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Adding to complexity: How a revived use of psychological theory can benefit attempts to stimulate change in patterns of personal travel

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ABSTRACT. This paper seeks to broaden the view of psychological theory in research in behavioral change in transport as a way of responding to climate change. In recent years the use of psychological theory has been increasingly criticized for supporting individualizing, atomized and simplistic perspectives on change (Watson, 2012; Geels, 2012; Chatterton & Wilson, 2014; Schwanen, Banister & Anable, 2011). While welcoming this important and justified critique this article seeks to capture and defend the fundamental insights that these models have contributed to. The aim is to separate the baby from the bathwater and point to how theories of individual behavior and aggregate perspectives such as theories of practice can inform each other and result in enhanced methods. First the use of psychological theory in journal articles on behavioral change in transport is reviewed. A comprehensive theoretical review is used to point to strengths and weaknesses in current approaches. Lastly an informed eclectic approach is advocated by proposing an operational framework that draws on established theories of attitude and behavioral choice as well as cultivating a better understanding of practices involved in personal travel.

Introduction

It is generally agreed that a reduction in carbon emissions from transport is necessary and urgent. It is also widely accepted that technological progress will not suffice (Banister, 2008; Dryzek 2013) and that changes in patterns of travel is also required. Interventions to support behavioral change in personal travel towards less carbon intensive modes of travel have had limited success (Graham-Rowe et.al, 2011; Friman, Larhult & Gärling, 2013) and have largely been employing individualized methods of intervention that were originally developed for different purposes.

Evidence from other areas of research concerned with institutionally motivated change of individual behavior such as organization development and treatment compliance confirms that additional insight into the dynamics of change can be obtained by using qualitative measures to elucidate meanings ascribed to change (Schein, 1999) and possible subjective understandings of the phenomenon that is to be changed.

Rich and qualitatively substantiated descriptions of actual everyday processes of travel choosing seems especially relevant when the power to make the change is as widely distributed, as embedded in other everyday choices and as subjectively driven as is the case with personal transport choices.

The field of transport is inherently complex involving multiple technological, economic and cultural aspects. From this perspective the idea of transforming the system one person at a time seems overwhelming, dauntingly time consuming and fundamentally inefficient. This view has indeed been expressed by proponents of sociotechnical systems approach (Geels, 2012) and proponents of sociological perspectives (Cairns, 2014) and I agree. Still, retiring the theories of individual behavior from transition research is premature.

This view built on three arguments: (1) Properties of individual agency are inherently present at the level of practice and properties of practices contribute to the properties of the overall system. Flexibility and leeway at a system's level is in part defined by how actors within the system perceive and react to opportunities and pressures. To counterpose focus on processes of individual behavior and processes at the level of practices in defense of the later is to move a fundamental problem of fragmentation from one arena to the next. (2) Actions are fundamentally energized at the level of individuals – To paraphrase Gregory Bateson: If I kick a dog, his immediately sequential behavior is energized by his metabolism, not by my kick (Bateson, 1972); and even though people are amazingly flexible in how they form cultures and adapt to the environment such flexibility is not absolute: not all configurations of change are equally compatible with the human organism including its cognitive and affective systems. (3) Attempts to define concepts and theories that allow for operationalization of complex matters into points of attack, are useful and the evidence base of this approach is, even if incomplete and partially flawed, fundamentally valuable.

Literature review

A literature search identified 436 peer reviewed journal articles and reviews within the domains of social science, environmental science, decision science and psychology containing the words “transport” and “behavior change¹”. 343 were excluded based on title and abstract. The remaining 93 titles were found to be relevant for a description of the conceptualizations of behavioral change in research on transport behavior. Based on stated research objective, theories employed and methodology seven conceptual groupings of articles were formed²:

1. Attitudes and preferences (n=40):
 - a) Attitudes as motives: Articles seeking to uncover the psychology of mobility behavior by mapping significant psychological determinants of this behavior (n=19)
 - b) Attitudes as indicators of segment: Articles seeking to identify groups in a population that are especially responsive to specific arguments (n=7)
 - c) Attitudes as parameters: Articles treating attitudes as one factor contributing to mobility behavior alongside other significant factors, e.g. household size or travel distance (n=11)
 - d) Attitudes and perceptions specifically about public transport services (n=5)
2. Habit and automatic behavior as a barrier to change (n=8)
3. Patterns in life course, major life events and mobility profiles - mobility behavior as consequence (n=7)

¹ Different spellings included

² Groupings are marked in the reference list with “*” followed by the relevant number.

4. Induction of behavioral change by methods of persuasion and influence (n=11)
 - a) Social psychological mechanisms as opportunity for change: Social influence / social marketing (n=5)
 - b) Irrationalities as opportunity for change. Behavioral economics / heuristics & biases (n=6)
5. Articles reviewing the evidence – generally raising conceptual and methodological concerns and point to needs for more systematic and rigorous designs (n=12)
6. Behavioral effects of “harder” measures – the effects of rewards and other targeted economic incentives on travel behavior (n=6)
7. Recent calls for more aggregate perspectives (n=7)
 - a) Potential of theories of practice: exposing transport behavior to a broader range of social science perspectives (n=4)
 - b) Sociotechnical systems approach to transport (n=3)

The titles were further divided into two groups one containing titles with reference to distinct theories (n=46)(Table 1) and one without direct theoretical references (n=47). Lastly the articles were listed chronologically for identification of developments in theoretical and/or conceptual trends.

A reading of the articles grouped by the employed behavioral theory shows that attitude theories have been by far the most used theoretical foundation. A chronological reading of the articles points to a development where emphasis on mechanisms of individual behavior is supplemented by an emphasis on mechanisms of influencing behavior. As a result a gradual change is found where an initial focus on the *motives* of the individual transport user is supplemented by investigation of the *utility* of models of persuasion tailored to stimulate change in mobility behavior, i.e. social marketing, behavioral economics, social influence, affective framing to name some of the more prominent approaches.

Common to the work in the first six groupings is a general orientation towards causal relationships between aspects of travel, traveler and behavior; from within this paradigmatic frame the objective of research is to identify determinants of mobility behavior and thereby isolate the keys to change - implicitly maintaining the surprisingly unchallenged assumption that such universal keys exist. The seventh grouping represents critiques of current conceptualizations and contains recent contributions advocating a broader focus on the actual process of travel choice and the significance of cultural understandings.

Theory:	Number of articles (n):
Theory of planned behavior (Ajzen, 1991)	29
Norm Activation Theory (Schwartz & Howard, 1981)	5
Stages of change models (Prochaska & DiClemente, 1983; Gollwitzer, 1990; Bamberg, 2010)	5
Reactance Theory (Brehm 1966)	1
Cognitive Dissonance Theory (Festinger, 1957)	1
Psychology of material possessions (Dittmar, 1992)	1
Theories of practice	4
Primacy effect (Ebbinghaus, 1913)	1
Behavioural economics / Heuristics & biases (Kahnemann et.al 1982)	5
Multilevel Perspectives (Geels, 2004)	2
Regret theory (Loomes & Sugden, 1982)	1

Table 1: Use of psychological theory

Theoretical review

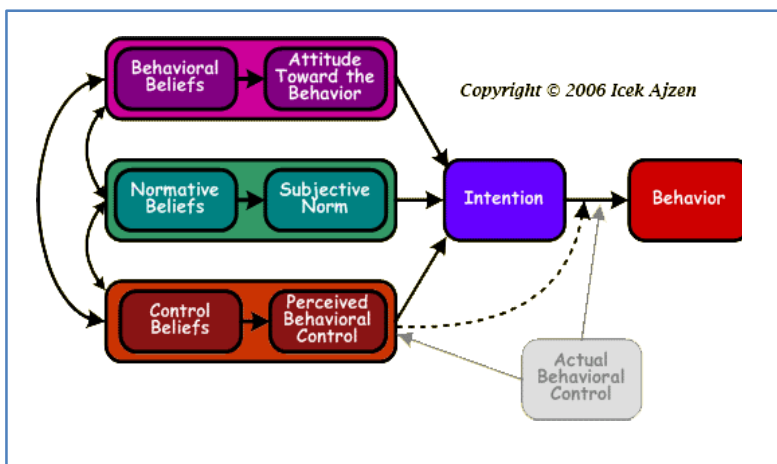
The history of the attitude construct

The concept of attitudes and attitude change has been a subject of interest for scientists of the mind for a very long time. One of the reasons for this interest might be the intuitively plausible assumption of attitude-behavior correspondence. This expected correlation runs like a volatile promise and a faithless partner through the entire history of the field. In his 1969 influential review of the literature A. W. Wicker considered the findings of 31 studies of the attitude-behavior relation and concluded: "Taken as a whole, these studies suggest that it is considerably more likely that attitudes will be unrelated or only slightly related to overt behaviors than that attitudes will be closely related to actions." (Wicker, 1969)

Twelve years later when reviewing the attitude-behavior consistency Zanna and Fazio concluded that the answer to the "is there a relation" question is a resounding "sometimes" – leading to the far more practical question: "Under what conditions do what kinds of attitudes of what kind of individuals predict what kind of behavior?" (Fazio & Zanna, 1981, p.165). For the purpose of designing effective behavioral change initiatives based on attitude, the core question could be formulated along the same lines: "under what conditions will a change in attitude of what kind of individuals predict what kind of behavior?"

The theory of planned behavior (TPB)

The TPB is a theory of the relationship between three measurable psychological constructs (Attitude, subjective norm and perceived control) and behavioral intention (Ajzen, 1991). The theory further anticipates a correspondence between behavioral intention and behavior. The theory was formulated as an extension of Theory of reasoned action (Fishbein & Ajzen, 1975) The theory of planned behavior is one of the most used theories in social science with more than 22.000 scholarly citations, hundreds of published studies and numerous reviews. Of the 46 articles on mobility behavior change that employ theory 29 have references to TPB.



The attitude component is determined by the total set of accessible salient beliefs linking the behavior to different outcomes, affective consequences and other attributes (Ajzen, 1991). The subjective norm construct measures an individual's perception of social normative pressures, or relevant others' beliefs that he or she should or should not perform the target behavior. The perceived control factor is informed by Bandura's concept of

self-efficacy (Ajzen 1991) rooted in his theory of social cognitive theory (Bandura, 1977).

The devil in the detail – the psychometrics of attitudes

In the late 1960s Martin Fishbein and colleagues developed a set of methods for the measurement of attitudes. According to Fishbein and Ajzen (1974) distinguishing between attitudes towards objects and attitudes towards behaviors is essential. In conjunction with this work Fishbein and Ajzen (1977) formulated the principle of compatibility, stating that the attitude-behavior relation is limited to the extent

that the measures of attitude and behavior match in terms of specificity. Thus attitude and behavior can correspond just as highly when both measures are specific as when both measures are general, but the hope to find a model that would reliably predict specific behaviors on the basis of global attitudes was abandoned with this principle. In a meta-analysis S.J. Kraus (1995) confirms that studies that conform to the principle of compatibility show much larger attitude-behavior correlations.

How potent is TPB as a means of predicting mobility behavior?

Armitage and Connor (2001) compiled the most comprehensive sample of TPB studies to date covering a range of academic disciplines. The overall variance explained for prediction of behavior was 27%. Albarracín et.al (2001) found a similar number, 28%, in a review of studies focusing on prediction of condom use.

In a meta-analysis of the psychological correlates of car use Gardner and Abraham (2008) found the utility of TPB variables in predicting car use to be generally supported. Attitude and perceived behavioral control were found to explain 27% and 31% respectively of the variance in self-reported driving. In four studies a direct measure of intention to drive was found, accounting for 53% of the variance in reported driving. It was generally the case that beliefs about non-driving showed a greater impact than beliefs about driving, indicating sensitivity to psychometric rigor. It should be noted that self-report methods generally show a higher intention-behavior correspondence than direct measures of behavior (Connor & Armitage 1998; Cristea, 2013 (on driver behavior)).

A range of extensions to the TPB have been proposed. Within the literature reviewed here self-identity, past behavior/habit (Thøgersen, 2006; Bamberg et.al, 2011), moral norm (Abrahamse et.al, 2009, Fujii, 2010) and affective beliefs (Steg, 2001) have received most attention. In a review of studies proposing extending variable including the four mentioned above Connor & Armitage conclude: "In each case, there appears to be growing empirical evidence to support the inclusion of these additional variables in the TPB and some understanding of the processes by which these variables may be related to other TPB variables, intentions, and behavior. Incorporation of all of these variables within the TPB might create an unwieldy theory. It seems unlikely that a researcher would wish to include all of these variables in a single study. Rather, depending on the nature of the behavior and the purpose of the study, different combinations of variables might be examined" (Connor & Armitage 1998). Connor & Armitage further discuss the methods used to identify salient beliefs in pilots, pointing to methodological difficulties in ascertaining what beliefs to include in surveys. In some cases it might come down to the wording of individual items whether or not e.g. the personal norm dimension is covered by the attitude variable whereas the influence of past behavior seems to relate to the TPB constructs in a more discrete way.

In the reviewed articles on mobility 19 use measures of attitudes for data collection. Typically the specific questions of the surveys are only partially included and no discussion of the psychometric properties are offered (Graves 2013 is a notable exception). Further the development of questionnaire items is generally problematic as items only in two cases are built on pilot studies to identify salient beliefs. Generally items are constructed based on research hypothesis or research conducted in other settings. This methodological shortcoming might exemplify that best practice for use of TPB requires considerable preparatory work in order to ensure the necessary qualitative frontloading of the TPB questionnaire items. The popularity of TPB is due in part to the fact that it is clearly operationalized and its parsimony makes the model useful in applied settings (McEachan et.al. 2011) but might at the same time mask the actual complexity of developing valid measures of the four components.

While recognizing the importance of developing operational concepts of travel behavior and travel behavior change, the prevailing reliance on data from structured interviews and questionnaires found in the reviewed journal literature appears to be a fragile strategy, as information that is not a priori contained in the mental models of the researchers is at risk of being lost in residuals or (worse) be subjected to fundamental attribution error (Gilbert, 2002).

Extended model

One extension of the TPB that appears to have relatively broad application is that of splitting components of the TPB (Ajzen & Fishbein, 2005; Conner & Sparks, 2005). In this extended model attitudes are split into affective/experiential and cognitive/instrumental components, norms are split into injunctive and descriptive components, and perceived behavioural control is split into self-efficacy and control components. It seems that such a model would account for most of the proposed further variables in the work on travel behavior change presented earlier except the effect of past behavior. A number of tests of this extended TPB have shown it to have good predictive power (Conner, 2014). An interesting finding is a direct effect of affective attitudes on behavior that is not mediated by intentions (Connor, 2014; Lawton, Conner, & McEachan, 2009).

Beyond extensions of the TPB

The theory of planned behavior has proven to be a useful tool for prediction of intention and behavior based on beliefs and perception operationalized in the four constructs of the model. In the following paragraphs, paradigm level criticisms and contrasting perspectives with particular importance for the development of interventions will be discussed.

The three objections that stand out for this purpose are: (1) the predominant focus on deliberate reflection as the cognitive mechanism by which behaviors are determined and (2) the fact that in exploring the attitude-behavior relation research has largely focused on the attitudes and variables tied to attitudes, mostly ignoring the nature of the behaviors to be predicted. Johnson & Boynton (2010) argue that: "behaviors are often just as complex as attitudes – if not more – and when studying the attitude-behavior relation, much can be learned by focusing on the criterion instead of solely on the predictor." (3) The survey methodology used for data collection generally leads to cross-sectional designs that does not allow for description of dynamic effects and situational fluctuations in appraisals.

Spontaneous behavior

In their 1999 article with the appealing title "The unbearable Automaticity of Being" Bargh & Chartrand reviewed the literature on automatic behavior and point to the need for a reevaluation of the role of deliberative cognition in human behavior throughout the social sciences. Especially the idea of deliberative cognition as a causal precursor to behavior is turned upside down indicating that behavior may often precede the reasoning. Most tests of the TPB have employed correlational designs that do not allow for test of causality (Conner 1998). Jonson & Boynson (2010) note: "People are often marginally rational, relying in heuristics and basic cues as the driving force behind much of their behavior. Thus structuring a behavioral prediction model around intentionality may not be universally appropriate".

A further influential contribution to the description of spontaneous behavior is formulated in the influential book, *Judgment under Uncertainty: Heuristics and Biases* (1982), by Kahnemann et.al. The core idea of the heuristics and biases program is that judgment under uncertainty is often based in a limited number of

simplifying heuristics rather than in more formal and extensive algorithmic processing (Gilovich, Griffin & Kahneman, 2002). An example of specific interest for the study of behavioral change is the “status quo bias” (Kahneman, Knetsch & Thaler, 1991) stating that even when a behavioral change would predictably lead to a more favorable outcome individuals have a bias that favors current behaviors. One way of conceptualizing this finding is by assuming a behavioral price of changing.

In later work which incorporates the automaticity perspective Ajzen (2000) contest the notion that intentions are necessarily conscious in nature: “At one end of the information processing continuum are novel or rarely performed behaviors that require deliberation, formation of an explicit intention, and conscious monitoring for their execution. At the other extreme are familiar behaviors that have become automatic as a result of frequent performance and are now guided by spontaneous attitudes and intentions. From a reasoned action perspective, at both ends of the continuum behavior is controlled by such cognitive factors as beliefs, attitudes, and intentions—effortfully at the controlled end and automatically at the spontaneous end. This view contrasts with the habituation perspective that assumes that routinized behavior is under the direct control of stimulus cues” (Ajzen 2000).

However the methodology for asserting the TPB components rely on questions that require verbalization of beliefs at a level that would seem to contrast with the process of spontaneous assessment. To assess pre-conscious antecedent of attitudes is notoriously complicated and greatly impacts the apparent parsimony of the TPB.

Automaticity and habit

Two concepts of automatic behavior – automaticity and habit – are common in the literature. The first is consistently described within psychology as well as physiology and learning. Automaticity refers to automatic motor behavior where sequences of motor actions that are cognitively “bundled” into a behavioral unit that is performed without the need for conscious overseeing of the coordination (Kahneman, 2011). The ability to ride a bike is a much-used example, i.e. a person can ride the bike but is most likely not able to give an adequate description of the steps involved. Automaticity is established through repeated and varied practice whereby declarative knowledge advances to procedural knowledge that “primes” rapid motor responses (Lee & Anderson, 1997). Once a procedural skill is established it carries little cognitive load, is hard to modify and even harder to reverse (Crossley, Ashby & Maddox, 2012). Evidence suggests that sensory feedback is more effective in modifying procedural behaviors than instructions (Fogg 2003, Crossley, Ashby & Maddox, 2012).

The concept of habit finds less unequivocal acceptance. In essence the study of habits is the study of links between past and future behavior. According to the findings of Wood and colleagues past behaviors that are repeated appear to lead to future behaviors provided that contexts remain relatively stable, whereas apparent “habits” are broken when contexts change (Wood, Tam & Witt, 2005). It was found that the environmental cues that are present in the “habit context” become sufficient to elicit the “habit behavior”, independent of a process involving intention. The controversy regarding the concept of habit regards the extent to which behavioral control is blocked by the formation of habit or just left outside conscious supervision as long as no need is found to reconfigure intention and behavior.

Across a range of applications it has been found that past behavior is a strong predictor of future behavior over and above measures of attitude and intention (Conner, 1998; Ajzen, 2002; Thøgersen, 2006). The relationship between past behavior and habit is less clear as measurable properties, such as repetition does not imply automatic activation. Reviewing the evidence on the effect of past behavior on intention, Ajzen

concludes: “when attitudes and intentions are held with a degree of ambivalence, indifference, or uncertainty, they are unstable and fail to provide clear guides to action. Empirical evidence shows that, under these conditions, past behavior is a good predictor of later behavior” (Ajzen, 2002). The nature of habit cannot be determined here, but it should be noted that this theoretical distinction has implications for whether the barrier to change in repetitive behaviors is lack of control, ambivalence, indifference or uncertainty. The evidence across theoretical approach shows that the formation of implementation intentions i.e. detailed plans for enactment of new intentions, supports behavior change.

Within the field of transport focus has been on strategies to break habits of car-use (Thøgersen, 2006; Bamberg 2007, 2013; Bamberg et.al. 2011; Friedrichsmeier et.al 2013, and encourage formation of cycling habits (Gatersleben & Appleton, 2007; Nkurunziza et.al. 2012). The dominant approach is a lack of volitional control perspective on habitual behaviors (See Schwanen et.al 2012 for a critical comment on this perspective).

The MODE model

A theoretical attempt to incorporate automatic behavioral processes is proposed by the MODE model (Motivation and Opportunity as Determinants of the attitude behavior relation, Fazio 1990). The MODE model offers a dual process model that is thought to complement the TPB by describing two divergent processes, one based on an automatic activation of established attitudes that directly impact behaviors, and one based on deliberate reflection and evaluation of salient beliefs.

The underlying premise of the MODE model is that deliberate reflection requires more effort than relying on spontaneous processes. This view is not new and finds support from various research traditions within psychology and cognitive neuroscience (Damasio 2005, Norretranders 1998). The critical questions that the MODE model seeks to answer are: “under what conditions one or the other orientation predominates, and how these processes interact on the path from attitude to behavior” (Olson & Fazio, 2009, p.23).

The MODE model proposes two mediating factors: motivation and opportunity. The motivation factor for engaging in reflection is supposed to rely on a fundamental “fear of invalidity” (Kruglansky 1989), a basic inclination to seek to make good decisions when possible and relevant. The opportunity factor is based on the observation of situational constraints that works as gating factors by inhibiting the ability to engage in reflection even when motivation is high. Time pressure is the most studied gating factor, but other factors, e.g. mental overload, and ego depletion have similar effects (Baumeister, Bratslavsky, Muraven & Tice, 1998). In recent work on the reasoned action approach (Ajzen & Fishbein, 2000) the factors of motivation and opportunity are partly incorporated.

The mode model challenges the orderly left to right organization of the elements in the TPB by introducing situational constraints and available cognitive resources as variable factors impacting the formation and (temporal) stability of intentions. More generally the MODE model points to the relevancy of considering the nature of the cognitive processes involved in specific behavioral choices.

Attitude accessibility

Research on attitudes accessibility points to the importance of how prominent a certain attitude or belief is in memory. It was found that both perception of the target behavior and the attitude-behavior relations were moderated by attitude accessibility (Fazio & Williams, 1986). Attitude accessibility is affected by properties of prior experiences i.e. proximity in time, tangible involvement and associated affect (Fazio & Zanna, 1981).

A travel related example of the effect of tangible involvement on attitude is reported by Rose & Marfurt who investigated the long-term effect of a one day event promoting bicycle commute (Rose & Marfurt, 2007). Five months after the event 80% of first time riders responded that the event had positively impacted their attitudes towards cycling and 57% of respondents reported that it had impacted their behavior (Response rate: 66%).

From prediction to persuasion: The influence of social, cognitive and spatial framing on behavior

Eleven of the included articles test or discuss the utility of theories of persuasion in impacting travel behavior.

The fact that behaviors can be impacted by framings, social sensitivities and contextual cues has been highlighted in the past decades. Chatterton & Wilson offer a historic review of the centralized efforts in the UK to develop a set of universal methods to influence behavior in largely automatic ways (See Dolan 2012 for a description of methods). In this approach behavior is treated as something that can be controlled from outside of the individual through tailoring of interventions based on social psychological mechanisms (e.g. Community-based social marketing (McKenzie-Mohr, 2000) and cognitive heuristics (e.g. behavioral economics) and thereby escape the need for attitude change.

The theory of social facilitation (Allport 1924) proposes that the actual or imagined presence of others impact behavior in various ways, one of them being a strengthening of compliance with normative rules. In short public behaviors tend to show a higher degree of compliance with perceived social norms than private behaviors (Kelman, 1958). More recently these effects have been utilized in software applications designed to support the willpower of individuals through public announcements of goals and progress (Thaler & Sunstein, 2008).

A somewhat similar approach can be found within the “nudging” toolbox presented by Thaler and Sunstein (2008) in their book on the implementation of libertarian paternalism methodologies to improve behavioral decisions. Thaler and Sunstein propose the use of a judicious design of choice architecture. Choice architecture describes the way in which decisions are influenced by how the choices are presented. It is in arranging the choice architecture in a certain way that individuals can be “nudged”, or gently pushed, to behave in a certain way. The nudging approach has received considerable attention in recent years and is largely built upon the previously mentioned work by Kahneman & Tversky (1982) on heuristics and biases, which in turn forms the theoretical foundation of the prospect theory (Kahneman & Tversky, 1979), decisively one of the most influential contributions to contemporary behavioral economics research. In 2002 Kahneman was awarded the Nobel Prize (economics) for this work.

Examples of behavioral change through changes in choice architecture vary greatly: putting parking lots further away from the entrance than the bike racks, or seeking out appropriate moments to confront people with essential information that would normally be rejected if presented under less favorable circumstances. A much-debated example is the Opt-in or Opt-out method of determining organ donation consent.

The perspectives for applications are obvious and the mechanisms described are relatively limited in number, despite this the results have been mixed. In a review of the evidence conducted by the UK House of Lords Science and Technology Committee, the following was concluded with regard to the use of non-regulatory (nudge-like) and regulatory interventions: “The evidence supports the conclusion that non-

regulatory or regulatory measures used in isolation are often not likely to be effective and that usually the most effective means of changing behaviour at a population level is to use a range of policy tools, both regulatory and non-regulatory. Given that many factors may influence behaviour, this conclusion is perhaps unsurprising.” (Science and Technology Select Committee, 2nd Report of Session 2010–12: “Behaviour Change”).

Detaching behavior from subjective deliberation in order to speed up transition to more sustainable ways is in the light of slow progress a compelling idea; it is though in sharp contrast to some theories of long term global transition pointing to deliberation and participation as a precondition to the negotiation of viable paths to sustainability (Gollagher 2013; Dryzek 2013).

Behavioral complexity

The second main criticism of the attitudes approach regards the imbalance between research on psychological factors and research on behavior factors. The articles reviewed here are symptomatic of this imbalance as the behavior aspect of the attitude-behavior correspondence perspective is not discussed in any of the articles on attitudinal factors. In the included articles adopting different theoretical offsets only five (Schmitt, 2013; Chatterton & Wilson, 2014; Nyblom, 2014; Aldred, 2014; Line 2010) discuss behavioral properties of the actions involved in current or target behavior.

The need for a conceptual framework for the categorization of behaviors seems long due. Any marginally interested observer will realize that not all behaviors are equally predictable and not all behaviors can be targeted using one universal model of behavioral change. The effect of behavior type on prediction in TPB is confirmed in a meta-analysis of health behavior studies (McEachan et al., 2011).

Johnson and Boynton has proposed a behavioral complexity variable, and found that as complexity increases, the predictive power of attitudes decreases, with more strongly held attitudes showing the greatest drop. The authors point to three possible explanations; Firstly simple behaviors can be expected to be more spontaneous than more complex ones, leading to a weaker attitude-behavior relation; secondly more complex behaviors can be expected to be more difficult to control. If there are many sub-behaviors necessary to enact some behavior, then attitudes, norms, and control over the sub-behaviors are more likely to vary. To the extent that these factors are in conflict, execution of the target behavior will be less likely (Johnson and Boynton 2010); A third proposed way to operationalize behavioral complexity is to consider the number of people involved in the behavioral choice. This parameter has not often been included in the attitude-behavior research. Even in the exploration of sexual behaviors such as condom use where the behavior is by definition impacted by more than one person the implications for the attitude-behavior relation has not been discussed (Johnson and Boynton, 2010). This omission seems contra-indicated when considering evidence from health promotion, showing that the support and active cooperation from reference group members are essential for the execution of intended health preserving behaviors (Kulik & Mahler, 1993).

Recently Chatterton and Wilson have proposed the “four dimensions of behavior” framework (Chatterton&Wilson 2014) which is a tool for characterizing behaviors to help design better interventions. The stated purpose of the model is to open up thinking about behavior change and avoid individualistic framings by treating behaviors as observable actions that can be described and categorized without inferring causes, influences or even assumptions about behavior as a unit of enquiry. Based on the described scarcity of research on behavior determinants of attitude-behavior consistency the idea of

identifying structural attributes of actions as a component in behavioral change intervention comes across as a necessary and timely step.

Persuasive technology: insights from a frontier

One of the areas where behavioral change initiatives have had the greatest impact is in the field of persuasive technologies where new opportunities have emerged with the development mobile devices. On the topic of behavioral complexities B. J. Fogg writes the following: "In real-world design [...] products that require people to learn new things routinely fail. Instead, to increase a user's ability, designers of persuasive experiences must make the behavior easier to do. In other words, persuasive design relies heavily on the power of simplicity. A common example is the 1-click shopping at Amazon. Because it's easy to buy things, people buy more. Simplicity changes behaviors." (Fogg, 2009)

Fogg makes another notable observation "Simplicity is a function of a person's scarcest resource at the moment a behavior is triggered. As researchers and designers of behavior change, we should seek to find what resource is scarcest for our audience: Is it time? Is it the ability to think? Is it money?" (Fogg, 2009). This view is in accordance with the perspective of limited temporal stability of intentions, with an emphasis on situational factors as well as with the perspective of situational limitations in or depletion of cognitive capacity for decision making and information processing.

The dominant persuasiveness of direct experience and experiential feedback

The third major objection to TPB as a complete theory of behavior regards its linear structure. When working to achieve shifts towards more sustainable behavior the general goal is a permanent change in behavioral patterns and not just one incident of new behavior. If new behaviors demand prolonged effort initial intentions may be ineffective in maintaining new behaviors.

The research on operant conditioning offers insights on how past experiences about outcome influence future choices. In 1905 Edward Thorndike published The Law of Effect, one of a very limited group of behavioral phenomenon to sustain the status of a scientific law. It states that a pleasing after-effect strengthens the action that produced it. The accumulated research on learning from consequences during the following decades allowed R.J. Herrnstein to formulate the matching law (Herrnstein 1961) that quantifies the relation between rewards and behavioral choices. According to the matching law, choices are distributed according to rates of reinforcement for making those choices. Basically the matching law states that when more behaviors are possible, behaviors that are not reinforced will with time and repetition be supplanted by behaviors that are. These fundamental principles still hold even if the mechanistic tone of the early researchers has been replaced by more holistic understandings (McDowell, 2005; Schneider, 2012).

In the work of Ajzen and Fishbein attitudes are conceptualized as a function of a person's salient behavioral beliefs, which represent perceived outcomes or attributes of the behavior. Following expectancy-value conceptualizations (Peak, 1955), the model quantifies outcomes as the multiplicative combination of the perceived likelihood that performance of the behavior will lead to a particular outcome and evaluation of that outcome (Connor, 1998).

Despite dissimilarities in terminology the importance attributed to perception of prior outcome as a key determinant of future behavior is shared by both theoretical traditions and points to the relevance of considering how experiences formed by engaging in target behavior will affect future beliefs and intentions.

The predictive power of intention is shown to deteriorate with the amount of time between assessment of intention and observation of behavior presumably due to changes in intentions caused by intermediate events (Sheeran, Orbell & Trafimow, 1999). Correspondingly attitudes that are stable over time fare better as predictors of behavior than less stable attitudes do (Connor, Sheeran, Norman & Armitage, 2000). Attitudes based on direct interaction with a given object or behavior are more stable than attitudes based on secondhand information (Doll & Ajzen, 1992) and predict later behavior better than attitudes based on secondhand information (Fazio & Zanna, 1978; Regan & Fazio 1977). In other words successful persuasive measures may lead to direct experience with the target behavior. This experience is evaluated by the individual in terms of perceived outcome and leads to changes in the subjective foundation of attitudes and intention, which will likely make these stronger and more stable than attitudes based on persuasive information and which will affect future rates of target behavior.

In accordance with the law of effect Schmitt, Currie & Belbosc found that first trip experiences significantly correlated with subsequent transit usage for travelers with access to a car (Schmitt et.al, 2014).

The valence of perceived outcome will rely on different aspects of the experience including whether the objective of changing was in fact met. If no signs of progress are available the effort of behavioral change might remain unrewarded which according to the learning principles described above will pose a risk to the upholding of new behaviors. There are numerous described factors that have an influence on the effect of reward on behavior. Contextual factors play an important role in the recognition of situations where a given behavior has previously proved successful and delay of a reward decreases the power of that reward dramatically (Thorndike, 1932; Schneider, 2012).

The specific environmental effect caused by alterations in the travel pattern of specific individuals will be untraceable. This means that regarding the overall goal of sustainability more often than not no feedback is available on goal progress. In some cases effective vicarious goals can be put in place by introducing strong incentives (e.g. road pricing), by a keen emphasis on moral imperative (e.g. Community based social marketing) or by intrapersonal motivation (e.g. self-identity) but this cannot convincingly blur the fact that in the case of long-term sustainability goals the intrinsically rewarding effect of success over failure is generally not working to consolidate behaviors.

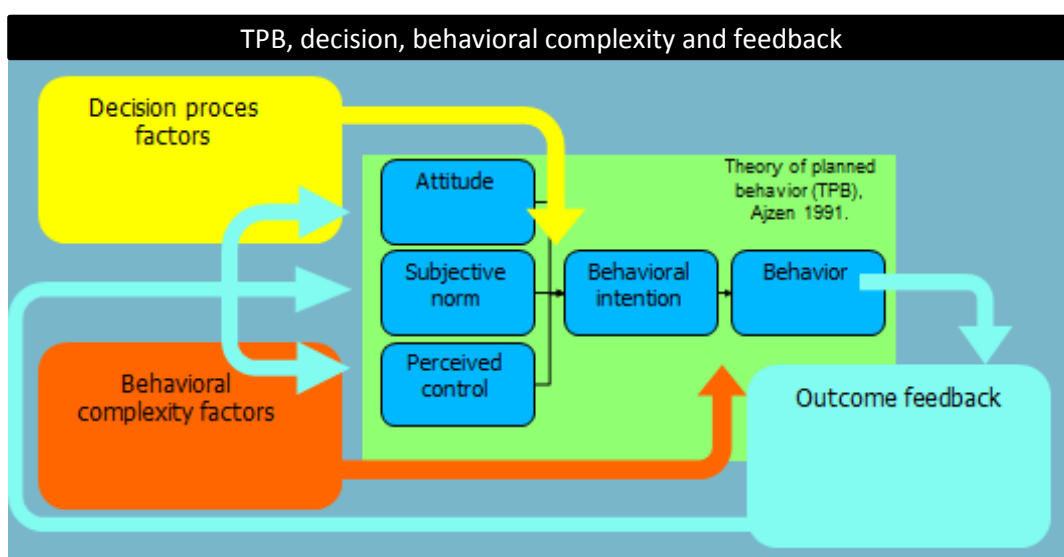


Figure 1: A first sketch of an operational framework

Operational framework

In this section an attempt will be made to combine the theoretic and empiric contributions presented in the first section in a conceptual framework suitable for evaluation of the behavioral aspects of interventions that seek to stimulate sustainable behaviors. The framework consists of four factors, each of which is further defined by two or three indicators (Table 2).

The basic idea of this framework is to seek to operationalize a view where the intentional factors of behavior are enhanced by factors related to the cognitive process of decision making, description of behavioral complexity/simplicity and outcome feedback. The methodological premise of the model is that different categories of information can inform on the adequacy of a given intervention design or policy proposal from the view point of transport consumers. The categories proposed build on the findings presented in the first section as diagrammatically sketched in figure 1: Decision factors are primarily impacting the formation of new intention; behavioral complexity is primarily impacting the intention-behavior relation and outcome feedback loops back to the antecedents of intention.

Factor	Indicator
Behavioral properties	<ul style="list-style-type: none"> • Target behavior properties • Entanglement • Autonomy
Decision process	<ul style="list-style-type: none"> • Criticality • Gating pressures • Frequency
Behavioral intention	<ul style="list-style-type: none"> • Favorable subjective norm • Favorable attitude • Perceived control
Outcome feedback	<ul style="list-style-type: none"> • Strength of feedback • Feedback delay

Table 2: Operational framework

In the following the proposed factors and indicators will be discussed.

Properties of behavior

The first category in the model is behavioral properties. The input is a qualitative exploration of the target behavior as it is unfolded in the context of related practices. Many scholars of physiology, neurology and psychology have pointed to the primacy of movement (Sheets-Johnstone, 2011), which is perhaps the most basic of all biological strategies. Still most of the time to most people, movement - be it in the form of railway transportation or in the form of bike riding - is primarily an instrument and not a goal per se. If the driving of the car is the primary goal – proposing a modal shift will make no sense. If driving the car is primarily a means to an end, proposing a modal shift will only make sense to the extent that the individual is able and willing to reevaluate the strategy, the goal or both – in essence engage in the implicit or explicit formulation of attainable and attractive (given the options) alternatives. In this case treating the mobility behavior as a standalone behavioral entity will violate the internal logic of the phenomenon observed.

Based on the perspective of behavior complexity as a moderating factor of the attitude-behavior relation three analytical categories are offered to “target behavior properties”, “entanglement” and “autonomy”.

The first analytical category, Target behavior properties, regards the “what, where and when” of current practice. “The second analytical category is termed “entanglement” is grounded in practical experience with behavioral change interventions. More often than not the behavioral complexity is embedded in social and situational complexities. In naturalistic settings many behaviors seem to be entangled: “I cannot exercise before two o’clock because I have to pick up Diana because I need her to return some books to the library for me tomorrow and she will not be home when I come back” etc. In other words: the systemic consequences of a new behavior can pose a challenge and increase the effort required to perform a relatively simple behavior. This entanglement category is thought to elaborate on how the target behavior is performed and how it is embedded in other elements of life. Further it should investigate how change in the target behavior is expected to impact the planning and execution of other behaviors or conflict with other goals or norms.

The third indicator included in the complexity factor is “autonomy”. The autonomy indicator is thought to describe ways in which changes in the target behavior require (formally or informally) the corporation or accept of other individuals, groups or institutions.

Decision process

The “decision process” factor deals with attributes of the decisions needed to engage in a given new behavior. The variables in this category are based on the MODE-model theory, on habit research by Wood et.al. (2005), and on ego depletion theory (Baumeister et.al, 1998). The decision-factor describes perceived importance and properties of the decision-making context. Properties that according to theory, are indicative of how likely it is that travelers will invest time and cognitive effort in the planning and execution of new behavior.

In the MODE model the “motivation” construct refers to the motivation to reduce the risk of invalidity with regard to the decision and not the motivation for engaging in the behavior that is being evaluated. To avoid confusion when incorporating the insights from the MODE model (Fazio 1990; Olson & Fazio 2009) into a broader framework, the “motivation” construct of the MODE model is replaced by “Criticality” – i.e. a indication of perceived relevance and assessment of the potential consequences that could be the result of a wrong or inadequate (non)decision.

For the same reason as for the “motivation”-construct, the gating mechanism termed “opportunity” is also renamed. In the framework presented here a variable is included termed “gating pressures”. The gating pressures variable describes the situational presence of factors that is expected to inhibit deliberate processes necessary to maintain new behavior: short time, ego depletion or mental overload, i.e. in plain language: stressors.

Based on the research on habit formation and decision-making presented in the earlier sections a measure of the frequency of decisions that maintains, supports or undermines the target behavior is included. To illustrate the practical implication of this measure, consider the following example: the decision to sell ones car has a different profile on the decision frequency variable than a decision to use the car less. In the first case the decision is made at one point in time and the consequences of this decision impact future mobility behavior without reactivating the context of the initial decision. In the second case, the case of intending to use the car less, the decision must be revised for every new trip, impairing habit formation and thereby putting strain on the decision-making system and in turn on the cost-benefit ratio of the behavior in general.

With regard to behaviors that are primarily based on sequences of mundane motor actions that are highly automatized like operating a car, a behavioral change that relies on frequent deliberate modifications of this behavior like the implementation of eco-driving principles, will from this perspective be expected to face a challenge due to the many operational decisions involved. A second challenge would be to maintain the appropriate level of focused attention as highly automatized behaviors predominantly operate outside the scope of attention (Kahneman, 2011). This is the case even when a deliberate effort to keep attention focused is initially deployed (Charlton & Starkey, 2011). Automatized behaviors are predominantly modified by perceptual feedback rather than cognitive cues (Crossley et.al. 2012).

A high value on the frequency variable describes situations where decisions are necessary at an operational level (i.e. ongoing when engaging in the target behavior). A medium value describes a situation where choosing between alternatives is a part of every occurrence of the behavior: bike or bus? Go or stay? Etc. A low value would be decisions that are strategic in nature and are only made once or very seldom, like moving to the city or work out of your home.

Behavioral intention

The behavioral intention factor measures the population's intention with regard to a given new behavior. It equals the TPB with the exception that the TPB questionnaire is informed by the qualitative explorations of current practice as well as assumptions about the new behavior and the consequences of change that come from the first two categories, i.e. behavior properties and decision factors.

Outcome feedback

The outcome feedback factor refers to feedback regarding the outcome of change. If the driving goal tied to the target behavior is reduction in CO₂ emissions and the behavior proposed is modal shift (bus to bike) then this factor should describe the level of feedback on the consequences of the new behavior on CO₂ emissions. If the driving goal tied to the same target behavior is a lower resting heart rate then this factor should describe sources of feedback with regard to changes in heart rate.

The first indicator included is 'feedback strength', and is thought to be an aggregate of availability and likely impacts of the feedback on future motivation – in essence: high, low or no reward. As not all behaviors are automatically followed by an observable change that can be attributed to the performed behavior it is often the case that the provision of feedback depends on the inclusion of activities that measure and feedback the output. The second indicator included is 'strength of reward' feedback delay, as remoteness in time will decrease the power of the feedback and can reduce motivation.

Application of operational framework

The operational model described above is thought to be useful in the design of interventions, where the analysis of the behavior embedded in other practices as well as attitudinal factors can serve as a tool to identify constraints and leeway with regard to change and allow adjustments in intervention design.

Regarding the ambition stated in the introduction, i.e. to specify an informed eclectics approach, it is perhaps even more interesting to pursue the possibilities of informing policy decisions. As a case example of such an application the implementation of a road-pricing system will be briefly discussed.

Please imagine that 100 families have volunteered to participate in a study of the implications of a roadpricing system for families or households living in varying vicinities of a major city.

To gain knowledge about the four factors of the model a five step method is necessary:

- Interviews about the coordination of daily activities (Behavior properties: What, where and when)
- Presentation of a road-pricing scenario to prompt assumptions and ideas about consequences, options (entanglement) and negotiation of solutions (autonomy) within the frame of their daily travel
- Daily coordination of activities – now in the context of a road-pricing scenario: A story about the new “what, where and when” is co-developed (Decision properties and potential situational stressors)
- Three different feed-back options are offered to prompt descriptions and assumptions about possible reactions to costs and gains (feedback strength and delay)
- Development of TPB questionnaire: Based on interviews possible behavioral responses and salient beliefs are identified. A questionnaire is developed for each behavioral response to quantify attitudes, subjective norm and perceived control regarding that particular option, e.g. avoiding peak hours or use public transport.

The output of the study would contain information about behavioral intentions as well as information about possible weaknesses in design and different paths mediating the effects on driving. In case of a field experiment with feedback on actual driving patterns, follow-ups could track development in strategies, gating pressures and attitudes.

Conclusion

Theories and research on individual underpinnings of behavior have a rich evidence base that is valuable for the implementation of more sustainable ways of living. The applications of this knowledge within transport suffer from limitation stemming in part from methodological weaknesses. Generally few theoretical perspectives have been employed mostly focusing on psychological determinants of behavior while the properties of the behaviors involved have received practically no attention.

One way of broadening the perspectives on behavior and behavior change is by calling for qualitative accounts of travel in practice. By combining qualitative analysis and the conceptual structure of well documented theories of human behavior the validity of quantitative measures of attitudes can be strengthened and explorative research is offered a fairly open analytical frame grounded in observations of behavioral mechanisms across contexts.

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