Do We Choose What We Desire? – Persuading Citizens to Make Consistent and Sustainable Mobility Decisions

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Abstract. A dilemma in urban mobility with tremendous effects on citizens' wellbeing is the unconscious antipode between their short- and long-term goals. People do not anticipate all consequences of their modal choices and thus make decisions that might be incoherent with their desires, e.g. taking their own car due to convenience but causing a congested city. Omnipresent Information Systems on smartphones provide the necessary information and coordination capabilities to support people for sustainable and individually coherent mobility decisions on a mass scale. Building upon extant work in travel behavior and social psychology, a framework is proposed to coordinate research efforts in the development of persuading measures for sustainable mobility decisions. This framework accounts for user heterogeneity, motivation and wellbeing as influential dimensions in the mobility decision process. Tied to social influence the derived measures contribute to a behavioral change in people's mobility behavior leading to a higher wellbeing level in urban areas.

Key words: Mobility behavior, Wellbeing, Modal Choices, Advanced Traveller Information Systems, Persuasive Technology, Social Influence

1 Introduction

Cities connect people and impact their lives [1, 2]. By now 54% of the world's population live in cities, generate 80% of the world's GDP, cause 70% of the world's CO_2-emisson, and consume 66% of the world's energy [3]. Facilitating human interaction in time and space, cities are places where people search for opportunities, money, and a better life [4]. This is not restricted to economic measures but comprises myriad activities to satisfy heterogeneous human needs [5–7]. Following Ben-Akiva [8] the pursuit of "a better life" is maintaining and enhancing 'happiness' (subjective wellbeing). And since not every need can be satisfied at a single place people need to be mobile to move towards their desired destination.

Cities are 'complex interdependent systems of infrastructure, economic, and social [networks]' [2]. Because of this interdependency citizens' mobility behavior impacts how a city looks, how it changes, and how well people feel inside of it. Considering limited space inside a city, growing mobility demand, and a habitual behavior towards

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using a car results in the conflict between short-term individual interests, e.g. single car usage because of convenience, and long-term collective interests, e.g. a non-congested and non-polluted city [9, 10]. Today's technology – with omnipresent smartphones and advanced traveller information systems (ATIS) like ridescout[1] or moovel[2] – purport to provide a comparable level of mobility and convenience. Combining diverse transportation modes in a mobility chain matching our preferences [11], they can make individual car use and the related problems thereof obsolete. Chin and Larsen [12] demonstrate that intelligent demand coordination in a communicating shared car fleet can provide the same level of mobility with a third of the present number of cars. Even though these solutions for a better life in cities are available, it is difficult to convince people to use such ATIS and even more to change their mobility habits permanently [13–15]. While classic financial incentives, e.g. free transportation for one month, are successful in breaking the car habit and introduce new technologies, they are not suitable as long-term incentives [16, 17].

Drawing upon socio-psychological theories and tying up with Stibe [18] a framework is proposed to identify measures that are capable to induce individual coherent and socially desirable mobility behavior by leveraging powers of social influence. Using motivation and subjective wellbeing as the framework's main dimensions the underlying literature and theoretical concept investigating mobility behavior are exposed in section 2. While section 3 describes the framework in detail, section 4 concludes and gives direction to future work.

2 Related Work

2.1 Mobility Decision Chain

The question '*Which kind of person is likely to choose what transportation mode under which circumstances?'* is complex and still requires more detailed studies [5, 19]. However, such insights are indispensable developing measures that are able to induce desired behavioral change [14, 20]. Investigating the underlying "mobility decision chain" enables the identification of levers that can be used to influence this decision. According to Ben-Akiva [8] all activities are planned and undertaken to satisfy various human needs so as to maintain and enhance subjective wellbeing as the ultimate goal.

Maslow [6, 7] attempted to define these multifaceted needs hierarchically. Though controversial, the ability to transfer his observations to the context of personal mobility a basic differentiation into economic and (recently) non-economic related needs is observable [21, 22]. Examples for the economic related needs are time and cost [23, 24] and for non-economic related needs metal effort, comfort, and flexibility [11, 25, 26].

[1] http://www.ridescoutapp.com
[2] http://www.moovel.com

Subjective wellbeing (SWB) refers to people's cognitive and affective evaluation of their lives' quality [27]. As a 'holistic composition' SWB encompasses individual related pleasant affects (e.g. happiness) and unpleasant affects (e.g. stress) as well as to the social position related life satisfaction (e.g. desire to change life) and domain satisfaction (e.g. role at work, recognition in one's group) [28]. Considering the hierarchical aspect one can distinguish between subjective wellbeing on an individual level, e.g. enjoying a safe financial position, and a communal (or even pro-social) level, e.g. living in an equal society.
Vallerand [29] operationalizes this influencing chain between needs as the origin and SWB as the goal in his Hierarchical Model of Intrinsic and Extrinsic Motivation. Therein social factors – on a global, contextual, and situational level – affect hierarchical levels of motivations over mediators and imply consequences on affects, cognition, and behavior. Conceptualizing personal characteristics as mediators, e.g. psychometric traits, competences or modal preferences, underpins the fact that motivational measures have to be consistent with the heterogeneous requirements of each user. Transferring Vallerand's [29] model to the mobility context provides a higher granularity over the factor's influencing the mobility decision. This is in line with recent mobility behavior studies emphasizing that clustering user groups according to individually characteristics, e.g. psychometric measures and habitual behavior, has higher predictive power than pure socio-demographic clustering [5, 21, 30].

2.2 Theory of Planed Behavior and extensions

Besides the mobility chain approach Anable [5] points out that many approaches orientate towards the Theory of Planed Behavior (TPB) [31] and their decomposed extension (DTPB) [32] to explain choice of transportation modes and thus individuals' mobility behavior. The DTPB combines intention and innovation research. It more completely explores the dimensions of subjective norms (i.e. social influence), attitudes (i.e. ease of use), and perceived behavioral control (i.e. self-efficacy) by decomposing them into specific belief dimensions. The innovational aspect makes it interesting for the case of the upcoming ATIS technologies. Providing valuable insights for the incentivizing measurement development they neglect to account for habit, a factor that has been proved to be highly influential in the context of mobility decisions [13, 20]. The UTAUT 2 model by Venkatesh et al. [33] aims at explaining the acceptance and usage of technologies. Established in the field of Information Systems (IS) it successfully explains a higher percentage of variance compared to TPB and DTPB in the consumer sector. Since the ATIS is the foundation for intelligent demand coordination and thus sustainable model choice recommendation UATUT 2 is eligible to provide further insights. In addition to habit it also comprises the constructs performance expectancy, social influence, facilitating conditions, hedonic motivation, price value and experience.

2.3 Social Cognitive Theory

Previous models cede social influence (SI) a crucial role in explaining the transportation mode decisions. It is further easy to implement into IS and has low costs compared to financial incentives, so it seems valuable to focus on social influence as a main dimension to derive behavioral changing measures. This is in line with the research by Stibe [18] who suggests it as a promising approach for behavioral influence on a mass level. A major source for SI related incentives is the Social Cognitive Theory (SCT). It is one of the most powerful theories explaining human behavior – especially when it comes to mass scale influence, see [34]. It states that an individual's behavior is related to their observations of others within the context of social interactions, experiences, and outside influences. Thereby the notion of consequences of other peoples' actions affects subsequent behaviors [34, 35]. Since the observation can take place in real or in a virtual environment [36] properly designed ATIS – as persuasive technologies – can become very effective for inducing behavioral and attitudinal changes in novel socio-technical contexts [18]. Relevant social influence aspects are social learning (SL) [34], social comparison (SC) [37], normative influence (NI) [38], social facilitation (SF) [39], cooperation (CR) [40], competition (CT) [41]), and recognition (RE) [29].

3 Measurement framework

In order to test the validity and influence of the previous constructs on mobility decisions 25 explorative expert interviews have been conducted and analyzed following the guidelines by Klein and Myers [42]. The findings have been used to develop and conduct a pilot study with 408 business students of research pool at a German university. The online-survey investigated their motivations for using an ATIS; the attributes determining their quality perception; typical mobility patterns; as well as their socio-demographic data, and psychometric measures. According to the processes and quality criteria suggested by MacKenzie et al. [43] and Chin [44] the constructs have been evaluated using a SEM-PLS approach. Thereby following results attract particular attention: 1) Motivational constructs have a significant effect on the intention to use an ATIS, 2) the motivational constructs can be grouped into categories of economic and non-economic factors 3) distinctive cluster of user groups can be derived based on their Technology Readiness Index 2.0 [45] and their mobility habits, and 4) the different cluster reveal significantly different factor loadings over the constructs influencing the intention to use an ATIS. Connecting these findings with the insights out of wellbeing and SI research results in the conceptualization of a framework for a systematic derivation of measures that are capable to persuade citizens to make consistent and sustainable mobility decisions, see Fig. 1.

The framework consists of motivation and wellbeing as the main dimensions with influence on mobility behavior and modal choices. Therein the distinct measures derived from the area of social influence to incentivize sustainable mobility behavior can be sorted. While motivation ranges from economic (E) to non-economic (NE), communal (C) and individual (I) goals have been chosen as scale-ends for wellbeing.

Accounting for the user heterogeneity the surfaced areas inside the framework indicate a set of measures that is particularly effective for a specific user type. This fosters motivational measures to be coherent with each user-type.

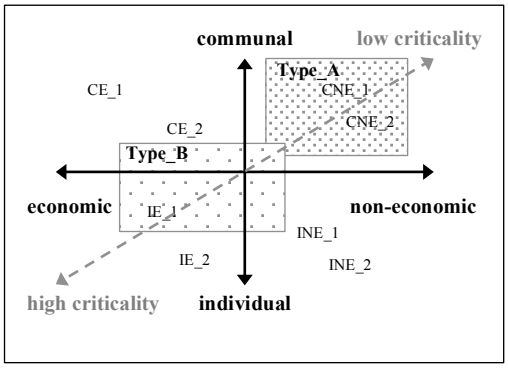

Fig. 1. Measurement Framework

For example, user of Type A is more driven by non-economic altruistic incentives, while Type B is more likely to respond to individual financial benefits. Using the portfolio of SI for potential levers this framework can be used to determine and structure user-type specific measures to incentivize the distinct user types to a sustainable mobility behavior. Thus Type A can be motivated to make a sustainable mobility decision by providing the measure that 'Only 2493 bike shares are required to ramp the fleet up!' (derived from CR), while 'You can safe US$ 30 and 180 minutes compared to your colleagues each week by using a modal mix of bike and underground!' (derived from SC) motivates user Type B.
The expert interviews further indicate that the more critical a desired activity at the destination is perceived to be, the more a person tend to refer to economic self-related measures for his decision. In other words: Stress reduces the tendency to altruism. To account for the fact the red line comprises influential circumstances, which are in this case represented by the dimension of 'criticality'.

4 Conclusion and future work

Citizens may make mobility decisions that might be inconsistent with their goals. Building upon research in mobility behavior and technology acceptance a pilot study reveals that motivation and wellbeing have a significant impact on peoples' mobility decisions. Both dimensions are main components of our proposed framework for investigating measures that incentivize people to make sustainable and individually coherent mobility decisions. Using the theory of social influence to derive these measures we provide a new perspective to current research in the area of mobility behavior. Considering the omnipresence of smartphones and ATIS technologies, where derived measure can be easily implemented, this approach seems promising when it comes to mass scale persuasion towards sustainable mobility behavior. As a

starting point for future research in this complex area our framework helps coordinating research efforts while investigating the wide field of possible measures.
Even providing well-founded hints surveys base on peoples' self-evaluation and inherently bear the risk of disclosing unconscious influences [46, 47]. As stated by Nisbett and Wilson [46] people typically lack insight into their own mental processes that can lead to the misreport of casual influences. Examples are the unawareness of the cues relied upon to make a decision and the weighting and integration of cue information [47–49]. Therefore future research requires laboratory as well as field experiments to investigate the behavior triggering determinants and the motivation measures' long-term effects on users' behavior. A proper experimental design will also enable to uncover the assumed effects' strengths in the mobility decision process.
The pilot study has been conducted with a relatively homogeneous user group. Therefore the next steps require a cross-sectional representative survey in urban and non-urban areas to gather a wider database of peoples' psychometric characteristics, their typical mobility behavior, and their stated motivations to do so. Since cities diverge in their infrastructures across countries a multinational survey is suggested. This is because the available infrastructure and socio-economic environment of a city have a high impact on the prevailing mobility cultures. Based on this data an optimization of behavioral stable user groups with distinct preferences will be generated, which enables a specific measurement development for each group. Since the user-type identification has to be seamless to be applicable on mass scale the automation of type detection via geo-spacial data in combination with environmental information will be an important issue in the future research agenda. Altogether this research will help people to make better mobility decisions and thus increase the level of wellbeing in cities.

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