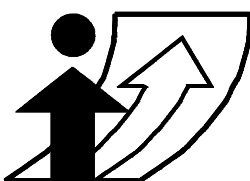


Understanding changing travel behaviour over the life course: Contributions from biographical research

A resource paper for the Workshop “Life-Oriented Approach for Transportation Studies” (version 16/10/15)

Kiron Chatterjee, University of the West of England, Bristol, UK
Joachim Scheiner, TU Dortmund, Dortmund, Germany



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Abstract

Life course approaches to travel behaviour, often labelled as mobility biographies, have emerged as a fruitful and promising research field over the past decade. They understand travel behaviour in the context of individual life courses and their phases of stability and change induced by life transitions and events, and they consider these individual processes to be embedded in personal networks and wider societal, economic and spatial processes. The paper first identifies motivations to pursue biographical research before introducing theoretical perspectives which can assist with biographical research of travel behaviour. It then summarises the contribution to date of travel behaviour studies which have adopted a biographical approach. This is presented in sections on life event effects on travel behaviour, the residential relocation and travel behaviour inter-relationship and the role of socialisation in travel behaviour. Research to date has shown that changes to travel behaviour are closely associated with life course events and with broader life development. Of particular interest for the future is to better understand what features of life course events are important in determining travel behaviour changes, to consider how life events themselves are influenced by travel preferences, to consider how different events interact to shape travel behaviour and to view and understand travel behaviour development over the life span.

Keywords

Travel behaviour, life course, biographical, habit, life events, life transitions, turning points, mobility biographies, panel data, life history interviews

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1. Introduction

The IATBR conference brings together the international research community with an interest in gaining a better understanding of travel behaviour: for example how behaviour varies in different contexts, varies across the population and in response to interventions. An area that has received relatively limited attention by the research community is how travel behaviour changes over the life course of individuals. Biographical research is concerned with the details of a person's life, considering their whole life or a segment of their life. Unlike research which concentrates on a current 'snapshot' of a person's life situation, it enables the person's current position to be seen in the light of their past experiences and development. The paper first identifies motivations to pursue biographical research before introducing theoretical perspectives which can assist with biographical research of travel behaviour. It then summarises the contribution to date of travel behaviour studies which have adopted a biographical approach. This is presented in sections on life event effects on travel behaviour, the residential relocation and travel behaviour inter-relationship and the role of socialisation in travel behaviour. The paper concludes with suggestions on future directions for biographical research.

2. Motivations for biographical research in travel behaviour studies

Motivation to conduct biographical research in travel behaviour studies has been driven by recognition of limitations of using cross-sectional data. We start the resource paper by identifying three key motivations for biographical research. The first motivation is to recognise how life situation context influences travel behaviour. The second motivation is to understand what specific contextual changes can disrupt habitual behaviour. The third motivation is that understanding the impact on travel behaviour of changes to the transport system requires us to understand the lives of the population that experience it.

2.1 Recognising life situation context

The interest in considering the long-term perspective in understanding individual travel behaviour is not new. Hägerstrand (1970) created time geography in the 1960s and introduced the concept of time-space paths: 'life paths become captured within a net of constraints, some of which are imposed by physiological and physical necessities and some imposed by private and common decisions'. Time-space paths have mainly been studied at the level of daily trips and activities, but in principle could be extended to the life span, as outlined by Martensson (1979). She studied workplace relocation and temporal organisation in family households. Her empirical work was largely based on cross-sectional data due to lack of available longitudinal data.

Salomon and Ben-Akiva (1983) argued for the importance of accounting for long-term life decisions in seeking to understand daily travel behaviour. They suggested that travel choices are best understood by recognising that they are part of an extended choice hierarchy. *Life-style choices*¹ are at the top level of the hierarchy,

¹ Lifestyle has been defined in different ways (see Van Acker, 2015), for example, in terms of socio-demographics, orientations (values, attitudes and preferences) or participation in activities.

representing the long term view of 'what life should be like' and manifested in decisions on family formation, participation in the labour force and orientation to leisure. These are made in the context of the social, cultural and political environments that prevail. Individuals will then make mid-term *mobility choices* (employment location, residential location, housing type, car ownership, mode to work) to fulfil their lifestyle choices and short-term *activity and travel choices* (activity type, activity duration, destination, route, mode) will be made in line with their *life-style and mobility choices*.

Salomon and Ben-Akiva (1983) claimed that "explanation of human behaviour is often done by the use of 'low-level' descriptors, such as income, expenditures, personality traits, attitudes toward specific issues, age, and family structure, etc." without "attempt to describe the individual in a comprehensive context". They also went on to note 'Unfortunately, even when such attempts are made...most often the temporal dimension is overlooked.' Salomon and Ben-Akiva wrote this over 30 years ago and at the time concentrated on measuring lifestyles and assessing (using cross-sectional data) how travel behaviour varied according to life style type, rather than investigating (presumably due to lack of longitudinal data) the temporal dimension: the effects on travel behaviour of changes to lifestyle choices. Until recently there have been limited efforts to follow up their call to action, but it is clear that biographical research has the potential to consider both the comprehensive context² and the temporal dimension.

2.2 Habitual behaviour

Social psychologists have observed that behaviour tends to be unchanged for long periods and developed habit theory which hypothesises that behaviour when first initiated is the product of rational decision making but when repeated in a stable context becomes automatic or scripted, even if circumstances change³. The 'habit-discontinuity hypothesis' posits that habits may become weakened when routine behaviours, such as commuting, are interrupted by a contextual change (Verplanken et al., 2008).

Habit theory would suggest that behaviour is only intermittently reconsidered when significant events (contextual discontinuities) occur in people's lives. This has led to interest about the nature of events which bring about reconsideration of behaviour. Events can be on the micro level (relating to the life of an individual and their immediate social network), or on the macro level (relating to wider social system, including transport system) and they can be planned or unplanned. Biographical research can seek to discover more about these events and the role they play in influencing behaviour.

² Even where cross-sectional research has included enriched measurement of the life context (e.g. Scheiner and Holz-Rau (2007), Van Acker (2015)) and helped to explain current travel behaviour, it is not able to provide insights on how travel behaviour changes over time.

³ An alternative conceptualisation of habit is provided by Schwanen et al (2012): "habit is understood here as a generative and propulsive capacity brought about through repetition and belonging to body-mind-world assemblages that exceed the human individual as conventionally understood". This conceptualisation emphasises habits being formed not just in the individual but by the combination of the individual and their wider social and physical world.

This conceptualisation of (un)changing behaviour as being shaped by micro and macro stimuli through the progression of life is still somewhat narrow. It ignores the importance of past experience and development. The lifestyle direction taken today is dependent on the path taken up to today. The way someone responds to a particular situation is likely to be affected by the knowledge, capabilities and preferences they have built. Schwanen et al. (2012) noted that habits can be latent, formed earlier in the life-course, and with possibility of being re-enacted if socio-technological changes can be brought about to support them. The way someone responds to a particular situation may also be affected by what they are aiming for in the future. Biographical research can capture the historic development process to explain plausibly how behaviour changes and it can also enquire about future aspirations and plans.

It can be argued that the main interest in transportation is to understand how people's travel behaviour responds to changes in the transport system, and not to changes in their lives (which are outside the control of transport planners). However, it is important to understand how secular factors (outside of transport) are influencing travel behaviour. Transport planning needs to account for these as they influence people's ability to respond to changes in the transport system. We now highlight evidence from studies, not overtly biographical in nature, which demonstrate that to understand the impact on travel behaviour of changes to the transport system we need to understand the lives of the population that experience it.

2.3 Understanding the impact on travel behaviour of changes to the transport system

Jones et al. (1983) provided detailed findings on how travel behaviour varied by family life-cycle stage, particularly noting the importance of constraints that exist at each stage⁴. The implication is that changes in life stage are likely to lead to change in travel behaviour. Dargay and Vythoulkas (1999) constructed a pseudo-panel using annual data from the UK Family Expenditure Survey to study car ownership profiles of different cohorts. They showed a car ownership life-cycle effect where car ownership increases as head of household reaches the age of 50 and thereafter declines. They found also that successive generations have higher car ownership than earlier ones, indicating the importance of the historic time in which the cohort lived. This highlights that in understanding travel behaviour we need to account for life development but also the broader context which people have experienced.

Goodwin (1997) discussed the widely observed aggregate phenomenon that long long-term elasticities (for example, with respect to motoring fuel costs or public transport fares) are larger than short-term elasticities and rationalises "that people's response to policy variables is often delayed until it can be incorporated within their response to personal changes. In that case, the time scale for a full response to policies is determined by the actuarial incidence of other life-shocks." The suggestion that people experiencing life events are more likely to change travel behaviour is supported by evidence from the Dutch National Transport Panel Survey that change

⁴ This resembles the construction of 'homogeneous behaviour groups' defined by stage in the life cycle, as suggested by Kutter (1973). It can be argued, however, that family life-cycle stage is a restrictive concept as it implies the existence of a common developmental pattern over the life span when there may be significant individual variation in developmental patterns.

in car ownership and public transport use from one year to the next were more common among those experiencing life events (births, deaths, marriages, retirement, and changes of workplace) than those who did not (Goodwin, 1989). It is also supported by the finding from an intervention in Copenhagen which targeted commuters who owned a car (Thøgersen 2012). An intervention group received a free public transport travel card and a control group did not receive the card. The study showed that it was only those in the experiment group who had moved home or changed workplace within the last three months that increased their public transport use.

There is also evidence that past experience can influence current behaviour. For example it has been found that there are differences in travel behaviour of people living in the same area based on where they lived previously (Weinberger and Goetzke, 2010). Those moving to cities in the United States from major metropolitan areas had lower car ownership than those moving from smaller metropolitan areas or non-metropolitan areas. Similarly, Simonsohn (2006) provides evidence of path dependencies in commute duration by showing that movers between cities tend to commute further in their new city if they have come from a city with a longer average commute duration.

These research insights suggest that a full understanding of travel behaviour change can only be achieved by examining it in the context of people's evolving life situation and therefore employing biographical research methods.

3. Theoretical perspectives

We now introduce theory that provides a basis for the study of how behaviour evolves over individual life courses. In particular we introduce the life course perspective which explicitly addresses the relationship between time and human behaviour. Its concepts and principles have not been widely adopted in travel behaviour studies, even within the research which we later summarise that has used biographical methods.

3.1 Life course perspective

The life course perspective focuses on the relationship between individuals and the historical and socio-economic contexts in which they have lived with the assumption that "any point in the life span must be viewed dynamically as the consequence of past experience and future expectation as well as the integration of individual motive with external constraint" (Giele and Elder, 1998). Rather than a formal theory, the life course perspective is a multidisciplinary paradigm for the study of people's lives, structural contexts and social change.

The life course perspective utilises a set of concepts which are described in Box 1. People arrive at their current life situation within *trajectories* that are developed over the course of their lives and shaped by the environments they encounter as well as *transitions* that they have made and *life events* that they have experienced. Life events can turn out to result in *turning points* when a lasting change occurs rather than a temporary diversion. It has been suggested that three types of life events serve as turning points (Rutter, 1996).

1. Life events that open or close opportunities.
2. Life events that make a lasting impact on personal environment.
3. Life events that change a person's self-concept, beliefs or expectations.

Figure 1 (from Jones et al., 2015) illustrates some of the above life course concepts in an application to the study of walking and cycling. From left to right at the centre it shows interwoven trajectories, including walking and cycling. It highlights transition to adulthood and work-retirement transition as being particularly sensitive periods for changes to be made in walking and cycling behaviour.

Text box 1: Life course perspective concepts

Trajectories – refer to long-term patterns of stability and change in a person's life. People's lives can be considered to be made up of multiple, interrelated trajectories in different domains such as health and work trajectories. The trajectory for a particular domain can encompass "thoughts, feelings, strategies and actions" (Sobal et al, 2006). Pathways may be considered to represent sub-periods of trajectories.

Transitions – these are occasions when a person experiences a change in role and status (e.g. leaving school, starting first job, marriage). The changes are discrete and bounded unlike trajectories which take longer view and may involve multiple transitions.

Life events – these are significant occurrences, involving a relatively abrupt change that may or may not have lasting effects. They refer to events (e.g. wedding) and not the consequences that arise (e.g. marriage).

Turning points – these are times when a major change occurs in the life trajectory, often associated with a life event. They represent a lasting change rather than a temporary diversion.

Contexts – represent the environments within which life course changes occur and encompass social structure, economic conditions, historical eras and the changing physical environment.

Cohort – group who experience a particular event in the same period and experience particular social change within a given culture in the same sequence and at the same age. Cohorts are mostly defined by their birth date. A generation is a similar concept but often applied to a period of about 20 years and sometimes on the basis of a recognised shared identity. Generations may also be defined based on their familial relationship (parent/child).

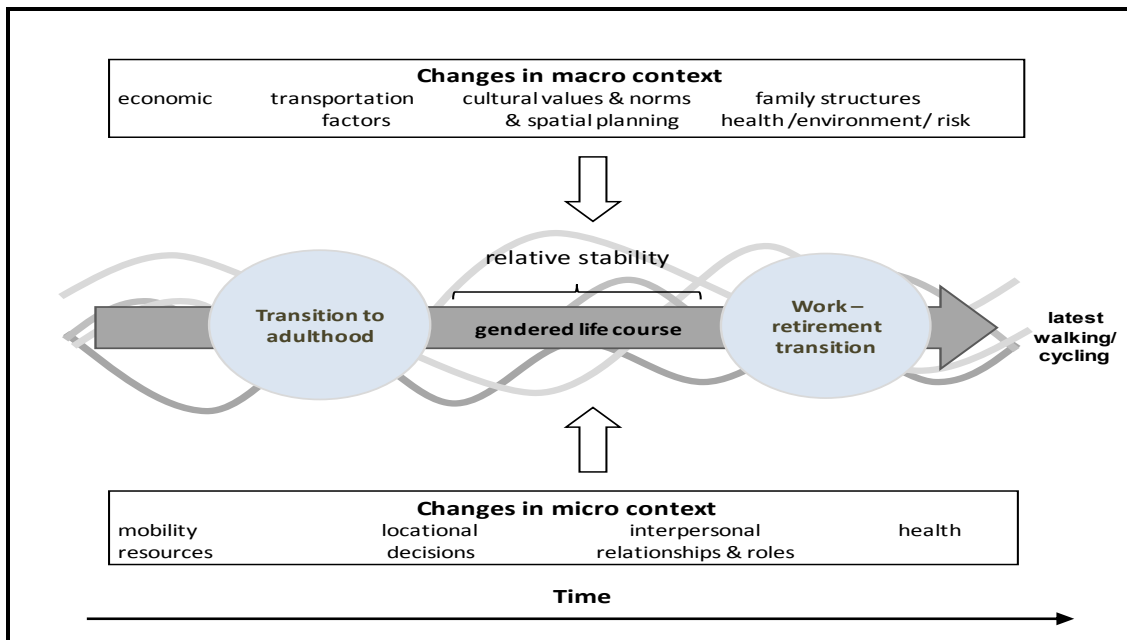


Figure 1: Conceptual framework of a life course trajectory of walking or cycling (originally included in Jones et al., 2015)

Glen Elder initially identified four primary analytic themes of the life course perspective (Elder, 1998):

1. *Historical time and place* – the life course of individuals is embedded in and shaped by the historical times and places they experience over their life-time. This signals the importance of cohort effects where distinctive formative experiences are shared at the same point in the life course by birth cohorts. The same historical events can affect different cohorts in different ways.

2. *Timing of lives* – the development impact of a succession of life transitions or events is contingent on when they occur in a person's life. The timing of life transitions and events can be considered as 'on-time' or 'off-time' based on social norms.

3. *Linked lives* – lives are lived interdependently, and social and historical influences are expressed through this network of shared relationships. The family has been the prime focus of life course research in this respect, but social relationships can be considered in a wider sense. Social relationships can both support and control behaviour. Intergenerational influences such as from parent to child and vice versa can be highly influential.

4. *Human agency* – individuals construct their own life course through the choices and actions they take within the opportunities and constraints of history and social circumstances. This acknowledges that individuals act with an orientation to the future (with an eye for 'possible selves') and not just present. Human agency is not considered to only be personal but can also be proxy (exercised to influence others with greater resources to act on one's behalf) or collective (when exercised at group level to meet common goals) (Bandura, 2006).

Two additional themes have been put forward subsequently.

5. *Diversity* in life course trajectories – this arises from between-cohort variations and within-cohort variations related to social class, culture, gender and individual agency (see Elzinga and Liefbroer (2007) and Widmer and Ritschard (2009) for examples).

6. *Development risk and protection* – experiences with one life transition or event may have an impact on subsequent transitions or events and may protect or present a risk. This can include adult impacts of childhood or adolescent transitions or events.

We now look at how life course perspectives have been applied in travel behaviour research.

3.2 Mobility biographies

Twenty years later, Lanzendorf (2003) returned to the ideas of Salomon and Ben-Akiva (1983) (of an extended choice hierarchy), but gave explicit consideration to the temporal dimension and introduced ideas from the life course perspective. He put forward the concept of mobility biographies where he defined the mobility biography as 'the total of an individual's longitudinal trajectories in the mobility domain'. In line with Salomon and Ben-Akiva, he proposed three domains (lifestyle, accessibility and mobility domains) which are interlinked with events in one domain affecting the others – see Figure 2. We understand the concept of mobility biographies to refer not only to the mobility domain but its interaction with other relevant biography domains.

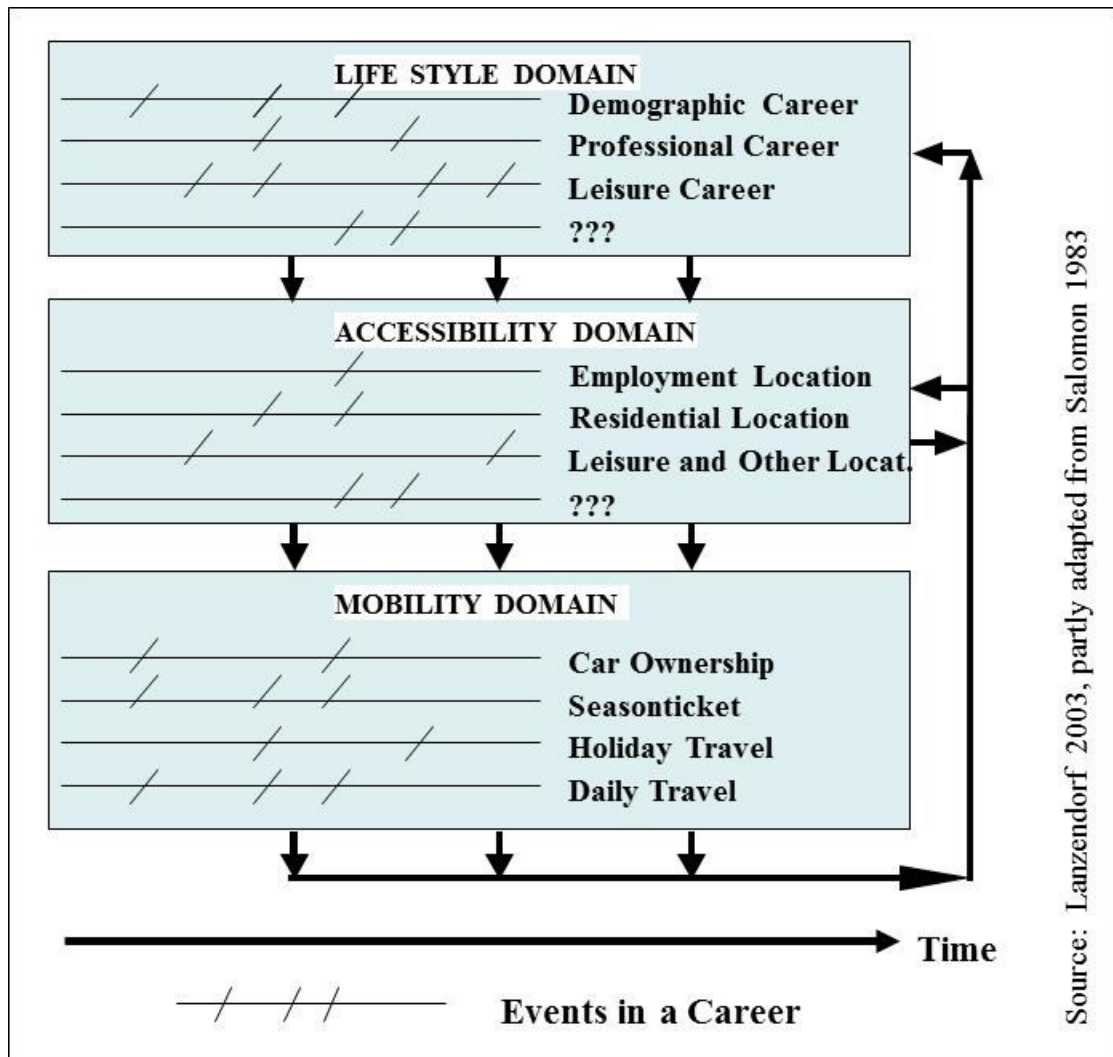


Figure 2: Life domains and related events that affect mobility biographies
 (Original source: Lanzendorf (2003). Reproduced with kind permission from Martin Lanzendorf)

Lanzendorf considered that “travel behaviour is to a large extent habitual” (Lanzendorf, 2003) and stated that “the main objective of the mobility biographies approach is to emphasize the importance of certain stages and events in the life course for travel behaviour of individual’s and households” (Lanzendorf, 2010). Consequently, the emphasis in mobility biographies research has been to study how events in the life course influence a change in travel habits. The preferred method of data collection for Lanzendorf has been retrospective qualitative interviews “to explore the variety of interactions and to discover causal relationships between different life domains”.

Scheiner (2007) noted that unidirectional causal relationships cannot be assumed between the mobility biography and other relevant ‘partial biographies’ (employment, household, residential) and what is regarded as the ‘dependent variable’ depends on the research question. If our interest is a better understanding of travel demand then this is regarded as a dependent variable. The three other partial biographies are explanatory background with events in them potentially affecting the mobility

biography. Scheiner makes a distinction in the mobility biography between availability of transport means (which may be regarded as a relatively stable pre-decision) and actual use of transport modes.

3.3 Why life events invoke change in travel behaviour

The mobility biographies concept emphasises life events as moments when stable travel behaviour is modified but it is important to consider what theoretical reasons exist for life events influencing travel behaviour. The general proposition is that life events disturb habitual behaviour by invoking imbalance, discrepancy, stress or role change.

Fried et al. (1977) suggested in their synthesized theory of travel behaviour that behaviour is continually in a process of adaptation to reduce imbalances in personal needs and environmental structures. They stated "Discrepancies in person-environment fit invoke the adaptional process consisting of informed trial-and-error sequences that continue until the discrepancies are resolved". A discrepancy in person-environment fit can logically arise as a consequence of changes in the conditions of the person or of the environment.

A similar idea has been put forward by Salvini and Miller (2005) who conceived of life events as causing a discrepancy between a household's aspiration level and its current circumstances and therefore acting as stressors (sources of stress). Oakil et al. (2014) noted that the effect of life events can be forward (path dependence) and backward (anticipatory) in time. The latter occurs when preparation is made for an anticipated future event by adjusting behaviour (for example, acquiring a car in advance of having a child). Oakil et al. (2014) also noted that a change in aspiration may arise due to internal sources (family) or external sources (income, social influence). They also note that time is required to adapt to stress since there may be the need for time and money investment, and that there is path dependency where a recent change may sets limits to new changes.

Clark et al. (2015a) put forward a conceptual model for turning points in travel behaviour (see Figure 3) where life events trigger consideration of behaviour and the occurrence of behavioural change is contingent on personal history, intrinsic motivations and facilitating conditions in the environment. This is founded on the argument that life events can alter the roles that people perform within their family and social networks, alter the values people hold, alter the resources available for travel and alter the context for travel.

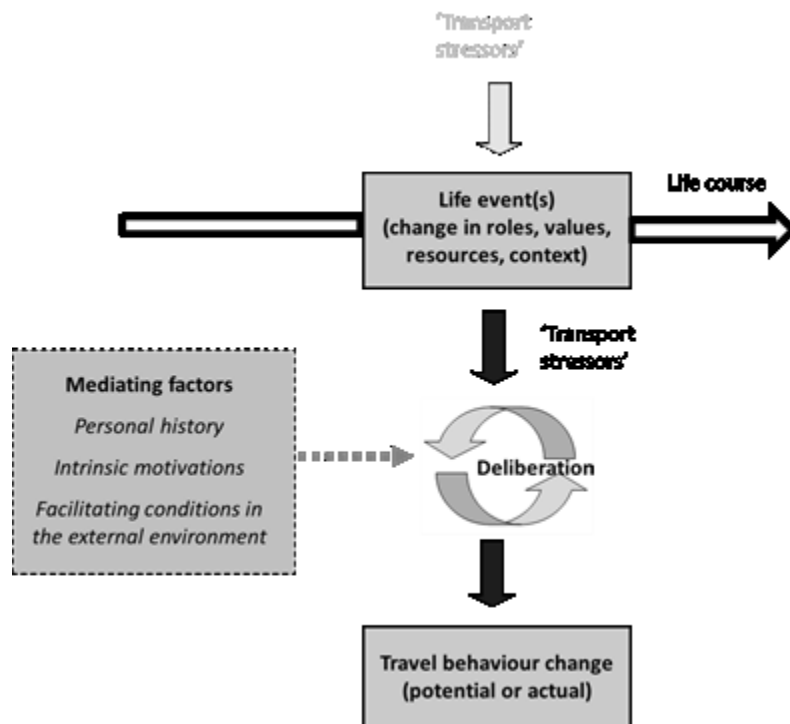


Figure 3: Conceptual model for explaining turning points in travel behaviour
(originally included in Clark et al., 2015a)

3.4 Socialisation

The life course perspective offers more than a framework to consider how life events influence behaviour. It emphasises the importance of accumulated experiences and learning on current and future behaviour. Experiences and learning take place in social and spatio-temporal settings and, hence, life courses must not be understood as isolated entities, separate from other people. This idea is captured in the analytic theme mentioned earlier of 'linked lives' and also in the concept of socialisation.

Socialisation has been defined as the "the ways in which individuals learn skills, knowledge, values, motives, and roles appropriate to their position in a group or society" (Bush and Simmons, 1981, p135). Socialisation has been proposed as a mechanism through which social norms regarding specific behaviour are transmitted via socialising agents (Haustein, 2009). With travel behaviour it has been suggested that the agents of socialisation for children are family, school, media and peer groups (Baslington, 2008). Döring et al. (2013) refer to Tully and Baier (2006) who define mobility socialisation as a process that makes the individual be a part of the mobile society. The outcome of this process is a mobility lifestyle which determines individual mobility behaviour in the long-term. Note that socialisation not only refers to children, but also to a life-long process of interaction with one's peers (family, friends, etc.).

Socialisation contributes to societal integration. It tends to reproduce and, hence, reinforce existing structures. For instance, the social norm to use the car in a strongly motorised society may be understood as an outcome of socialisation. Aggregate car use produces and reproduces this norm which in turn reinforces car

use. Socialisation may thus work against change in the aggregate. It might also be understood as a 'habit on the aggregate (or system) level' and seen to have much in common with the concept of habitus. Habitus is "society written into the body, into the biological individual" (Bourdieu, 1990, p63).

4. Data collection methods

It is outside the scope of this paper to give detailed consideration to data collection but in this section we briefly introduce different methods that can be used to collect data for biographical research. The aim in biographical research is to obtain accurate life history data. Adopting the mobilities biographies approach, this would include information on events in domains of employment, household, residential mobility and travel behaviour. It can also be sought to obtain subjective reasoning from individuals for notable developments in trajectories.

- a) Panel studies – these are prospective studies involving repeated surveys of the same individuals over time gathering the required breadth of information regarding people's lives. Panel studies need to be continued for many years to bear fruition in terms of providing whole life courses. It is rare that longstanding panel studies are available permitting analysis. Reporting of events should be accurate in panel studies conducted on an annual basis given that relatively little time will have elapsed between the event and survey. However, it is possible that events will be missed due to timing of survey. There are well-known problems with panels of attrition meaning that limited numbers of participants provide long histories.
- b) Pseudo-panels from time series data – this involves utilising data from cross-sectional surveys from different time periods to construct cohort-specific data and examining mean behaviour for cohorts at different time points and differences between cohorts at the same time point. It does not allow the effects of individual biographical events to be analysed and hence does not meet the full requirements of biographical research.
- c) Retrospective surveys – these involve asking participants to recollect relevant information about their lives to date. They rely on the autobiographical memory of participants. The surveys can be designed to support elicitation of biographical details, for example, through starting with the most recent event and working backwards, and the use of life calendars. Schoenduwe et al. (2015) discuss the design and use of life calendars.
- d) Life history interviews – these are semi-structured or narrative and involve open ended questions about current and past thoughts and actions regarding the behaviour and how they relate to other aspects of the life course. This method specifically allows the reconstruction of someone's biography from his/her own perspective, depending on subjective importance, memory and interpretation.

Quantitative analysis of biographical data can be used to examine interactions between trajectories or between events in different domains to seek to identify patterns and seek significant explanations. Qualitative analysis can be conducted to

seek to understand trajectories as interpreted by the subjects of research themselves.

5. The effects of life events on travel behaviour

We begin our review of literature with findings from studies which have investigated the effects of life events on travel behaviour. We start with some exploratory studies which set the scene for subsequent research.

5.1 Exploratory studies

Van der Waerden et al. (2003) identified 90 key events and critical incidents with potential to influence travel behaviour, short-listed 16 that appeared from an initial survey to be most influential and conducted a detailed survey, asking respondents to identify one or two of these that had influenced their mode choice behaviour the most. The most commonly mentioned events were a house move, starting first job, change of work situation, getting a driving licence and getting a car.

Klößner (2004) carried out an online survey about the effect of life events where he asked participants to identify up to 10 life events over their lifetimes that had influenced a change in travel mode and to select the three most important. The most commonly identified events were moving to a new town (mentioned by 61%), starting studies/apprentice (55%), acquiring driving licence (54%), change to secondary school (28%), buying a car (27%) and starting employment (23%).

It is noticeable that two of the events found to be most influential relate to acquiring the means for mobility (or 'mobility tools'): driving licence and a car. These could be regarded both as life events that affect travel behaviour ('independent variables') or dimensions of behaviour itself that are influenced by life events. Scheiner (2007) suggested they are regarded as relatively stable pre-decision characteristics of mobility. We next look at evidence from studies that have investigated the effects of life events on acquisition or relinquishment of the means of mobility.

5.2 Means of mobility

A number of studies have analysed the effects of life events on changes in car ownership/access. Table 1 summarises these studies and their findings. It is apparent from Table 1 that there are consistencies in findings despite the different national contexts, data used and analyses performed. Changes to car ownership are likely to occur when there are changes to adult composition of households and to driving licence availability. Birth of a child has been found to be associated with an increase in car ownership, although Clark et al. (2015a) found this only applied to households without a car and not those with a car already. Where the residential context of households has been taken into account (most fully by Clark et al. 2015a), it has been found that there is a modest effect of access to public transport on car ownership, both for those that continue living in the same dwelling and those that move to a new dwelling.

There remain specific areas worth further investigation such as further examining whether car ownership changes are made in response to or in anticipation of life

events and whether car ownership decisions have an influence themselves on future life development. For example, Gurley and Bruce (2005) showed using longitudinal data from welfare-to-work recipients in Tennessee that gaining car access increases the probability of becoming employed and leaving welfare.

It would also be valuable to investigate driving licence acquisition and relinquishment. There is much current interest in the reasons for lower driving licencing rates seen among young adults in countries in Australasia, Europe and North America in recent years. For example, Delbosc and Currie (2014) used travel survey data for the period 1994 and 2009 for Melbourne, Australia, to find that full-time employment and having children (decreasing in prevalence) are associated with higher young adult licencing rates whereas part-time work and studying (increasing in prevalence) are associated with lower licencing rates. Further evidence to understand this phenomenon could be obtained by collecting biographical data and examining the timing of driving licence acquisition with respect to other events in people's lives.

The same approach could also be used for driving licence relinquishment. Giving up driving has been found to be associated with negative well-being outcomes (see Chihuri et al. (2015) for a review) and understanding the factors that affect the timing of driving cessation could be helpful in devising strategies to alleviate these outcomes. A qualitative study involving a ten month study of 21 older drivers who were considering giving up driving showed that driving incidents, health issues and social influence were triggers for contemplating giving up driving (Musselwhite and Shergold, 2013). A larger, longer term study of older drivers could reveal more about life course events that influence driver cessation.

The decision to acquire and relinquish other means of mobility such as a bicycle or public transport annual pass can significantly shape everyday mobility. Alongside their investigation of the effects of life events on car availability, Beige and Axhausen (2012) found that an increase in income, moving out of parent's house and migrating from abroad increased the likelihood of acquiring a season ticket. There is no research known to the authors that has investigated how life events influence bicycle ownership.

Table 1: Studies of the effects of life events on car ownership and access

Study	Data	Analysis	Effects of life events	Contribution
Mohammadian and Miller (2003)	Retrospective car transaction data for 9 years for 700 households in Toronto	Dynamic multinomial logit model for buy, disposal, trade or do nothing (unit=household-year)	Strong effect – no. adults Moderate effect – no. workers Also relevant – recent buy or trade	Considered transactions rather than only holdings. Limited life event information available.
Prillwitz et al. (2006)	Panel data for 2 waves (5 years apart) for 4,700 households in Germany	Binomial probit model on the propensity to gain an additional car (unit=household)	Strong effect – no. adults, first child, income Moderate effect – move house No effect - employment status, retirement	Considered increase in car ownership only
Dargay and Hanly (2007)	Panel data for 11 annual waves for 5,300 households in Britain	Bivariate associations between car ownership increases/decreases and life events (unit=household)	Strong effect – no. adults, employment status Moderate effect – move house, change employer No effect - retirement	Simple bivariate relationships only
Yamamoto (2008)	Panel data for 15 annual waves for 3,600 households in France	Competing risks duration model for car replacement, disposal and acquisition (unit=household)	Strong effect – no. adults, birth of child, income, move house	Tested one/two year lagged effect of events and found some significant results
	Retrospective car transaction data for 3 years for 2,200 households in Kofu, Japan	Multinomial logit model for decrease, increase or stay the same (unit=household)	Strong effect – no. drivers, no. workers Moderate effect – move house Also relevant – public transport access	Considered public transport access
Rashidi et al. (2011)	Panel data for 3 annual waves for 600 households in Seattle Metropolitan Area	Joint system of duration models between job relocation, residential relocation and car transaction (unit=household)	Strong effect – household member leaves, fuel price increase, Moderate effect – move house Also relevant – urban density, average household travel time	Jointly considered different car transactions (buy, dispose, trade)
Beige and Axhausen (2012)	Retrospective life history data for 20 years for 1,000 households in Switzerland	Random effects binary logit model for change in car availability (unit=person-year)	Strong effect – income, moving out of parent's house, birth of child, migration from abroad Moderate effect – increased distance from home to workplace	Did not differentiate between car availability increase and decrease

Oakil et al. (2014)	Retrospective life history data for 21 years for 300 households in Utrecht, Netherlands	Random effects binary logit models for car ownership increases and decreases (unit=person-year)	Strong effect – cohabitation/separation Moderate effect – birth of child (anticipated), move house, change employer, retirement (anticipated)	Considered simultaneous, lagged and anticipated effects of life events. Only small sample size.
Zhang et al. (2014)	Retrospective life history data for 1,000 households in major cities in Japan	Chi-squared Automatic Interaction Detector (CHAID) analysis to examine inter-dependence between car ownership changes and life events	The timing of car ownership changes are more influenced by residential moves than household and employment/education changes The timing of car ownership changes are strongly inter-dependent with past and future car ownership changes	Considered simultaneous, lagged (up to 25 years) and anticipated (up to 10 years) effects of life events. Did not distinguish acquiring and relinquishing car.
Oakil (2015)	Retrospective life history data for 21 years for 300 households in Utrecht, Netherlands	Random effects binary logit models for getting and losing full car access (unit=household-year)	Strong effect – cohabitation/separation Moderate effect – birth of child, move house, change employer Also relevant – above effects greater for women	Focused on gender differences and finds female car access is more sensitive to life events. Only small sample size.
Clark et al. (2015a)	<i>Understanding Society</i> panel data for 2 annual waves for 19,300 households in England	Binary logit models for different car ownership level changes (0-1, 1-2, 2-1, 1-0) (unit=household)	Strong effect – no. adults, cohabitation/separation, driving licence Moderate effect – employment status, income, birth of child, move house No effect – change employer, retirement Also relevant - public transport access	Separately considered different car ownership level changes (0-1, 1-2, 2-1, 1-0)
Clark et al. (2015b)	In-depth interview of 184 households in Bristol, UK	Thematic coding of main reason for latest car ownership change	Most common reasons: change employer, change employment status, cohabitation, move house, birth of child; child reaching driving age; company car acquisition or relinquishment	Inductive approach to identifying role of life events

5.3 Use of transport modes

The studies summarised in Table 2 have analysed a variety of different indicators of daily mobility. Findings on the relative importance of life events differ. Considering the two studies with the largest samples and most comprehensive recording of life events, Scheiner and Holz-Rau (2013a) found modest effects of life events when considering general mode use frequency and Clark et al. (2015c) found large effects when considering commute mode. It is unsurprising that a more substantial effect is found for more specific behaviour. Kroesen (2014) considered changes in general

mode use frequency using qualitative classification of overall behaviour into travel behaviour clusters or modality styles. He found that moving home and changing job influenced modality style.

Table 2: Studies of the effects of life events on daily mobility

Study	Data	Analysis	Life events*	Contribution
Prillwitz and Lanzendorf (2006)	Panel data for 2 waves (5 years apart) for 5,500 households in Germany	Change in annual household car kilometres travelled - bivariate relationships and linear regression model (unit=household)	Significant effects – number of adults and children, number of cars, change in commute distance, retirement (negative), move house for house quality reasons (positive), move to traditional urban area (negative)	Only study that has considered household overall car travel
Scheiner and Holz-Rau (2013a)	German Mobility Panel 1994-2008 (each household provides up to 3 annual observations) for 6900 individuals	Change in year-to-year number of trips per day of different modes (car driver, car passenger, public transport, walk, cycle) using cluster-robust regression (unit=individual)	Significant effects – driving licence, car availability, birth of child (increases walk), cohabitating (increases car passenger), change in employment status (gain increases car driver, loss increases walk) easier parking at workplace (increases car driver), house move to periphery (decreases walk), house move to urban centre (increases walk)	Comprehensive set of life events examined. Only modest effect of life events found but strong baseline effects (implying delayed response to life course changes).
Scheiner (2014a)	As above extended to 1994-2010 for 7700 individuals	As above but with separate models for females and males and only for car driver, public transport and walk (unit=individual)	Gender differences in effects – birth of child (increases walk of females only), leaving employment (decreases public transport for females), house move to urban centre (increases public transport for females)	Theory-based examination of gender differences in travel behaviour change-life event effects, finding modest differences.
Kroesen (2014)	Dutch Mobility Panel 1984-89 for 5300 individuals	Latent class transition analysis for between year changes in travel behaviour clusters (strict bicycle user, strict car user, light traveler, joint car and bicycle user, public transport user) (unit=individual)	Significant effects – moving house (changing from strict bicycle user to strict car user, strict car user to public transport user, public transport user to strict bicycle user), job change (changing to public transport user)	Using latent class approach allows qualitative categorisation of daily mobility style and analysis of how life events contribute to change.

Prillwitz et al. (2007)	Panel data for 2 waves (5 years apart) for 3,200 workers in Germany	Change in commute distance - linear regression model (unit=worker)	Significant effects – number of household cars, availability of car for commute, house move to less urbanised area (negative), house move to single family house (increase), job change (increase) No effect – family changes, change in income, change in public transport access	Only study that has considered commute distance
Dargay and Hanly (2007)	Panel data for 11 annual waves for 5,400 workers in Britain	Bivariate associations between commute mode changes and life events (unit=worker)	Strong effect – move house, change employer	Simple bivariate relationships only
Oakil et al. (2011)	Retrospective life history data for 21 years for less than 200 workers in Utrecht, Netherlands	Random effects binary logit models for changing between car and non-car commuting (unit=worker-year)	Strong effect – household car ownership, changing employer (simultaneous and 1 year after), birth of first child (to car only), changing to part time work (to non-car), separation from a partner (1 year after). No effect – house move.	Considered simultaneous, lagged and anticipated effects of life events. Only small sample size.
Clark et al. (2015c)	<i>Understanding Society</i> panel data for 2 annual waves for 15,200 workers in England	Binary logit models for changing between car and non-car commuting and active and non-active commuting (unit=worker)	Significant effects – driving licence, distance to work (associated with house move and/or job change), change in residential context (associated with house move), job change in its own right, separation from a partner (to non-car) No effect – birth of child, change in income	Detailed spatial data considered. but Also strong baseline effects for residential context (implying delayed response to life course changes) and for environmental attitude (implying adjustment in behaviour towards attitude).

Note: * Direction of effect of life events indicated where helpful, otherwise as intuitive

Evidence of delayed (lagged) responses to life events is explicitly available from Oakil et al. (2011) and implicitly available in other studies where it is found that changes in mode use are related to baseline variables such as family composition and residential and workplace context (Scheiner and Holz-Rau, 2013a). It has been found that commute mode changes are made consistently with baseline environmental attitude (Clark et al., 2015), implying long-term held attitudes play a role alongside life events.

It would be valuable to extend research on the use of transport modes to examine more specific types of travel behaviour (not only commuting but also other purposes of travel) and to extend the scope of life events (micro level events) considered, as well as also considering the influence of macro level changes (such as changes to transport system). The main barrier to this is the challenging data requirement of comprehensive information on travel behaviour and on life situation (both needing to be captured repeatedly) which is difficult to justify on a large-scale for the study of transport alone. It is also difficult to recreate retrospectively. Oakil et al. (2011) attempted this but their sample size is modest and Schoenduwe et al. (2015) discussed memory issues with recollecting past, routine behaviours.

5.4 Turning points in travel behaviour

A small number of studies have investigated the reasons for significant turning points occurring in the trajectories of travel behaviour with particular attention to the role of life events. They have all focused on cycling. Bonham and Wilson (2012) collected the cycling histories of 49 women in Australia who had returned to cycling and revealed the events and circumstances that triggered cycling returns. Social relationships were important for women returning to cycling in their 20s, while health and fitness concerns were important for those in 30s.

Chatterjee et al. (2013) investigated turning points in the cycling behaviour of residents living in 12 city and towns in England that experienced investment in cycling through the use of retrospective in-depth interviews, supported by the use of three-year life segment calendars. They found that turning points were usually triggered by life events but external changes to the bicycle environment played a facilitating role in enabling change. The types of life transitions/events that were relevant varied over the age span of participants but included educational and employment events, relationships and residential location events, children's development, physical health episodes and changes in leisure and fitness activities.

Underwood et al. (2014) investigated why teenagers abandon cycling based on 54 in-depth interviews with adults in Davis, California. They found that attitudes to cycling (particularly image associated with cycling) changed in the transition between elementary school and high school.

5.5 Summary

Changes to car ownership and access are found to be strongly associated with household composition changes and driver licence availability. Results for changes to daily travel behaviour depend on the degree of specificity in how travel is measured. Commuting behaviour is strongly affected by changes in residential and workplace location. General use of travel modes is less clearly affected by particular life events. Existing studies have not given much insight into the timing of travel behaviour change with respect to life events and how combinations of life events act together to influence travel behaviour.

6. The residential relocation and travel behaviour inter-relationship

Studies have looked at the effect on the use of transport modes of the birth of children (Lanzendorf, 2010), leaving higher education (Harms and Lanzendorf, 2007) and an office relocation (Walker et al., 2014), but moving home has been the life event that has been researched the most and we provide a summary of what has been learnt about the relationship between residential relocation and travel behaviour.

6.1 Theoretical considerations

In Europe, about 7% of the population change their residence every year, compared to about 16% in the US. The figures vary strongly by country. The annual mobility rate in the UK is about 10%, while in Germany it is only 6% (Janiak and Wasmer 2008, p22). These figures are roughly twice as high among young adults (ibid.). Further, changing residence is more likely among single households than couples, among households without children than those with children and among renters than home owners (see Kley, 2009).

Home moves often coincide with other life events. It has been found that of those moving home in England between 2009/10 and 2010/11, 19% had switched employer, 8% had gained employment, 10% had begun cohabiting with someone new and 7% had a baby (author's own analysis of Understanding Society data - unpublished). The strongest association is with employment changes, indicating that the two life events are often related. People often accept a need to move home in order to access a new job or alternatively need to find a new job having moved location for other reasons.

The reason why residential relocation can be expected to affect travel behaviour is because access to opportunities is likely to change. Such opportunities include activity places like the workplace, retail and leisure facilities, and transport opportunities (Van der Waerden et al. 2003). These considerations suggest that two features of relocation are important.

Firstly, the combination of the pre-move home location and the post-move home location is of great importance, as a change in accessibility is as much influenced by neighbourhood/location attributes at the former place of residence as those of the new place (Krizek, 2000). For instance, there is no reason to expect a move to an inner city neighbourhood will increase public transport use if the former residence was in a similar neighbourhood. Secondly, distance of the move needs to be considered, as it indicates the extent to which existing activity places can be maintained after the move. Long-distance migration might lead to more long-distance travel to visit relatives (Axhausen et al. 2006; Frändberg 2008), whereas the former workplace is not likely to be maintained (in many cases a workplace change will have triggered the long-distance relocation). In double-income households, relocating closer to the workplace of one partner might lead to longer commutes for the other.

6.2 Empirical findings: Car availability and use of transport modes

Several studies have found that car availability and travel mode use change after residential moves. This counters the idea of residential self-selection in travel behaviour to some extent. If spatial differences in travel were caused exclusively by residential self-selection, no changes to travel would be expected after residential relocation as such changes suggest adaption to the built environment while the self-selection hypothesis suggests that travel behaviour is instead an effect of preferences.

Handy et al. (2005) found from California data that there are significant changes in travel mode choice as well as in travel distances by car after residential moves, even when controlling for attitudes. This is confirmed for mode use (Cao et al., 2007b), while conclusions in a related study on changes in car ownership are more cautious (Cao et al., 2007a). Even though built environment effects are found in these studies, the effects of socio-demographics and attitudes on travel mode choice and car ownership dominate.

Scheiner and Holz-Rau (2013b) showed that suburban moves in Cologne are followed by increases in car use and decreases in public transport use, cycling and walking. The opposite is true for relocations into the city. The changes are stronger for car and public transport than for cycling and walking. These changes are not only induced by changes in the objective built environment, but also by changes in the levels of satisfaction with attributes of the built environment. They conclude that people adapt their travel behaviours to the new environment following a move. Scheiner (2005) confirms this for the number of cars per adult in households. He adds that the number of cars per adult in suburbanising households *before* their move is distinctly higher than that of 'stayers' in the city, suggesting that households select themselves into certain neighbourhood types according to their car availability. This result controlled for demographic differences between the groups. Conversely, Buchanan and Barnett (2006) find little change in mode choice after relocating from a relatively central to a remote residential development in Christchurch, New Zealand. This may be due to the heavy reliance on the car in this setting irrespective of the residence.

Weinberger and Goetzke (2010) studied car ownership among recent movers in the US. They find that those whose move originated in a major metropolitan area own fewer cars than those who moved from smaller metropolitan or non-metropolitan areas. They conclude that learning processes based on previous experience are at play. Learning processes are also evident after relocation. Stanbridge and Lyons (2006) found that travel mode options are reconsidered to a considerable degree after residential moves, even if this does not result in actual changes in behaviour.

Verplanken et al. (2008), using a sample of university employees in England, found that people may use moving home as an opportunity to re-align their commuting behaviours with attitude orientations. People with environmental concern who had moved home within the last year were shown to use a car less to get to work than those who had environmental concern and not moved, and those who had moved and did not have environmental concern

6.3 Empirical findings: Activity spaces and trip distances

Destination choice, activity spaces and related trip distances (before and) after residential moves have been examined less frequently. The few studies available appear to be mostly from Germany. They typically focus on spatial ties to the former place of residence after the move.

In Berlin suburbs, Holz-Rau (2000) compares destination choice between the long-established population and those who have recently moved from the urban core. He shows that those who moved travel more often to the city centre. He also points out that the 'core city orientation' in commuting decreases with increasing duration of residence in the suburbs, suggesting time-lagged changes of workplace. Both findings are echoed by Scheiner (2009) in a Cologne study. He adds that trip distances are positively correlated with relocation distance. This correlation is most pronounced for leisure activities.

Kloas et al. (2001, pp. 118-137) investigate travel effects of relocating from cities to suburbs and vice versa in Germany, as measured by population density. Multiple regression models indicate that travel distances increase by 140 km per capita per week after moving to a less dense area, even when socio-demographics and car availability are being controlled. Vice versa, travel distances decrease after moving to a denser area.

Albrecht (2014) uses a sample from the Ruhr region (Germany) to study daily spatial ties to the former place of residence in terms of shopping, personal errands, leisure and private visits. She defines these ties as trip destinations located near the former residence in a circle whose radius is half the distance between the former and the recent residence. Six of ten respondents in her sample have such spatial ties; these amount to about 10% of trips. Regression analysis shows that the ties decrease over time after the move, with the distance of the move, and with land-use diversity at the new residence. Conversely, ties are stronger when the workplace is located close to the old residence.

Buchanan and Barnett (2006) study trip distances after relocating to a remote residential development in Christchurch, New Zealand. The distances per trip increase by about 40% and 50% for trips to work/education (from 6.8 to 9.6 km) and shopping (from 2.9 to 4.4 km), respectively, while leisure trip distances increase marginally. The similarity between the increases in work/education and shopping trips is of particular interest, as in almost all cases the destination of work/education trips remained the same, while the majority of shopping destinations changed. Hence, distances increased even though shopping activity spaces were adapted after the relocation.

Matthes (2015) reconstructs daily travel patterns from qualitative interviews held in Hamburg with households who relocated from a suburb to the urban core. Her data show that shorter trips and less car use after the move are based on households' deliberate considerations. For instance, households take into account any new workplaces taken up by a household member in their relocation decision.

6.4 The role of transport and access in relocations

Not only does residential location affect travel behaviour but transport and access also can influence residential choices, even though the primary factor for residential choices is the property market (availability, price and spatial distribution of property and dwellings). Transport and access in this context include a range of different dimensions: (1) transport supply i.e. transport infrastructure and services, (2) individual transport options and behaviour, and (3) access to facilities, which is determined by proximity (which is in turn a function of density and land-use) and transport (the former two dimensions). In combination with residential preferences these elements result in a trade-off made by households between housing costs and transport costs (Boarnet and Crane, 2001).

The role of transport supply and facilities (dimensions 1 and 3) in residential choice may be measured economically by the effects they have on land prices (e.g., Diao, 2015), or by households' preference ratings. Different considerations come into play, if one approaches the problem from an individual travel perspective (dimension 2). The impact of individual travel options and behaviour on housing mobility may be illustrated with respect to the car. By the very cost of the initial investment, the purchase of a car predetermines future mode choice and multiplies the possibilities of a household's location choices, while the choices of non-car households depend on access to public transport and the quantity and quality of neighbourhood facilities (van Wee et al. 2002, Prashker et al. 2008). What is more, daily destinations such as the workplace or school, residences of family or friends, or leisure facilities regularly visited, may affect or even determine residential choice (see Michielin et al. 2008 for family network), albeit only in cases where these destinations are expected to be maintained after the residential move.

Although transport may not be the main factor for a move for most people, it nevertheless remains an important consideration during the moving process. Stanbridge and Lyons (2006) conducted a survey of 229 recent home buyers in Bristol in 2005 (rental movers were not considered in the study) and found that 26 per cent of the sample reported travel related prompts for moving home. The most commonly reported transport prompts were moving nearer to work (13% of all reported prompts for moving) followed by being nearer to family (10% of all reported prompts for moving) and being nearer to school (7% of all reported prompts for moving). With respect to the property search criteria, housing and neighbourhood quality/location were found to be ranked as being more important than transport considerations. However, accessibility to shops and schools was listed as the 5th most commonly reported search criterion, with travel to work and parking being ranked 8th and 9th respectively.

6.5 The effectiveness of travel behaviour change interventions that target movers

A number of studies have targeted home movers to encourage reduced car use. These are often part of wider programmes of voluntary travel behaviour change (VTBC) or Travel Demand Management (TDM) (Chatterjee, 2009).

A widely cited international study by Bamberg et al. (2003) targeted people who had moved to a new home in Stuttgart, Germany. Half of the subjects in this study were

given a public transport information pack (including a free day ticket) six weeks after they had moved and half were not given the pack. They found from comparing behaviour before the move and 12 weeks after the intervention that for both groups the change in decision context caused the subjects to re-evaluate their behaviour. Furthermore the experiment group was more likely to change to public transport use after the move compared to the control group (19% to 47% for those that received the travel information compared to 19% to 24% for those that did not receive the travel information). The effect was found to be particularly large for those that expressed a more positive intention to use public transport use prior to the move and it was considered that the free ticket provided a 'final push' to act. Rölle et al. (2001, p. 112-116) report from the same study that the modal share of public transport was still higher in the experimental group than in the control group eight months later. This finding, however, was based on a very small sample (n=49 in the experimental group).

Further intervention studies aimed at new residents have taken place in other German cities (generally consisting of public transport information and free public transport taster ticket) and showed similarly positive results (Bamberg et al., 2008, Bamberg and Farrokhikhiavi, 2009, Vallée et al., 2010).

The SEGMENT European project (SEGMENT 2013a) tested interventions aimed at people experiencing life change moments and sought to use attitudinal segmentation as a basis for differentiated marketing (the segmentation distinguished people by their attachment to the car, self-identification with alternative travel modes and motivations for fitness and environmental protection). Interventions aimed at new residents were undertaken in Almada (Portugal), Munich (Germany), Sofia (Bulgaria) and Utrecht (Netherlands). In Utrecht two types of new residents were identified: 'practical peddlers' and 'aspiring environmentalists' (SEGMENT 2013b). The marketing campaign attempted to reinforce desirable behaviour and to get people to experiment with new means of transport. It involved welcome packs issued a few weeks after the residents moved to/within Utrecht, including a letter from the deputy mayor and a cycling map. A treatment group received the welcome packs and a control group did not receive the packs. The results for the treatment group compared to the control group indicated a modal share reduction of 4% for car use and modal share increase of 3% for public transport and 2% for cycling. Results from similar surveys in Sofia showed positive results (7% reduction in car modal share) but for Munich showed negative results (2% increase in car modal share).

6.6 Summary

The findings on residential relocation show that transport preferences enter into the decision making of many movers and they adjust their travel behavior to the new residential context but are also influenced by their former residential location. VTBC interventions have been shown to have an effect on the car use of new residents, indicating that at least some are in a deliberative phase in the period after making a move. Indeed, Stanbridge and Lyons (2006) found about 30% of new home buyers in Bristol still gave transport consideration some time after the move. Jones and Ogilvie (2012) found that people differ in the extent to which they plan travel, including the journey to work during the moving process, and are not fully aware of transport opportunities until after the move.

7. The role of socialisation in travel behaviour

We now move away from considering discrete events to looking at the impact of peers on individual travel behaviour. This issue has been studied less, and the link to the life course is not always obvious. For instance, there is a large research on intra-household interactions in travel that does not explicitly consider life course issues (Ho and Mulley 2015). However, given that the effects of a partner or other family members on an individual's travel behaviour are likely to persist rather than just affect behaviour at a discrete point in time, these effects may best be understood with a life course perspective.

Haustein et al. (2009) conducted a study showing three different aspects of socialisation are relevant for car use: communication with parents about the environmental impact of travel mode choice at the participants' age of 15; the symbolic-affective importance of driving and acquisition of a driver's licence at the age of 18; and multi-mobility in the peer group at the age of 18. Driller and Handy (2013) showed from qualitative interviews with parent-child pairs in Davis, California, how parents shape their children's attitudes towards and use of the bicycle.

Döring et al. (2014) used a sample of German students, their parents and grandparents to study inter-generational influences in residential choice, travel attitudes and commute modes. The latter are measured roughly over the whole span of an individual's employment career. The study is limited to the parental and grandparental generation in the sample, as few students had experienced any work trips. They find significant and positive interrelations between the generations in a family both with respect to residential choice and travel attitudes, while the evidence for inter-generational (socialisation) effects in mode use is limited.

Albrecht et al. (2015) use the same data as Döring et al. (2014) to focus on residential biographies. They found that the residential migration history of respondents at their family formation stage – being immobile, mobile or returner – is positively affected by having a parent with a similar migration history. In a similar way, Myers (1999) found that an adult child's number of moves is positively associated with his/her parents' number of moves. Blaauboer (2011) found inter-generational similarities in the choice of residential environment.

In a wider sense, cohorts may be understood as peers in that they share collective experiences and histories. People belonging to a cohort may reinforce each other's attitudes and behaviour by way of developing social norms. This is also true for those sharing a place of residence where they develop a specific 'mobility culture' (see for discussion Weinberger and Goetzke (2010), Klinger and Lanzendorf (2015)). This may contribute to cohort effects in travel, but also to period effects, in cases where a historical event or situation at a particular point in time affects everyone who experiences it.

Cohort and period effects have been studied simultaneously with life course events by Scheiner and Holz-Rau (2013a) and Scheiner (2014a, 2014b) using the German Mobility Panel. Scheiner and Holz-Rau (2013a) found that subsequent cohorts in Germany drive more and use public transport less than their predecessors, but the

cohort changes are smoothing over time. No period effects in mode use could be detected. In a follow-up paper, Scheiner (2014a) found that these trends differ by gender. While driving trends for men are more affected by cohort, those for women are subject to period effects. Scheiner (2014b) added that both tour complexity (trips per tour) and activity pattern entropy increase from one cohort to the next up to those born around 1980, but decrease in younger cohorts.

Jones et al. (2015) conducted life history interviews with participants from two cohorts to study differences in the development of travel behaviour over the life course. The participants comprised eight females and eight males in their 50s and 60s (born 1945 to 1955 and labelled as 'Boomers') and a further eight males and nine females in their 20s and 30s (born 1975 to 1985 and labelled as 'Echoes') with all participants recruited from the Bristol area in the UK. Distinctions were apparent between the gender and cohort groups in their travel behavior trajectories. For instance Echo Females tended to learn to drive earlier in life than Boomer Females and organise their travel behaviour based on car use, while Echo Males exhibited longer periods in early adulthood without daily use of the car than the Boomer Males. The study also offered some support for early life experiences having longer term influence on later outcomes, specifically in that episodes of cycling in early adulthood enabled later engagement with cycling. This was evident for Boomer Females who cycled more in early adult life (often during breaks in employment careers) and made successful returns to cycling in later adulthood and for Echo Males who continued to cycle in youth (often as a social/leisure interest) and incorporated cycling to work in their early working careers.

Socialisation plays an important part in the development of travel behaviour. As such it may be used as a key concept in holistic approaches to studying travel behavior over the life course. Miles et al. (2013) argue for the use of life history interviews to investigate this. They make a case for interpretive, narrative research involving "accounts of the past as a resource for better appreciating the ways in which people make meaning of (and justify) their lives" (Miles et al. 2013, p. 176), rather than employing what they call linear, positivist, cause-impact oriented approaches.

8. Future research directions and concluding remarks

From our review of the literature we identify ten recommendations for future research in the area.

1. Broaden scope of travel behaviour considered. Most studies focus on changes in car ownership/access and the use of transport modes. The few existing studies on changes in trip distance, activity spaces and spatial orientations suggest that this may be another fruitful area of research. Changes in activity patterns, trip chaining and other dimensions of travel have hardly been studied (but see Scheiner, 2014b).

2. Broaden scope of life events considered. While life events in the residential, employment, and household domains have been found to be important for understanding the development of travel behaviour, events in other domains such as leisure participation or health could be helpful for understanding travel behaviour. Also undesirable events, such as traffic accidents, should also be accounted for in more depth in biographical research (see Lee et al. 2012 for a study that considered

effect of bicycle incidents and crashes). Further, the effects of life events experienced by one family member on another family member have hardly been studied to date.

3. Consider interactions between events in different domains. The interactions between different life events have hardly been considered. For instance, residential moves often are concurrent with household or work related events and the impact on travel behaviour will be affected by this. Also the sequence in which events occur will be important for future life development.

4. Apply biographical research to study responses to changes to the transport system. While we argued at the start of the paper that a major motivation for biographical research is to understand the role of life course changes in how people respond to (temporary or permanent) changes to the transport system, few studies have sought to investigate this (Chatterjee et al. 2013 is an exception). To undertake this is challenging. It requires the collection of longitudinal data for a sufficient sample of individuals at an appropriate geographical scale (related to the transport system change) and capturing changes to their life situation and travel behaviour. What is more, judging the policy relevance of behavioural changes requires not only looking at their statistical significance, but also the magnitude of effects of policy relevant variables.

5. Account for reverse dependencies. The findings from studies of residential relocation and travel behaviour are of importance for spatial planning, as they contribute to knowledge about causality of the interrelationship between the built environment and travel behaviour. They are closely linked to the debate on residential self-selection effects in travel behaviour (see the special issue of Journal of Transport and Land Use, Vol. 7(3), 2014). Future research needs to account more fully for reverse dependencies.

6. Develop theory. Theoretical explanations for the effects of life transitions and events have not been fully developed to date. The concept of stress could be useful as a theoretical mechanism here. This not only refers to the stress induced by life events on travel behaviour, but also to the possible impact of accessibility or mobility stress on life events such as residential relocation (Motte-Baumvol et al., 2010).

7. Develop analytical methods. Even though most studies have utilised statistical modelling, more sophisticated frameworks for analysing interdependencies between transitions, events and trajectories would be helpful. These may include structural equation modelling, Bayesian networks, latent growth models and other analytical methods. The integration of lagged effects and anticipated events is also an important point here (Oakil et al., 2014).

8. Recognise subjective perspective of individuals. The subjective perspective of individuals and their own reconstructions of their mobility biographies has received little attention (Miles et al. 2013). Looking at mobility biographies from the perspective of respondents and reflecting their statements and narratives against other historical material could further enhance understanding of the development of travel behaviour.

9. Investigate longer term trajectories. Most of the research using biographical methods has focused on short segments of people's life courses or on discrete events. Study of longer-term trajectories offers potential to understand the broad development of travel behaviour over time and the key factors that influence individuals to take different paths. Jones et al. (2014) used life history interviews to retrospectively construct life-long trajectories of walking and cycling and to seek to understand these. Outside transport, Barnett et al. (2008) examined trajectories of individual behaviour constituted by prospective self-reporting of physical activity at three time points within a twenty-two year period. Latent class growth analysis identified distinct classes of trajectory and found that being female, older, having low income or lower educational achievement predicted a type of trajectory that was inactive or decreasing.

10. Gain an appreciation of the wider context. By obtaining biographical data for different cohorts (living in different times and places) it is possible to discover the role of social, economic and cultural contexts in a methodologically sound way and to contribute to a deeper understanding of the context for travel.

In conclusion, life course approaches to travel behaviour, often labelled as mobility biographies, have emerged as a fruitful and promising research field over the past decade. They understand travel behaviour in the context of individual life courses and their phases of stability and change induced by life transitions and events, and they consider these individual processes to be embedded in personal networks and wider societal, economic and spatial processes. Doing so, they contribute to a better understanding of travel. Research to date has shown that changes to travel behaviour are closely associated with life course events and with broader life development. Of particular interest for the future is to better understand what features of life course events are important in determining travel behaviour changes, to consider how life events themselves are influenced by travel preferences, to consider how different events interact to shape travel behaviour and to view and understand travel behaviour development over the life span.

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