Understanding the stages and pathways of travel behavior change induced by technology-based intervention among university students

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A R T I C L E   I N F O

A B S T R A C T

We describe how a mobility behavior change support system, called Blaze, is able to achieve a shift in changing the travel behavior of university students. We identify a causal pathway linking the effect of the technology intervention to its behavioral outcome through the mediation of a number of variables. The stage model of self-regulated behavioral change (SSBC) is used as a theoretical framework to understand how the outcome may be influenced by determinants (conceptual theory), and how the determinants may be activated by different intervention types (action theory). Using longitudinal data from a social experiment conducted over a month at a university in the Philippines, we test three hypotheses regarding the mechanism of change induced by Blaze. Our main findings suggest, in agreement with SSBC, that travel behavior change is achieved by a transition through a temporal sequence of four stages: predecision, pre-action, action and post-action. In an extension from SSBC, we further distinguish post-action depending on whether the behavior is on initiation or under maintenance. We observe that the former (initiation) is characterized by instability (either relapse or progress), while the latter (maintenance) by stability. Moreover, we validate most of the determinants of intentions as postulated by the stage model. Finally, we find that that Blaze can significantly change only the proximate implementation intention and not the more distal ones (e.g. goal and behavioral intentions). We discuss the implications of our results on the potential role of technology interventions in mobility management.

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1. Introduction

With the widespread adoption and pervasive use in society of information and communication technologies (ICT), technology-based interventions (TBI) to modify behavior, notably in the health domain, have undergone rapid development in the last decades. Nonetheless, in the domain of travel behavior modification, less advances have been made (Cohen-Blankshtain and Rotem-Mindali, 2016). Sunio and Schmöcker (2017) observed that voluntary travel behavior change programs have not yet fully taken advantage of the ICT platform, which is unfortunate since some empirical evidence suggest that TBIs can produce effects that are comparable to, or better than, approaches delivered through conventional methods (e.g. Jariyasunant et al., 2015; Bamberg et al., 2015).

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In TBI studies, researchers must establish not only the cause of behavior change, but also the mechanism of change (Dallery, Jarvis, Marsch, & Xie, 2015). That is, they must provide evidence through what processes the intervention, previously demonstrated to be effective, achieved its effects. Research on mechanisms in travel behavior change in non-technological context has been done (e.g. Thøgersen, 2009); but, to the best of our knowledge, there is none yet on the technological context. Dallery et al. (2015) and Baraldi, Wurpts, Mackinnon, and Lockhart (2014) argue there may exist significant differences in mechanisms of change between non-technological and technological contexts.

In the travel behavior change domain, two stage theories have been used to establish the mechanism of change: the transtheoretical model (TTM; e.g. Prochaska & Velicer, 1997) and the stage model of self-regulated behavior change (SSBC; Bamberg, 2013a). Both TTM and SSBC understand travel behavior change as a transition through stages, and both also specify the various stage-specific socio-cognitive constructs or processes of change that may trigger transition to advanced stages (Bamberg, 2013a; Prochaska, DiClemente & Norcross, 1992). These constructs and processes underlying stage transitions can be used to provide insights on possible links or pathways between the interventions to the causal determinants of behavior change.

Our objective is to understand the mechanism of change induced by a TBI. The TBI used in this study is called "Blaze" (Sunio, Schmöcker, Estuar, Dela Cruz, & Torres, 2017). The present work represents one of the first studies on the mechanisms associated with TBIs for travel behavior change. In contrast, studies on the nature of mechanisms of behavior change in the health domain, including reviews, have been extensively carried out (e.g. Schwarzer, Lippke, & Luszczynska, 2011; Dallery et al., 2015).

"Blaze" comes from "trailblazers", individuals who show the way or new behavior to a larger population. In Blaze, social traces or patterns of behavior of trailblazers are provided as social information to others in order to induce behavior change. In the development of Blaze, the Stage Model of Self-Regulated Behavioral Change or SSBC (Bamberg, 2013a) is used. Analysis shows that Blaze is effective in inducing a positive change across a wide range of indicators, as specified by the stage model: car use reduction, stage membership and intentions (Sunio, Schmöcker & Estuar, 2017).

The overall goal of Blaze is to persuade the individual to use shared transport modes or services that result in higher per vehicle occupancy. In many cases, this means reducing use of cars or frequency of drive-alone trips, and instead taking shared rides, including public transport. Blaze embeds SSBC which focuses not only on the observable behavioral change, but also on the latent psychological change, which can be measured via change – better progression – in stage membership or in the set of social/cognitive variables. Hence, Blaze also aims to influence individuals to progress from early to later stages.

The structure of this paper is as follows: after this introduction, we provide a theoretical background and a brief overview of Blaze in Section 2. In Section 3, we present the three main hypotheses on the conceptual and action components of the mechanism of change. In Section 4, we present the methodology, including the field experiment conducted, the survey instruments used to measure a number of variables, and the analytical methods. In Section 5, we present our results on the conceptual and action components. We discuss our results in Section 6. In Section 7, we present the limitations and implications of our results, and discuss areas for future work.

2. Theoretical background and development of TBI

The Stage Model of Self-Regulated Behavioral Change (SSBC) is used to guide the systematic development of our technology-based interventions within Blaze. Using SSBC as a blueprint, we develop interventions targeting and activating the determinants in the model (Sunio et al., 2017). In what follows, we present the stage model then describe Blaze.

2.1. Overview of the stage model of behavior change

The SSBC theory posits that behavioral change is achieved by a transition through a temporal sequence of four stages: (I) predecisional, (II) pre-actional, (III) actional and (IV) post-actional. Transition to the next stages is marked by formation of goal, behavioral and implementation intentions. The formation of goal intention marks the individual's transition from pre-decisional to the pre-actional stage. Similarly, the formation of a behavioral intention marks the transition to the actional stage, and the implementation intention marks the transition to the post-actional stage of the behavioral change process. SSBC also includes stage-specific affective and socio-cognitive constructs. These variables, according to SSBC, influence the formation of the three intention types (Fig. 1).

In the pre-decisional stage, the individual performs the environmentally harmful behavior in a habitual way, without much deliberation. SSBC specifies the social-cognitive variables that motivate the individual to bind himself to a goal, i.e. to form a goal intention. When a person becomes aware of the negative consequences of his current behavior and accepts personal responsibility for causing harm, he may feel negative emotions. These negative moral feelings may activate his personal norm and urge him to act in accordance with his personal moral standards. At the same time, the ascription of personal responsibility may give rise to concerns about expectations of important social referents. Fear of their social disapproval may further activate his personal norm. The felt moral obligation to fulfill the personal norm may elicit positive emotions, which, together with personal norm, urge him to form a goal. Nonetheless, whether he actually binds himself to a goal depends on perceived goal feasibility. The formation of goal intention marks the individual's transition to the pre-actional stage.