



Accounting for the Theory of Planned Behaviour in departure time choice



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ABSTRACT

Motivating people to change their departure time could play a key role in reducing peak-hour congestion, which remains one of the most prevalent transport problems in large urban areas. To achieve this behavioural change, it is necessary to better understand the factors that influence departure time choice. So far departure time choice modelling focussed mainly on objective factors, such as time and costs as main behavioural determinants. In this study, we derived psychological factors based on the Theory of Planned Behaviour, estimated them based on structural equation modelling, and included them into a discrete choice model. The psychological factors were measured based on an online questionnaire addressed to car commuters to the city centre of Copenhagen ($N = 286$). The questionnaire additionally included a travel diary and a stated preference experiment with nine departure time choice scenarios. All psychological factors had a significant effect on departure time choice and could improve the model as compared to a basic discrete choice model without latent constructs. As expected, the effects of the psychological factors were different depending on framework conditions: for people with fixed starting times at work, the intention to arrive at work on time (as estimated by subjective norm, attitude, perceived behavioural control) had the strongest effect; for people with flexible working hours, the attitude towards short travel time was most relevant. Limitations, the inclusion of additional psychological factors and their possible interactions are discussed.

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1. Introduction

Road traffic congestion remains one of the most prevalent transport problems in large urban areas as it decreases the attractiveness and liveability of cities. In addition, the fuel and time wasted in traffic have huge financial consequences as well as negative impacts on public health (e.g. [Levy, Von Stackelberg, & Buonocore, 2010](#)).

Congestion is related to commuting to work and a change of departure time could play a key role in reducing peak-hour congestion. A number of studies have shown that people are more likely to change their departure time to avoid congestion than to change their transport mode ([Hendrickson & Planke, 1984](#); [Hess, Daly, Rohr, & Hyman, 2007](#); [Kroes, Daly, Gunn, & Van, 1996](#); [SACTRA, 1994](#)). The question is, however, how people can be motivated for this behavioural change. To answer this question it is necessary to better understand the psychological factors that influence departure time choice. While this

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question is of particular importance for both commuting by car and by public transport, the focus of this paper is on car commuting.

So far, departure time choice has mainly been investigated from a microeconomic perspective, considering objective factors, such as travel time, arrival time and travel costs as main behavioural determinants. The basic assumption of this rational choice approach is that individuals make a trade-off between costs, travel time and deviations from their preferred arrival time in such a way that their personal benefit is maximised. Later works also included travel time (un)reliability accounting for uncertainty about the actual travel time during a journey, i.e. the unexpected delay (Arellana, Daly, Hess, Ortúzar, & Rizzi, 2012; Börjesson, 2007, 2008, 2009; Ettema, Timmermans, & Arentze, 2004; Koster & Verhoef, 2012; Lam & Small, 2001; Lizana, Arellana, Ortúzar, & Rizzi, 2013; Noland & Small, 1995; Small, Noland, Chu, & Lewis, 2000; Tseng, Koster, Peer, Knockhaert, & Verhoef, 2011). This concept, often referred to as travel time variability (TTV), is important because people might re-think their departure time choice under the condition of high travel time variability. The subjective importance of time reliability for transport choices was confirmed in a study based on Q-methodology (Cools, Moons, Janssens, & Wets, 2009).

A few studies approached departure time choice taking into account assumptions of prospect theory (Fujii & Kitamura, 2004; Senbil & Kitamura, 2004). These studies point to the importance of the decision frame: Fujii and Kitamura (2004) in particular demonstrated that the choice of more or less risky departure times depends on commuters' working conditions and position. Thereby they indirectly proved the relevance of attitudes, namely the subjective importance of arriving at the preferred arrival time for departure time choice.

An alternative research strategy to the indirect measurement of people's preferences through their choices is the direct measurement of psychological factors that are assumed to influence behaviour by standardised items. The selection of these factors should preferably be based on a theoretical model. This strategy allows for the consideration of factors that go beyond specific preferences.

The theoretical relevance of combining psychological and microeconomic perspective roots to the work of McFadden (2000) and Kahneman (2002), and has been operationalised by Ben-Akiva, Walker, Bernadino, Gopinath, and Morikawa (2002) using the hybrid choice models (HCM). During the past decade there have been several applications of HCM to different fields, including transport, but they have focused only on selected psychological factors, mostly attitudes, and the selection of these factors was not strongly theory-based. To our knowledge the only study that explicitly measured psychological factors in econometric models to explain departure time choice is Arellana (2012). He measured attitude towards being on time and towards changes in trip conditions, but finally did not include them into the departure time choice model. In the present paper we investigated potentially relevant psychological factors of departure time choice and included them into a discrete choice model based on stated preference experiments. The selection of the psychological variables was based on the assumptions of the Theory of Planned Behaviour (Ajzen, 1991) as described in the following section. In Section 3, we present our specific hypotheses.

2. Accounting for the Theory of Planned Behaviour in departure time choice

The Theory of Planned Behaviour (TPB, Ajzen, 1991) can be regarded "as a social psychological variant of the general rational choice approach" (Bamberg, 2012, p. 222). It is one of the most well-established psychological models of individual decision making. According to a meta-analysis of 185 studies it accounts for 27% and 39% of the variance in behaviour and intention, respectively (Armitage & Conner, 2001). In transportation research it has in particular been applied to explain and influence travel mode choice (e.g., Bamberg & Schmidt, 1998, 2001, 2003; Haustein & Hunecke, 2007; Heath & Gifford, 2002) and driving violations (e.g., Cestac, Paran, & Delhomme, 2011; Forward, 2009; Møller & Haustein, 2014). According to the TPB, the intention to perform a given behaviour indicates people's readiness to perform the behaviour, and it is a direct predictor of behaviour. Intention is influenced by attitude, subjective norm, and perceived behavioural control (PBC). Attitude is the degree to which the performance of the behaviour is positively or negatively valued. Subjective norm is defined as the perceived social pressure to engage or not to engage in the behaviour, while PBC refers to people's perceptions of their ability to perform the behaviour. The latter is assumed to be a direct predictor of both intention and behaviour. The lower the actual control over a given behaviour, the more the influence of intention decreases in favour of PBC. In the context of travel mode choice, research on PBC mainly focused on beliefs related to the built environment (accessibility/transport infrastructure; cf. Bamberg, 2012). Haustein and Hunecke (2007) introduced the concept of perceived mobility necessities (PMN) to more directly address how the actual living situation (e.g. complex household routines due to children and employment) and resulting perceived travel demands influence car use. While PBC and PMN are correlated, merging them to one latent variable resulted in an unacceptable model fit, which indicates that they should be modelled as separate latent variables. The differentiation between PBC and PMN is expected to also be relevant for departure time choice: beliefs about the transport infrastructure are supposed to make it more or less difficult to arrive at the preferred arrival time, while the personal living situation and related perceptions of flexibility and time pressure are supposed to make people less willing to reschedule their departure time.

Departure time choice is a complex task, which to our knowledge has not yet been explicitly studied in the psychological literature. We suggest departure time choice to be determined by three behavioural intentions that may be in conflict with each other, namely (1) the intention to arrive at the preferred arrival time – or more specifically "on time"; (2) the intention

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