Judgments of travel experiences, activity envelopes, trip features and multi-tasking: A panel effects regression model specification

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ABSTRACT

Modeling the contribution of multi-tasking to the utility of travel episodes would be an important objective in the development of the next generation of activity-based models. Conducting activities whilst traveling may affect the utility of activity episodes in a daily schedule. If evidence to that effect can be established, an elaboration of current activity-based models seems warranted. In this paper, as a first step towards the development of such comprehensive activity-based models, we formulate a random effects regression model to analyze the effects of multi-tasking on respondents' judgments of travel experiences of distinct travel episodes. We extend previous research with a focus on the extent and nature of multi-tasking during a single trip. We analyze repeated judgments of the same individuals for multiple travel episodes, collected over a period of three consecutive months. This longitudinal data analysis allows us to better differentiate between personality traits, temporal effects, multi-tasking and the embedding of travel episodes in the larger activity-travel chains. Results indicate that multi-tasking has a positive impact on travelers' judgments of travel experiences. Significant effects were also found for the kind of activity that was conducted immediately before and after the travel episode. We conclude therefore that it seems beneficial to include multi-tasking in a new generation of activity-based models, and that the suggested conceptualization and model formulation are feasible and valuable building blocks in the development of such more comprehensive activity-based models.

1. Motivation

The last decade has witnessed a substantial growth in interest in the development and application of activity-based models of travel demand (Henson et al., 2009; Rasouli and Timmermans, 2014). The travel behavior research community has explored competing modeling approaches, including advanced discrete choice and other econometric models (Ben-Akiva and Bowman, 1998; Goulias et al., 2012) constraints-based approaches (Kwan, 1997), and rule-based, computational process models (Arentze and Timmermans, 2004; Roorda et al., 2008; Bellemans et al., 2010). Regardless of the specific approach,

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however, all these models predict the temporal and spatial parameters of a finite sequence of activity-travel episodes, including start time, duration, destination, and transportation mode. A common property of existing activity-based models of travel demand is that each activity episode is defined to represent a single activity. Similarly, each travel episode is defined by travel only.

While this assumption of distinct, single-faceted travel episodes may be realistic when seminal work on the formulation of activity-based models commenced, the increasing availability of ubiquitous mobile information and communication technologies has blurred the boundaries between travel and activity participation. Increasingly, people can access Internet wherever they may be, and whenever they may so desire. Conducting activities, such as emailing, phoning, gaming, chatting, text-messaging etc. whilst traveling has become an integral part of the daily travel experience of individuals.

This phenomenon has been called multi-tasking in the travel behavior research community (Circella et al., 2011; Kenyon, 2010). Multi-tasking has been defined as conducting activities whilst traveling. This definition differs from the use of this concept in time use research. Multi-tasking in the time use literature traditionally indicates that an individual conducts a primary and a secondary activity at the same time (e.g., reading a book while watching TV). In contrast, previous research on multi-tasking in travel behavior research has been focused on the analysis of the intensity and nature of multi-tasking, and its covariance with commonly used socio-demographic variables (Kaufman-Scarborough and Lindquist, 1999).

Although empirical evidence on multi-tasking is slowly accumulating in transportation research (Kenyon and Lyons, 2006; Lyons et al., 2006; Kirby et al., 2007; Ettema and Verschuren, 2007; Timmermans and van der Waerden, 2008; Timmermans and Zhang, 2009; van der Waerden et al., 2009; Zhang and Timmermans, 2010), the rapidly increasing prevalence of multi-tasking in travel contexts warrants more substantial and more advanced research efforts than prior research has delivered. Once multi-tasking develops beyond some marginal impact and becomes an integral part of daily activity-travel scheduling decisions, any comprehensive activity-based model of travel demand should systematically address the issue of multi-tasking. Activities conducted while traveling may affect the duration of the same and other activities during that day. In general, multi-tasking may influence the timing and fragmentation of activities. The opportunity for multi-tasking may also affect transport mode choice decisions.

Moreover, multi-tasking may influence the utility that is derived from travel episodes. It may be one of the reasons why the utility of travel time may become positive (Mokhtarian, 2005; Mokhtarian et al., 2012; Zhang et al., 2009). Rasouli and Timmermans (2013) developed a mathematical framework, based on different functional forms for the (dis)utility of the travel component, to (i) identify the duration at which the utility of conducting an activity whilst traveling becomes equal to the disutility of travel time, and (ii) identify the conditions under which the accumulated utility derived from the duration of conducting activities whilst traveling exceeds the accumulated disutility of travel time. This framework encompasses but also extends previous research on multi-tasking.

Using central notions of this mathematical framework, the goal of this paper is to estimate the utility of travel episodes, taking into account the extent and nature of multi-tasking. Particularly, judgments of travel episodes are modeled as a function of the duration of the trip and socio-demographic variables, plus a function of the amount and kind of multi-tasking during that travel episode, day of the week, time of day, travel party and the kind of activity that precedes and follows the travel episode. The data used for the analysis is a longitudinal data set of activity-travel patterns. Thus, the analysis is based on repeated measurements of judgments of travel experiences for a series of travel episodes. It allows estimating the effects of unobserved heterogeneity, multi-tasking, trip characteristics and the larger activity schedule.

The remainder of the paper is organized as follows. We will first, after positioning this study in the context of previous research on multi-tasking, develop a conceptual framework and model to analyze the effects of multi-tasking on judgments of travel episodes. Next, we discuss the data collection process that led to the data used for the analysis. We then report estimation results and provide interpretations. The paper is completed with a discussion of implications for travel demand forecasting practice and travel demand management.

2. Contribution

The activity-based approach, which constitutes one of the pillars of current transportation research, traditionally differentiates between activities and travel. A fundamental premise of this approach is that travel is a derivative of activity participation. Individuals and households engage in a set of activities (in part at-home, in part out-of-home) to satisfy their needs and desires. Travel is a logical consequence in the sense that individuals need to travel to connect activity locations that are scattered in space. It marks distinct boundaries between different activities, conducted at different locations. Although people may always have been involved in reading and talking whilst traveling, data collection, analysis and modeling have typically separated activity from travel.

More recently, the rapid growth and diffusion information and communication technologies, such as mobile phoning, emailing, text messaging, and gaming has blurred these boundaries between activity engagement and travel (e.g., Ory and Mokhtarian, 2005; Handy et al., 2005). The apparent need for effective time use has further stimulated multitasking. Increasingly, travelers can check their emails, scheduling appointments, prepare for work, etc. whilst traveling. These trends have triggered a series of multitasking studies in transportation research, motivated by one or more of the following arguments.