Commuters' attitudes and norms related to travel time and punctuality: A psychographic segmentation to reduce congestion

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ABSTRACT

Congestion remains one of the most prevalent transport problems in big cities. As a starting point for more targeted interventions to reduce congestion, this paper suggests a segmentation of commuters. Based on psychographic factors derived from an expanded Theory of Planned Behaviour, we identify three distinct commuter segments: (1) Unhurried timely commuters, who find it very important to arrive on time but less important to have a short travel time; (2) Self-determined commuters, who find it less important to arrive on lime and depend less on others for their transport choices; and (3) Busy commuters, who find it both important to arrive on time and to have a short travel time. Comparing the segments based on background variables shows that Self-determined commuters are younger and work more often on flextime, while Unhurried timely commuters have longer distances to work and commute more often by public transport. Results of a discrete departure time choice model, estimated based on data from a stated preference experiment, confirm the criterion validity of the segmentation. A scenario simulating a toll ring illustrates that mainly Self-determined commuters would change their departure time as a response to this economic intervention, while we suggest alternative interventions for the two other segments. The results stress the need for more targeted efforts to change departure time choice and point to ways to improve the suggested segmentation approach.

1. Introduction

Congestion remains one of the most prevalent transport problems in big cities around the world. Rush-hour commuting increases fuel consumption and emissions and thereby the negative impact of motorized transport on public health and the environment (e.g., De Vlieger et al., 2000; Levy et al., 2010). Moreover, time and fuel wasted in traffic congestion comes with considerable – though hard to estimate – economic costs (e.g., Lo et al., 2016; Morris & Hirsch, 2016).

Congestion can be tackled by two changes in commuters' travel behaviour: modal shifts and departure time shifts. Measures to achieve such behavioural changes are divided into two groups: structural (or 'hard') measures and cognitive-motivational (or 'soft') measures (Vlek, 2004). The most common hard measures to reduce congestion are pricing policies that increase costs for travelling during rush hours (e.g., road pricing in city centres, public transport ticket pricing). Opposed to hard measures, which focus on infrastructure and regulations, soft measures aim for *voluntary* changes of travel behaviour, achieved for instance by information provision, awareness raising or social modelling. To develop targeted (and thus more efficient) soft measures,

knowledge about the motivations and needs of potential target groups is crucial. Therefore, the development of soft measures is advantageously proceeded by a market segmentation (e.g., Anable, 2005; Beirão and Sarsfield Cabral, 2007; McKenzie-Mohr, 2000). So far, segmentation studies and related targeted measures have mainly been developed as a basis for *modal* shifts but not for *departure time* shifts.

This paper suggests psychographic commuter segmentation as a basis for targeted measures to change departure time. We focus on *departure time choice* because individuals are more likely to change departure time as a response to congestion than to change their preferred travel mode (Bianchi et al., 1998; Hendrickson and Planke, 1984; Hess et al., 2007a; Kroes et al., 1996). We use a *psychographic segmentation* because commuters differ in the motivational basis for departure time choice (e.g., Fujii and Kitamura, 2004), which should be taken into account when trying to shift demand away from rush hours.

The remainder of this paper is organised as follows: Section 2 provides the background of this paper both on modelling departure time choice (Section 2.1) and applying segmentation studies in transport research and practise (Section 2.2). Section 3 describes the data, while Section 4 describes the applied methods of data analysis. Section 5

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presents the results in three subsections: Section 5.1 describes the identified commuter segments; Section 5.2 assesses the congruent validity of the segments based on a discrete choice model; and Sections 5.3 demonstrates to what extent the different commuter segments reschedule their departure time choice in a toll-ring scenario. In Section 6 we discuss possible interventions, the limitations of the suggested segmentation and how these can be addressed in future studies. Section 7 discusses broader theoretical and practical implications of the results.

2. Background

2.1. Departure time choice

Within the transport literature, the predominant way of modelling departure time choice is the Scheduling model (SM; Small, 1982), which assumes that individuals select their departure time as a trade-off between travel time and scheduling delay. The scheduling delay is a re-scheduling penalty that measures differences in the actual arrival time and the preferred arrival time. Previous studies have also extended the scheduling model by considering travel cost (Small, 1987), a discrete lateness penalty (Noland and Small, 1995), and travel time variability to measure reliability (Noland and Small, 1995; Small et al., 1995).

In addition, flexibility is crucial when studying departure times. Most studies only focus on the temporal flexibility of the commuting trip from home to work (e.g., Arellana et al., 2012; Börjesson, 2007; Börjesson et al., 2012; De Jong et al., 2003; Kristoffersson, 2013; Polak and Jones, 1994; Small, 1982), while Thorhauge et al. (2016a) consider the spatial and temporal flexibility of the full daily activity pattern. They found that other activities performed on the trip to work in the morning or from work in the afternoon/evening impact individuals' departure time in the morning (i.e. segments with other non-work activities in the morning, afternoon or evening are less likely to reschedule).

Apart from objective aspects, such as travel time, costs and scheduled delays, as well as framework conditions, such as fixed working hours and activity patterns, also subjective aspects, such as subjective norm, the perception of control, and attitudes are relevant for departure time choice as Thorhauge et al. (2016b, 2017) demonstrated when integrating the Theory of Planned Behaviour (TPB, Ajzen, 1991) in a discrete choice model to explain departure time choice. The relevance of subjective norm (SN) to arrive on time has also been shown by Fujii and Kitamura (2004). Both studies indicate that people who feel pressure by relevant others to arrive on time are less likely to reschedule their departure time when this may cause delays than people with lower SN. In contrast to SN, personal norm (PN) measures the intrinsic feeling of moral obligation to behave in accordance with the individual value system (Schwartz, 1977). In the context of departure time choice PN refers to the perceived intrinsic obligation to arrive on time. While PN has often been integrated in models to explain mode choice (e.g., Bamberg et al., 2007; Lo et al., 2016), the effect of PN on departure time choice has not been studied yet.

With regard to attitudes, Thorhauge et al. (2016b, 2017) have shown that people, who find it important to arrive on time, are less likely to reschedule, while people who find it important to have a short travel time, are more likely to reschedule their departure time in order to reduce travel time. Why people find it more or less important to minimise their travel time may be related to the actual living situation and complexity of daily routines. Haustein and Hunecke (2007) introduced the concept of perceived mobility necessities (PMN) to account for such effects of the actual living situation (e.g., complex daily routines due to children and employment) in transport related decisions. According to Thorhauge et al. (2016b) people with high PMN are less likely to reschedule their departure time than people with low PMN.

2.2. Segmentation in the transport sector

In market segmentation, the population is divided into homogeneous sub-groups with similar attributes (e.g., age, attitudes, values, place of residence) that are considered as or related to the motivational basis of the targeted behaviour. This approach is motivated by the aim to create more targeted and thus more efficient interventions (e.g., McKenzie-Mohr, 2000). In addition, the characterisation of population segments is easier to communicate to practitioners as compared to abstract statistical models and thus more likely to be taken up for the design of concrete interventions in the transport sector (e.g., Schubert and Kamphausen, 2006).

Segmentation approaches in the transport sector can be divided by the factors that are used as a basis for segmentation: spatial factors (e.g., Hunecke et al., 2010), socio-economic factors (e.g., Hildebrand, 2003; Ryley, 2006), psychographic factors (e.g., Anable, 2005; Pronello and Camusso, 2011), the travel behaviour itself (e.g., Böhler et al., 2006; Prillwitz and Barr, 2011) or a combination of different kind of factors. The suitability of the different approaches depends on the area of application (Haustein and Hunecke, 2013).

With regard to departure time choice, demographic factors, such as age, education, household type, and employment (white collar workers, part time workers, frequent home-worker, flexible work hours) have been found to be relevant factors (Small, 1982) as well as trip characteristics. In addition, Oakil et al. (2016) demonstrated that gender and childcare responsibilities are important factors of rush-hour commuting. A few studies used these factors as a basis for segmentation. De Jong et al. (2003) and Hess et al. (2007b) divided travellers into sub-groups based on the trip purpose. Thorhauge et al. (2016a) grouped car commuters based on their work time flexibility, their flexibility constraint across all daily trips and activities, and based on both criteria (flexibility and constraints). They found that the willingness to shift departure time is highest among people with flexible working hours and no constraints, while the willingness to pay is highest for people with fixed working times and constraints.

While segmentations based on socio-demographic variables allow for an easy identification of segment members who can then be targeted according to their specific needs, we assume that individuals with similar background variables still differ in their willingness to change their departure time choice as well as in other psychological factors that may determine departure time choice and potential behavioural change. Psychographic segmentations provide better starting points for information and communication strategies as these can be adjusted to the attitudinal profiles of the segments (Haustein and Hunecke, 2013). With regard to mode choice, psychographic segmentations have additionally shown higher predictive power than sociodemographic and spatial segmentations (Hunecke et al., 2010; Hunecke and Schweer, 2006). Therefore, this paper suggests a psychographic segmentation of commuters.

3. Data

3.1. Measures

The data used in this research comes from a survey carried out in 2014 (see Thorhauge et al., 2016a,b) where we collected the following information: (1) a full travel diary covering all trips and out-of-home activities within a 24 h period during the latest working day, (2) detailed questions measuring the flexibility and constraints of each trip and activity in the travel diary, (3) a stated preference experiment enabling the estimation of departure time preferences, (4) psychological variables measuring attitudes, norms, and perceived barriers, and (5) background variables covering age, sex, income, location, household type and the flexibility of the start/end of the working hours.

The Stated Preference (SP) experiment contained hypothetical but realistic scenarios that were customised to match the respondents'