Does the social context help with understanding and predicting the choice of activity type and duration? An application of the Multiple Discrete-Continuous Nested Extreme Value model to activity diary data

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Abstract

An understanding of activity choices and duration is a key requirement for better policy making, in transport and beyond. Previous studies have failed to make the important link with individuals' social context. In this paper, the Multiple Discrete-Continuous Nested Extreme Value (MDCNEV) model is applied to the choice of activity type and duration over the course of two days, using data from the Chilean city of Concepción. In common with other studies, heterogeneity across decision makers is accommodated in the model by analysing the impact of different socio-demographic, mobility and residential location variables on both the activity choice and the time allocation decision. In addition, different social network and social capital measures are found to be significantly correlated with the choice and duration of different activities, and we show how these relationships seem to differ from the effects of socio-demographic variables. Finally, we perform a forecasting exercise using the MDCNEV model, highlighting the differences in substitution patterns from a standard MDCEV model.

1. Introduction

In recent years, activity-oriented approaches have gained considerable ground in the study of travel behaviour (Axhausen and Gärling, 1992). Travel demand is believed to be mainly a derived demand, directed at objectives such as going to work or performing recreational activities (Bhat et al., 2013; Ettema and Timmermans, 2003). The understanding of activity scheduling, which includes the decision of which specific activities to perform, with whom, for how long and using which transportation mode (Doherty et al., 2002; Gärling et al., 1998), can in turn lead to greater insights into the drivers of travel behaviour. Initial contributions to the literature treated the different dimensions of activity choice (such as type, timing and duration) separately, while in the last decade a growing amount of literature has highlighted the value of jointly investigating these aspects (Bowman and Ben-Akiva, 2001; Ettema et al., 2007).

The first econometric models accommodating both the discrete and continuous dimensions of choice were developed starting from the late 1950s by Tobin (1958), Heckman (1977), Dubin and McFadden (1984), Train (1986) and De Jong (2002). However, these models were developed in the context of travel demand and did not consider the nature of the activities.

The original idea of the MDCNEV model was first introduced by Hess et al. (2007) and further developed by Hess et al. (2011) and Hess and Calastri (2013) for activity diary data. The MDCNEV model is able to capture the simultaneous decision-making process of activity choice and duration, taking into account the heterogeneity of decision makers. In this paper, we apply the MDCNEV model to activity diary data from the city of Concepción, Chile, and investigate the impact of different socio-demographic, mobility and residential location variables on both the activity choice and the time allocation decision.
and social activities, specifically on their frequency (Carrasco and Miller, 2009) and duration (van den Berg et al., 2012), while we pay careful attention to. Causality remains, it clearly still important to test for these effects in models to understand the relationship between the social network and the choice of out-of-home recreation is found, then it may of course be tempting to infer that the person conducted many such activities as a result of having many friends. However, it is similarly possible that the person developed careful here in not positing a specific directionality of this relationship at the outset. Indeed, if a relationship between a large social network and the choice of out-of-home recreation is found, then it may of course be tempting to infer that the person conducted many such activities as a result of having many friends. However, it is similarly possible that the person developed a large social network to facilitate him/her performing out-of-home recreational activities. While the challenges in terms of causality remain, it clearly still important to test for these effects in models to understand the relationship between the choices and the context in which they are made. This is one of the aims of the present paper. At the same time, it is also important to test for confounding between these contextual variables and other socio-demographic characteristics, another point we pay careful attention to.

The closest existing work has got to this issue has come in attempts to find an impact of the social dimension on leisure and social activities, specifically on their frequency (Carrasco and Miller, 2009) and duration (van den Berg et al., 2012), while some work has also jointly modelled several dimensions (Moore et al., 2013; Carrasco and Habib, 2009; Habib et al., 2008). These efforts showed the importance of considering the social dimension to explain engagement in social and leisure activities, highlighting the relevance of the cultural context examined (Kowald et al., 2013). One of the aims of the present work is to investigate the broader relations of the social dimension with time use going beyond just leisure and social activities, by looking at the time allocation for entire days.

The remainder of this paper is organised as follows. The next section describes the data used for our analysis, followed by a discussion of the modelling framework. We then present our application and the different models we estimated. After describing our results, we forecast with the MDCEV and the MDCNEV models and discuss the implications of including the social network variables for model performance and forecasting. We conclude by drawing policy considerations and suggesting directions for future work.

2. Data

2.1. Survey and data collection

The dataset used for our analysis was collected in 2012 within the Communities in Concepción project, which involved people from four neighbourhoods of the Chilean city of Concepción. Concepción is located approximately 500 km south of the capital Santiago and with its 1 million population it constitutes the second largest urban centre of the country. Two of the neighbourhoods (Agüita de la Perdiz and La Virgen) are close to the city centre, with the first one being a medium–high income neighbourhood, and the second being a medium–low income one. The other two (S. Sabina and Lomas S. Sebastian) are further away from the city. Medium–low income households mainly populate the first one, while the second one is home to medium–high income people. The specific sampling approach adapted for this study implies that there is not enough variability to control for accessibility, walkability and other measures normally used to describe the built environment characteristics.

The data were collected face-to-face in respondents’ homes. Participants were initially asked to complete a detailed socio-demographic questionnaire, including questions about themselves, their family composition and their mobility and communication tool ownership. They were then asked to complete a 2-day activity diary by filling a grid with detailed information about the activities they have been engaged in during one recent weekday and one recent weekend day, and during which time slots these took place.

In addition to these more traditional components, respondents were asked to elicit their social network by completing a so-called “name generator”. This technique, extensively used in the sociology (Campbell and Lee, 1991) and travel behaviour (Carrasco et al., 2008, Kowald et al., 2010, Pike, 2014) literature, consists of asking people to recall their entire social network.
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