Modelling determinants of walking and cycling adoption: A stage-of-change perspective

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A B S T R A C T

Shifting travel away from cars and towards more active modes has proven a formidable policy challenge. This study aims to uncover the determinants of walking and cycling adoption by applying a stage-of-change framework. Drawing on the Transtheoretical Model, this framework models the adoption of active modes as a series of stages from pre-contemplation to maintenance. Ordinal logit models applied to US data (n = 914) illustrate the importance of both observable demographic-personal and perceptual-attitudinal variables for determining stage-of-change membership. Comparing walking and cycling, the model reveals both shared variables (vehicle ownership, self-identity) and differing factors (gender, environmental spatial ability) distinguishing among adoption stages, which has significant implications for transport policy. Results indicate that a model combining both demographic-personal and perceptual-attitudinal factors has the best fit and validity, suggesting that travel behavior interventions would benefit from multivariate segmentation methods that consider an array of individual and group characteristics. This research also gives evidence of different determinants motivating change processes for cycling versus walking. Taken together, results suggest a need for tailored policy interventions to promote behavioural adoption based not merely on the specific mode selection, but also on the usage stage under consideration.

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1. Introduction

Campaigns that encourage sustainable travel and accentuate quality-of-life factors in transport policy are becoming more common in response to the fallout from car-centrism as the be-all and end-all of daily mobility (Banister, 2008; Sharples, 2017). As Voluntary Travel Behaviour Change programs continue to grow in popularity (Hiselius & Rosqvist, 2016; Hsieh, Kanda, & Fujii, 2017), there is concurrent interest in behaviour change theories that could increase program effectiveness and generalizability (Richter, Friman, & Gärling, 2011). For example, in the context of cycling, recent literature has examined the utility of Social Practice Theory (Spotswood, Chatterton, Tapp, & Williams, 2015) and community-based social marketing (Savan, Cohlmeyer, & Ledsham, 2017) as unifying frameworks for encouraging modal adoption.

Another promising concept is that transport policy should be implemented in a series of stages to reduce resistance to change and accommodate the cognitively demanding practice of breaking habits, as in the case of motor vehicle safety (Whitcomb, Askelson, Friberg, Sinelnikov, & Bukowski, 2017) or reduction in its usage (Bamberg, 2013). A well-known

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stage-based theory that could further illuminate the process of behaviour change is the Transtheoretical Model (TTM) from health psychology (Prochaska, Redding, and Evers (2008). Originally developed for the purposes of creating a holistic smoking cessation program, this model asserts that behaviour change is a process best described as a series of qualitatively distinct stages from an undesirable behaviour to a desirable one. An essential implication is that individuals in separate stages require different sets of interventions to become more ready to adopt a new behaviour (Prochaska & Velicer, 1997). The TTM has appeared sparingly in the transportation literature and in such contexts as active commuting in a campus setting (Redding et al., 2015; Shannon et al., 2006; Thigpen, Driller, & Handy, 2015), barriers and policy interventions related to cycling adoption (Nkurunziza, Zuidgeest, Brussel, & Van Maarseveen, 2012), work cycling (Gatersleben & Appleton, 2007) and awareness of the impacts of travel choices on climate change (Waygood & Avineri, 2016). More research studies are needed to verify the potential utility of the TTM as interest in psychological theory continues to expand in the field, especially given observed shortcomings of the more predominant Theory of Planned Behaviour (TPB) in addressing *behaviour change* (Gehlert, Dziekan, & Gärling, 2013). In addition, the TTM framework seems to behave differently when the focus is on refraining from past behaviour compared to attaining new behaviour (Nigg et al., 2011), suggesting the relations conjectured by the model are context-dependent rather than universal.

The focus of this research is to model walking and cycling adoption by adding to the growing body of literature exploring the role of stage-based theory to improve understanding of mobility choices and to inform transport policy. Specifically, we postulate that the stages-of-change perspective can inform segmentation approaches related to the idea of personalized mobility solutions. More concretely, there are three primary research objectives. *First*, we develop an application of the TTM that contributes to the literature by proposing (a) an original definition of the stages-of-change construct and (b) interpretations of three selected processes of change: self-reevaluation, self-liberation, and environmental reevaluation. *Second*, employing an online survey (n = 914) we examine the most relevant determinants for these change processes and hence mode adoption, distinguishing between two main types of variables, namely; demographic-personal (DP) and perceptual-attitudinal (PA) variables. Whereas the former variable class includes observable individual factors related to sociodemographic and geographic information, the perceptual-attitudinal variable class encompasses responses to Likert-scale questions representing selected internal psychosocial phenomena. *Third*, we compare the stage-of-change processes for walking and cycling adoption through the construction of three ordered logit models for each mode using (1) demographic-personal, (2) perceptual-attitudinal, and (3) combined sets of variables. The resulting odds ratios inform us of whether an individual with the corresponding characteristic is more likely to be in an earlier or later stage of adoption.

Overall, this research identifies determinants of stage membership previously not considered in transportation-related TTM applications, some of which are profoundly lacking in the travel behaviour literature in general. Moreover, our work is the first to explicitly compare how the change processes vary when different types of variables and adoption decisions are considered. The rest of the paper proceeds as follows. Section 2 reviews the relevant findings on explanatory variables targeted to illuminate the process of change from the TTM. The survey instrument and exploratory statistics are overviewed in Section 3, along with results of the factor analyses utilized to extract some of the perceptual-attitudinal variables. Section 4 presents the (partial) proportional odds model used to classify respondents into the stages of change, while results and the surrounding discussion, particularly implications for policymakers, comprise Section 5. Finally, Section 6 addresses shortcomings in the current study as well as considerations for future research, relating to both the survey data used here and the design of other data collection instruments.

2. Literature review

This section gives a brief overview of the original formulation of the Transtheoretical Model to illustrate our focus in this paper on the processes of change components. The remainder of the section details the connections between these components and selected psychological and socio-cognitive theories to explain the stage of adoption of biking and walking.

2.1. Brief overview of the Transtheoretical Model

Prochaska et al. (2008) outline four major components of the Transtheoretical Model. The (1) stages of change, of which there are (typically) five, comprise the foundation of the model. *Precontemplation* is the stage during which an individual does not foresee behaviour change within the next six months. In contrast, *Contemplation* represents the scenario where an individual is considering making a change during the same period. *Preparation* involves a reduction of this time scale to one month and might involve a recent—yet unsuccessful—attempt at behaviour change. After an individual adopts the target behaviour, he or she enters the *Action* stage. After six months, the new behaviour becomes habitual—at least to a certain degree—and thus the individual moves into *Maintenance*. An additional stage, usually referred to as *Termination*, could be utilized to describe a situation in which the individual completely removes a targeted (undesirable) behaviour. Furthermore, researchers may denote *Relapse* as the condition in which the individual reverts to an old behaviour, effectively moving from a post-action stage into a pre-action stage. The (2) processes of change comprise another model component, of which there are ten. In short, five *experiential processes* relate to a realized cognizance of the behaviour change environment while five *behavioural processes* relate to the actual practice of changing behaviour. These change processes are the least studied aspects of the TTM even though they are, in theory, determinants of the progression through adjacent stages