



Collecting a multi-dimensional three-weeks household time-use and activity diary in the Bandung Metropolitan Area, Indonesia



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ABSTRACT

This paper describes a comprehensive panel data collection and analysis at household level, including detailed travel behaviour variables and comprehensive in-home and out-of-home activities, individual cognitive habits and affective behaviours, the rate of physical activity, as well as health related quality of life (QoL) information in the Bandung Metropolitan Area (BMA) of Indonesia. To our knowledge, this is the first attempt to collect an individual's activity diary over an extended period as it captures the multi-tasking activities and multidisciplinary factors that underlie individual activity-travel patterns in a developing country. Preliminary analyses of the collected data indicate that different beliefs, anticipated emotions, support and attachment to motorised modes significantly correlate with different groups of occupation, gender, age, activity participation, multi-tasking activities, and physical health, but not with different social and mental health. This finding highlights the reason why implementing car reduction policies in Indonesia, without breaking or changing the individual's habits and influencing his/her attitudes have not been fruitful. The results also show that endorsing more physical activities may result in a significant reduction in the individual's motorised mode use, whilst individuals who demonstrate a tendency to use their spare time on social activities tend to have better social health conditions. Furthermore, undertaking multi-tasking out-of-home discretionary activities positively correlates with better physical health. All these highlight the importance of properly understanding and analysing the complex mechanisms that underlie these fundamental factors that shape individual daily activity-travel patterns in developing countries. This type of multidisciplinary approach is needed to design better transport policies that will not only promote better transport conditions, but also a healthier society with a better quality of life.

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1. Introduction

Trip-based analysis, based on cross sectional observation of one representative day, especially during a peak hour period, has been the most common, if not the main practice in transport demand analysis in developing countries. However, this approach has been criticised for failing to explain and forecast the individual's real travel needs and demands (Fox, 1995; Flyvberg et al., 2005). Flyvberg et al. (2005), for example, show that more than 9 out of 10 rail projects were overestimated. Approximately 50% of all road projects showed a difference between actual and forecasted demand of more than $\pm 20\%$. Presumably it is because trip-based analysis does not address the linkages between trips and activities, temporal constraints on activity scheduling and interdependencies among activities and across individuals (McNally, 2000). This form of analysis disregards the mechanisms that underlie the traveller's decision-making processes, especially when dealing with the individual's time-space constraints (Hägerstrand, 1970; Miller, 2005). The conventional approach assumes that the individual engages in similar travel and activities every day and only encompasses inter-personal variability (Senbil and Kitamura, 2009). During the past three decades, however, a new approach has been developed, that of activity-based analysis, which analyses travel as a derived demand and an individual's activity-travel pattern as subject to their time-space constraints (Schönfelder and Axhausen, 2002; Jones, 2009).

Using this approach, more recent studies have revealed that different individual's needs and desires, routine obligations, commitments between household members, changes in travel environment and the intention to spread risks over time and space demonstrate that individual activity-travel engagements are subject to day-to-day variability, repetition, flexibility and/or systemic variability (Huff and Hanson, 1986; Axhausen et al., 2002; Susilo, 2005; Bayarma et al., 2007; Buliung et al., 2008; Chikaraishi et al., 2011; Susilo and Axhausen, 2014). The individual has different sets of activities each day and there is no typical or superior day at any given time (Susilo and Kitamura, 2005; Kang and Scott, 2010; Dharmowijoyo et al., 2014). Different daily activity-travel patterns and constraints transform the individual's daily activity-travel pattern into a dynamic pattern on the one hand, and rhythms and routines on the other (Susilo and Axhausen, 2014). As such, different sequences of activities/travel patterns that repeat over time in the individual's daily life, in which they visit the same destination, using the same travel mode and/or with the same person, will create systemic variability within habitual behaviour in the long-run (Huff and Hanson, 1986). However, these daily rhythms, repetitions and systemic variability are difficult to identify through a survey focusing on a short period of time and, as such, require longer multi-day periods for the application of a (panel) survey. Jara-Díaz and Rosales-Salas (2014), for example, have provided methods to test and represent a week's variation of workers' activity participation by weighting the datasets of shorter periods (one or two days). However, such an approach would not enable us to understand the repetition patterns of less frequent trips (e.g., long term shopping and out-of-home social-recreational). A longer term dataset will help us not only to predict the frequency of individual activity participation, but how different activities and different group of travellers plan and optimise different activity-travel patterns (Susilo and Kitamura, 2005; Kang and Scott, 2010; Chikaraishi et al., 2011; Susilo and Axhausen, 2014; Moiseeva et al., 2014; Dharmowijoyo et al., 2015a). This understanding is important, not only to understand different needs for different travellers and the purpose of different trips, but also to promote the most suitable urban and transport planning policy based on the travellers' characteristics. The Uppsala Travel Survey dataset that was used in a series of studies by Hanson and Huff (1986), and the Mobidrive dataset (Axhausen et al., 2002) are prior examples of panel surveys conducted in developed countries over long periods of time. These datasets have significantly contributed to the progress of travel behaviour research and to the development of various new panel data collections.

Whilst recent panel datasets have provided rich information on individual-activity travel patterns, most of the current panel surveys only focus on out-of-home travel and activity engagement, and rarely record individuals' in-home activities. Since individuals' out-of-home activity and trips are also constrained and negotiated according to in-home activities (Yamamoto and Kitamura, 1999), the lack of information concerning in-home activities in our current dataset was a hindrance to better understanding these trade-off mechanisms. This factor has, therefore, been a barrier to formulating a better understanding of the more holistic approach which individuals take in planning and arranging their daily activity-travel patterns.

Furthermore, recent studies have highlighted that the individual's constraints and opportunities offered by space and time are not the only factors that influence and shape travel behaviours and activity participations (Lewin, 1936; Stokols, 1977). Lewin (1936) argues that behaviour (B) is a result of the interaction between the individual's internal, subjective (personal, IP) and objective characteristics (ED), and the external variables of his/her environment, that is, $B = f(IP, ED)$. Lewin (1936) and Stokols (1977) stated that human behaviour is not only about how to answer and adapt to environmental information. Human behaviour also interact them with perspective of human itself to absorb, to respond and might distort it according to the individual's capacity to understand it, their personal beliefs, the norms they subscribe to, physical constraints and other individual constraints. In other words, the individual's objective characteristics as represented by constraints and opportunities, as well as environmental variables, may influence their subjective characteristics as they relate to cognition (attitude, perception and social norms), habits and affective behaviour (Dijst et al., 2008; Van Acker et al., 2011; Susilo and Liu, 2015). The lack of availability of this information in the current travel behaviour datasets often results in the objective and subjective characteristics of individuals being examined separately in a bid to explain the individual's daily activity-travel choices (Van Acker et al., 2011). Obviously, incorporating the individual's objective characteristics and the external variables of the environment into a planned behaviour approach will provide novel insights into

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