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An analysis of the dynamics of activity and travel needs in response to social network evolution and life-cycle events: A structural equation model

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ABSTRACT

Several studies in transportation literature have shown that in the short-term social networks play an important role in discretionary activity and travel decisions of an individual. However, social networks may not remain unchanged in the long term, particularly in response to life-cycle events (for instance, an employment transition). A change in the social network in turn may have a repercussion on activity and travel behaviour, indicating that an investigation of the long term dynamics of social networks are relevant for understanding activity scheduling, or rescheduling behaviour. To this end, the paper advances the concept of social network dynamics in dynamic activity travel behaviour modelling. It explores the dynamics of social networks and life-cycle events, and their influence on activity and travel needs. Dynamics are assumed to be triggered by life-cycle events. For the purpose of the study an event-based retrospective survey was conducted in 2011 in the Netherlands. A structural equation model was developed to elicit activity and travel needs and their dependencies on life-cycle and social network dynamics. The estimated model takes history dependence of activity and travel needs into account. Results suggest that activity and travel dynamics are influenced by life-cycle and social network dynamics. Moreover social network and activity travel dynamics were found to be interdependent (i.e. a change in one leads to change in the other). Furthermore, the study results confirm the general assumption that travel needs are for the most part influenced by activity needs. The paper concludes that the theory and modelling framework of travel behaviour dynamics should take the dynamics of personal networks into account.

1. Introduction

The activity-based approach to travel modeling came to replace traditional four-step models with the argument that four-step models take travel as an isolated incident, whereas it is related and generated from the activities one plans or needs to perform. Now, with the progress of time-use and travel behaviour research, contemporary studies in the field argue that activity-travel models are somewhat static in nature looking at one particular moment in time whereas activity and travel demands are quite dynamic. In an attempt to capture those dynamics the focus is shifting towards dynamic modeling. Relevant to the discussion is the issue of incorporating the triggers that induce those dynamics, which in many cases are life-cycle events. A further fundamental element of activity and travel behaviour concerns social activities and travel companions

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which emerges from one's social network. This paper relates to these three domains, aiming towards an integrated analysis of activity travel needs, social network dynamics, and life-cycle dynamics.

Individuals constantly change their daily activity schedules and decisions. The changes can be short (day to day dynamics) or long (year to year dynamics) term. Several studies advance a dynamic view on daily activity decision making process (Kang and Scott, 2010; Meurs, 1990; Srinivasan and Athuru, 2005). The intra-household joint decision dynamics are reported to be dependent on socio-demographic characteristics and car availability (Habib et al., 2008b, 2013; Schwanen et al., 2007a). Another stream of studies focuses on the life-cycle events and how they are triggering travel choices, such as car ownership (Oakil et al., 2013; Prillwitz et al., 2006; Verhoeven et al., 2006), commute time and activity and travel duration dynamics (Lanzendorf, 2010; Prillwitz et al., 2007; Sharmeen et al., 2013a). A relatively new group of studies concentrates on the relationship between social networks and activity and travel behaviours (Axhausen, 2005; Carrasco and Miller, 2009; Dugundji et al., 2008; Han et al., 2011; Ronald et al., 2012a; Sharmeen and Ettema, 2010; Van den Berg et al., 2008, 2012). These studies note the importance of incorporating activity companions as this factor leads to a negotiation between activity and travel parties, eventually causing dynamics in activity-travel scheduling. Collectively the above studies argue that activity and travel are dependent on socio-demographics, social networks, and life cycle events. However, individually these studies are limited to two of the three domains (i.e. life-cycle events, social networks, and activity-travel behaviour). An integrated approach in the field is missing.

Life trajectory events, social networks, and activity travel assumably have some level of interrelation. Therefore, looking at them in groups or individually would entail only fragmented information. Life trajectory events act as triggers to induce long term dynamics in the system. In the short-term, social networks have an important role to play in discretionary activity and travel decisions of a person. However, the social network supposedly does not stay the same in the long run. The changes observed in social networks through time lead to changes on activity and travel behaviour. These changes call for an in depth investigation into the long term dynamics of social network and effects on activity scheduling, or rescheduling behaviour. Similarly, as one progresses through life several life-cycle events take place. These events may bring in changes in one's personal social network. For instance, a change in employment means new colleagues and this may have direct, or indirect (via the social network), effects on activity and travel scheduling. Scott et al. (2012) found that social networks at the workplace may influence the decision of teleworking. Reversely, a change in activity and travel schedule may also introduce modifications in one's time budget. This may promote, or hinder, the maintenance of social ties causing the social network to change. Therefore, the study contends that social network and activity-travel schedules are interdependent and triggered by life-cycle events.

To this end, the objective of this paper is to explore the dynamics of social networks and its influence on activity scheduling. Dynamics are assumed to be triggered by life-cycle events (e.g. neighbours change as one changes house). In earlier work, it has been argued that social networks are dynamic and a conceptual framework was developed (Sharmeen et al., 2010). The present study is based on that concept. It elaborates and verifies the concept by means of empirical evidences. Sharmeen et al. (2013b) found that activity and travel duration dynamics are affected by life cycle events. The effects differ according to type of event and type of activity and travel. On the other hand, Sharmeen et al. (2013a) report that social network dynamics influences mode choice for social interactions. The intriguing results of the previous studies provided substantial empirical evidences to investigate dynamics induced by life-cycle events to social network and activity travel needs in an elaborate and integrated framework, so as to explore the interdependencies as well. This study thus is able to provide an insight on the dynamics of three domains yet also exploring their interrelations, which was missing in transport literature.

The remainder of the paper is organized as follows. Section 2 contains a review of relevant literature. Section 3 describes the conceptual framework. Section 4 explains the data and methodology used in the paper. Section 5 includes a detailed discussion of the results, and Section six presents concluding remarks.

2. Literature review

The influence of life-cycle events and social network on activity and travel behaviour has caught much attention in the last few years. A number of studies have offered new insights in order to better predict travel demands in both short term, and also long term. Activity and travel decisions are dynamic (in the short, mid and long term). They cannot be predicted using static models. Therefore, dynamic models are replacing cross-sectional models to incorporate variability in activity and travel decisions. In the short term, day to day dynamics are investigated both within and between households (Kang and Scott, 2010; Neutens et al., 2012; Roorda and Ruiz, 2008; Srinivasan and Athuru, 2005). They report that time-use variations are evident between weekdays and weekends for different types of activities (Habib and Miller, 2008; Kang and Scott, 2010) and between weekdays even for full-time workers due to space–time constraints (Neutens et al., 2012). In addition, Habib and Miller (2008) report that the start (Monday), middle (Thursday) and end (Sunday) of the week are significantly different than the other days of the week. Within household dynamics in allocation of maintenance activities are dependent on the role of an individual in the household and several constraints, such as cost and availability of time/vehicle/driving license (Srinivasan and Athuru, 2005). Moreover gender effects are also reported in within household task allocation (Schwanen et al., 2007b; Srinivasan and Athuru, 2005).