to expand our understanding of behavior and behavior change in transport. Biosensor data can more and more easily be collected with wearable sensors, such as advanced wristbands (Jimenez-Molina et al. 2018). The incorporation of psychophysiological data measured while traveling has the potential to improve survey-based modeling of transport choices (Castro et al. 2020). Besides showing individual differences in the perception of travel options, it may especially help to identify critical aspects in the journey leading to stress and mental discomfort or environmental aspects leading to enjoyment and relaxation and thereby provide concrete hints for improvements in design, particularly when combined with surveys, qualitative interviews, or focus groups.

A better understanding of the long-term processes of behavior change and connecting it to changes in the environment and personal living circumstances requires more and better (quantitative and qualitative) longitudinal data and adequate methods to identify causal relationships in such large, complex datasets. The detection and inference of causality is a relatively new and growing research area in machine learning (Peters et al. 2017), which offers great potential for the verification of theoretical assumptions and the detection of causal relationships in the context of transport behavior and may lead to great theoretical and methodological advancements in transport research.

While this chapter has emphasized the psychological perspective to behavior change, it also highlights that understanding behavior change in transport profits from an interdisciplinary approach, combining expertise in advanced modeling, psychology, physiology, sociology, urban design, transport planning and geography.

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