Departure time choice: Modelling individual preferences, intention and constraints. - DTU Orbit (29/09/2019)

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Copenhagen – like most other major cities – is facing problems with congestion, (especially) related to commuting in dense urban areas, in which the demand is condensed in peak-hours (Mahmassani, 2000; The Forum of Municipalities, 2008). A number of studies have shown that people are more likely to change their departure time rather than changing their transport mode to avoid congestion (Hendrickson and Planke, 1984; SACTRA, 1994; Kroes et al., 1996; Hess et al., 2007a). Hence, understanding the departure time choice from an individual perspective is important to develop policies aimed at addressing growing congestion issues. A common approach to study departure time choices is the Scheduling Model originally formulated by Small (1982). Assuming that people have a specific preferred arrival time, the basic concept of the scheduling model is that individuals choose their departure time as a trade-off between travel time and a delay “penalty” resulting from being late or early. However, studying departure time choice is complicated as it is affected by additional factors. Firstly, it is related to a range of other trip-related decisions such as choice of mode, destination and trip purpose. Secondly, it is more generally related to the overall activity schedule of activities. Such an activity schedule is planned in coordination with household members as well as other social interactions, e.g. friends, colleagues, clients, etc. When considering activities within the activity schedule it is important to consider the level of flexibility (or lack of the same) as well. Flexibility is a complex issue affecting departure time in multiple dimensions. The most straightforward constraint when studying commuter trips is on the arrival time at the work place (e.g. due to individuals having fixed or flexible working hours) as the penalty of late arrival is very likely to be higher for individuals with constraints on arrival time. However, flexibility is not only a matter of fixed arrival time. Activities can be mandatory or discretionary (Yamamoto and Kitamura, 1999), performed alone or jointly with family and/or friends (Thorhaug, et al., 2012), and restricted or non-restricted in terms of time and space (Bowman and Ben-Akiva, 2000). Depending on the type of activity, temporal, spatial and/or social constraints might play an important role in scheduling the activities and in choosing a specific departure time. Parallel with the micro-economic theory, the psychology literature has evidenced that individuals’ behaviours are driven by underlying latent constructs, such as attitude, norms and perceptions. In the past decades, more attention has been given to incorporate and understand underlying psychological effects (such as attitude, norms, etc.) into discrete choice models (Koppelman and Lyon, 1981; Ortúzar and Hutt, 1984; McFadden, 1986). However, most studies usually focus only on a few latent constructs, often considering only attitudes (see e.g. Daly et al., 2012; Jensen et al., 2013; Paulsen et al., 2013; Kamargianni and Polydoropoulou, 2013; Kamargianni et al., 2014). None of these studies, nor any studies in the psychological literature, deal with the departure time problem. It is reasonable to believe that the departure time choice can also be substantially affected by individuals’ attitudes, norms and perception towards being on time (or towards reducing travel and cost) other than by objective measure of times and costs. Arellana et al. (2012) are the only ones who consider these effects in the context of departure time, though they focus only on attitudes. This thesis approaches the problem of the departure time choices for car commuters in the greater Copenhagen area under a more general framework that recognises that the choice of when to depart is affected by both micro-economic and psychological factors. Moreover, it is not an isolated decision, but rather a decision within a complex activity decision chain, where constraints imposed by one activity can affect all other activities in the chain and in particular the preference for the departure time to work. Constraints can be objective (temporal, spatial and social) and directly affect individual departure time choice, but can also be perceived by the individuals as barriers towards participating in activities. Perceived constraints affect the departure time choice through the individual intention of being on time. This PhD thesis also contributes to the departure time literature by discussing the problem of collecting appropriate data to analyse departure time choices. The travel time variation observed in repeated preference data is usually not large enough to be able to identify departure time preferences. For this reason, much recent research has used stated preferences data. Building stated preference designs is especially challenging for departure time studies because of the interdependence among attributes. A number of studies have addressed this challenge in different ways. Other studies focus on the development of building stated experimental designs, while nearly none of the departure time studies have relied on efficient experimental designs. Koster and Tseng (2009) presented the first efficient design for departure time studies. Later, Arellana et al. (2012b) developed a pivoted efficient design including activity participation time (i.e. duration) at work. In order to create the design they had to sacrifice the traditional one-step process of creating efficient designs, thus relying on a two-step efficient design which reduces the efficiency. To the best of my knowledge, no researchers have used a fully efficient stated preference experimental design for the scheduling model. Summarising, the contribution of this PhD thesis is as follows. Firstly, it provides evidence of a fully efficient stated choice design for a departure time context. Using a pivot design (Rose et al., 2008) built around a reference trip (usually from the day before), the thesis shows that the efficient design performs well in cases where good prior knowledge about the parameters is available. Secondly, it investigates the impact of accounting for a daily activity schedule and the corresponding constraints. It shows the importance of taking the daily activity schedule and their constraints into consideration. In particular, the thesis explores whether and to which extent the willingness to shift departure time to avoid congestion and willingness to pay for reducing travel time and travel delay to work is affected by the way information on flexibility at work is collected and by other trips/activities realised during the day and also whether they are constrained. The thesis also provides empirical evidences of the policy implication of not accounting for other activities and their constraints. Thirdly, the thesis shows that the departure time choice can be partly explained by psychological factors, which have previously been neglected by nearly all studies within departure time. More importantly it shows that the underlying psychological processes are more complex than simply accounting for attitudes and perceptions which are typically used in other areas. The work in this PhD thesis accounts for the full Theory of Planned Behaviour (Ajzen, 1991), in which Intention act as a mediator between the underlying latent factors (attitude, norms, and perception). It was found that the psychological factors not only influenced the choice but also individual preferences.