



Residential location and daily travel distances: the influence of trip purpose



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ARTICLE INFO

Keywords:

Daily distance travelled
Trip purpose
Residential location
Multilevel modelling
Sweden

ABSTRACT

This paper investigates the extent to which residential location influences daily distance travelled if travel purposes are differentiated. Statistical multilevel models are applied to Swedish National Travel Survey data from 2005–2006. Travel purposes are categorized by considering time–spatial constraints and hypothesized factors of personal freedom of choice. Results indicate that the influence of residential location on daily distance travelled is highly conditional on trip purpose in a nationwide Swedish context. Although statistically significant proportions of the variation in daily distance travelled to work, on service errands, and on weekdays were dependent on residential location, daily travel distances for leisure activities and on weekends varied greatly among people living in the same neighbourhood. From a policy perspective, these results suggest that measures intended to alter the built environment to reduce the volume of travel will be most efficient as regards work trips, while trips taken during free time are unlikely to be much affected. In addition, the multilevel models applied reveal several important interactions between the variation in travel distances across residential locations and individual characteristics of which researchers should be aware, especially when examining service trips.

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1. Introduction

Studies in the academic field of travel behaviour often consider the extent to which spatial circumstances relative to individual characteristics explain daily travel demand. Some scholars emphasize spatial patterns, the friction of distance, and proximity to various amenities as important determinants of travel choices (see, e.g., Ewing and Cervero, 2010; Newman and Kenworthy, 1999). Others find that individual attributes and activities have a decisive effect on spatial behaviour in today's society (e.g., Kitamura et al., 1997; Weber and Kwan, 2003). It is often argued that contradictory empirical results are caused by variations in geographical settings or research designs, or by differences in the dimensions of travelling behaviour being considered (Van Acker and Witlox, 2011). Although such factors may be significant, there is still a lack of knowledge of how and why study results vary (Boarnet and Crane, 2001; Pontes de Aquino and Timmermans, 2010). Still, both policy-makers (CEC, 2001; CNU, 1998) and scholars (Ewing and Cervero, 2010; Newman and Kenworthy, 1999) often express a strong belief that travel behaviour can generally be influenced by adjusting the

built environment through urban planning and design. This paper contributes to these discussions by investigating whether residential location has a greater influence on some travel purposes than others in a nationwide Swedish context using a unique combination of micro-level datasets. In this study, trip purpose was elaborated from a time–space–fixity perspective.

According to the human activity approach (Fox, 1995; Jones, 1983), travel behaviour is a strategy by which individuals fulfil their needs and wishes by performing activities at various locations. Different activities are characterised by different degrees of choice and spatiotemporal constraints, depending on what needs the activity is intended to fulfil (Hägerstrand, 1970; Ås, 1978). A plausible hypothesis is that the relative importance of spatial circumstances and individual choice to travelling behaviour is conditional on the type of activity being performed. For example, a common way of categorizing activities is by differentiating between mandatory and discretionary activities. Trips carried out to perform discretionary activities can reasonably be expected to have a more flexible relationship with space and location than do more compulsory activities, such as work or grocery shopping. Individuals can generally choose more freely where and when to perform discretionary activities based on their own preferences, while wage labour generally must be performed at particular workplaces. Though such hypotheses were proposed decades ago

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(Hägerstrand, 1970; Jones, 1983), there are still surprisingly few direct and thorough empirical explorations of the associations between the spatial-fixity levels of various activities and travel (Schwanen et al., 2008) and no studies of which the author is aware that examine the extent to which residential location influences travel behaviour if trip purposes are differentiated in a nationwide Swedish context.

The aim of this paper is to examine whether residential location relative to individual attributes affects daily distance travelled when individuals travel for different purposes. To explore these matters, statistical multilevel models are applied combining geocoded micro-level data from two sources: data from the Swedish National Travel Survey (RES) conducted in 2005–2006, which capture individual travel behaviour, and Swedish register data for the Swedish population, which capture geographical contexts. Separate models are fitted to examine the extent to which everyday travel distances to various activities vary among individuals who share residential locations.

This paper addresses previous research suggestions concerning the need to apply more complex models to advance the exploration of individual and spatial effects on travelling (Mercado and Páez, 2009; Shuttleworth and Gould, 2010; Snellen et al., 2002). Previous studies often ignore the hierarchical nature and spatial clustering of travel data, and problems of cross-level inference could occur if individuals and neighbourhoods are treated at the same data level. This study takes account of possible biases by using multilevel modelling and hierarchical data structures, allowing the effects of variables to be explored at different data levels (Goldstein, 2011). Another contribution concerns the fact that the processes underlying spatial behaviour and organization have developed rapidly (Kwan and Weber, 2003; Miller, 2007), so it is reasonable to believe that the relationships between everyday travel, individual characteristics, and locational premises have changed in recent decades (Elldér, submitted for publication; Susilo and Maat, 2007). This fact calls for empirical reconsideration of currently accepted associations between the spatial-fixity levels of activities and travel, and the extent to which the influence of location on daily travel distances is conditional on trip purpose. Most previous studies have been limited to single metropolitan areas, mainly in the USA or the Netherlands. Sweden provides a new and interesting case, when unique nationwide micro-level data with high spatial resolution are accessed to analyse the relative importance to travelling behaviour of spatial circumstances versus individual choice.

Section 2 reviews research related to the aim of the paper, after which Section 3 presents the data, methods, and variable definitions. Results and analyses are discussed in Section 4, while Section 5 reviews the main findings and presents the conclusions.

2. Literature review

2.1. Diverse time–spatial constraints when travelling to perform various activities

All human activities have temporal and spatial attributes that impose various constraints on the individual's ability to perform them (Hägerstrand, 1970). Space–time constraints that influence travelling to activities have been the subject of several empirical studies (see, e.g., Cullen and Godson, 1975; Doherty, 2006; Næss, 2006, 2013; Schwanen and Dijst, 2003; Schwanen et al., 2008; Vilhelmson, 1999), suggesting that the level of spatial-fixity varies significantly among everyday activities. The fact that some activities are more time and space bound than others could be elaborated on with reference to Ås's (1978) categorization of time use. Ås differentiates activities based on their hypothesized degree

of association with personal freedom of choice and time constraints, dividing them into four time-use categories: 1. necessary, 2. contracted, 3. committed, and 4. free.

Necessary time is required to fulfil basic physical needs (e.g., sleeping and eating) and is characterized by very little flexibility. Most necessary time is fixed in the home, making it the place that most shapes daily activity patterns and constitutes the main “pocket of local order” (Ellegård and Vilhelmson, 2004). *Contracted time* refers mainly to wage labour. Activities allocated to contracted time are also characterized by the fact that, once they have been decided on, they remain relatively unaffected by personal choices. Most people have to earn a daily living and the time–spatial premises (e.g., working hours and location) associated with doing so are determined mainly by the employer (Breedveld, 1998).¹ Activities associated with *committed time* are linked predominantly to household work, such as grocery shopping and raising children. These activities also must be carried out regularly, but are expected to be associated with more individual flexibility concerning when or where they are performed than are activities performed during contracted time. People have greater opportunities both to postpone such activities and to make decisions concerning where to perform them in relation to their own premises. For example, several researchers have demonstrated that individuals often do not choose the nearest service facility (e.g., Handy and Clifton, 2001; Næss, 2013). In a Swedish context, the distance travelled to access services increased between 1995 and 2005–2006, even though Swedes lived closer to service amenities in 2005–2006 than in 1995 (Haugen and Vilhelmson, 2013). Other factors, such as socio-economic status, preferences, attitudes, and lifestyles, greatly influence service destination choices.

All other activities are performed in people's *free time*; these activities are expected to be the most flexible in time and space and, consequently, to be the products mostly of personal preferences and resources. For example, Næss (2013), examining the mobility of residents of Hangzhou, China, found that individual socio-cultural factors are central to explaining the rationales of travel to leisure activities.

2.2. Empirical explorations of how the relative significance of locational and individual attributes varies with trip purpose

Several studies gauge the relative significance of the spatial attributes of residential location and individual characteristics for everyday travelling (see, e.g., Kitamura et al., 1997; Schwanen et al., 2004; Shuttleworth and Gould, 2010; Zhou and Kockelman, 2008). Research designs, data, and geographical contexts, however, differ substantially in the literature. For example, both Shuttleworth and Gould (2010) and Schwanen et al. (2004) used multilevel models to explore the extent to which distance travelled to work varies among workers versus across neighbourhoods, but their analyses are conducted in different geographical contexts, i.e., Northern Ireland and the Netherlands. Schwanen et al. (2004) found that the residential location has a very small effect, while Shuttleworth and Gould (2010) found that a large share of variance in distance travelled to work can be explained by residential location.² It is therefore risky to use these studies to draw general conclusions about how the relationships between residential locations, individual attributes, and travel demand vary with trip purpose.

¹ High-status occupations, however, are generally associated with more time–spatial autonomy.

² One possible explanation is that the Netherlands is far more densely built-up than is Northern Ireland, which implies that people generally have many options for where to work, which should relax the relationships between residential location and commuting behaviour.

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