

Clark, Chatterjee, Melia, Knies and Laurie

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1 **LIFE EVENTS AND TRAVEL BEHAVIOUR: EXPLORING THE INTER-**
2 **RELATIONSHIP USING THE UK HOUSEHOLD LONGITUDINAL**
3 **STUDY**

4
5 Ben Clark

6 Kiron Chatterjee (corresponding author)

7 Steve Melia

8
9 Centre for Transport & Society

10 Department of Geography and Environmental Management

11 University of the West of England

12 Bristol

13 BS16 1QY

14 UK

15 Tel: +44(0) 117 32 8 {3066; 2032; 3267}

16 Fax: +44(0) 117 32 83002

17 E-mail: {Ben4.Clark; Kiron.Chatterjee; Steve.Melia}@uwe.ac.uk

18
19 Gundi Knies

20 Heather Laurie

21
22 Institute for Social and Economic Research

23 University of Essex

24 Wivenhoe Park

25 Colchester

26 CO4 3SQ

27 UK

28 Tel: +44(0) 1206 87 {2734; 3556}

29 Fax: +44(0) 1206 873151

30 E-mail: {gknies; laurh}@essex.ac.uk

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1 ABSTRACT

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3 Recent research has indicated that changes in travel behaviour are more likely at the time of
4 major life events. However, there remains much to learn about the extent to which different life
5 events trigger behavioural change and the conditions under which life events are more likely to
6 trigger change. The UK Household Longitudinal Study (UKHLS) offers a previously
7 unavailable opportunity to investigate this for a large, representative sample of the UK
8 population. We have also linked UKHLS data to local spatial data, drawn from the census and
9 other sources, to elucidate the effect of the spatial context on changes to travel behaviour in
10 association with life events. Findings from an exploratory analysis of UKHLS waves 1 and 2
11 data are presented first. Transition tables demonstrate a strong association between changes in
12 car ownership/commute mode and the following life events: employment changes, residential
13 relocations, retirement, child birth and changes in household structure. Results are then shown
14 of logit models which relate the probability of an increase and decrease in the number of cars
15 owned to the occurrence of life events, controlling for individual and household characteristics
16 and spatial context. These show, for example, that urbanizing and ruralizing moves have
17 contrasting effects on travel behaviour and having a new child in itself is not a significant
18 influence on car ownership in the short term.
19

1. INTRODUCTION

Worldwide, there is interest in reducing the negative impact of motorised personal transport. The UK Department for Transport's (DfT) business plan incorporates priorities to "encourage sustainable local travel" (1). Making public transport, walking and cycling more attractive is seen as instrumental in achieving this priority. DfT's behavioural insights toolkit argues that "people...are likely to be most open to changing habitual behaviours at key 'transition points' or 'moments of change' (2). We refer to these as life transitions and use the definition of these as 'major or minor life events that may cause changes in one's life and relationships' (3).

Longitudinal data provides information regarding the process of behavioural change and thus provides a stronger evidence base for identifying the antecedents of behavioural change than cross-sectional data (4). Longitudinal research has shown that the formation of habits acts to maintain stable travel behaviours but life transitions can prompt a reconsideration of routine behaviours, breaking habits and prompting travel behaviour change (5). This body of evidence has nevertheless relied on relatively small scale retrospective surveys. It has also not been examined how spatial context affects how people respond to life events or how the role of life transitions varies at different life stages. The aim of this paper is to explain how a longitudinal data set, based on a sample representative of the English population, has been generated to investigate the inter-relationship between life transitions and travel behaviour. The paper also contributes new evidence on the effect of life transitions on car ownership and commuting behaviour.

The next section reviews current knowledge on the relationship between life transitions and travel behaviour after which a research framework is established. The generation of a data set suitable for the research is described before results are presented on the prevalence of life transitions and their association with changes in travel behaviour. Multivariate analysis of car ownership change is then used to illustrate what can be learnt about the role of life events while controlling for other factors.

2. EXISTING KNOWLEDGE ON LIFE TRANSITIONS AND TRAVEL BEHAVIOUR

2.1 Theoretical and Conceptual Development

Jones et al (6) emphasised the importance of family life-cycle stages in determining travel behaviour, particularly noting the importance of constraints that exist at each stage. The implication is that changes in life stage are likely to lead to change in travel behaviour. Cohort studies compare different age cohorts and how their travel behaviour differs over the life span. As well as differences between life stage groups, cohort studies enable the effect of different historical experiences to be identified. Dargay and Vythoukias (7) used pseudo-panel data to show that car ownership increases as head of household reaches the age of 50 and thereafter declines, but also that successive generations have higher car ownership than earlier ones, indicating the importance of the time in which the cohort lived. It can be argued, however, that life 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 within the same age cohort.

A more general proposition was made by Fried et al (8). Behaviour is considered to be continually in a process of adaptation to changes in personal needs and environmental structures.

1 Life events can be viewed in this context as internal forces that lead to changes in circumstance.
 2 Salomon and Ben-Akiva (9) introduced the concept of a decision hierarchy with three inter-
 3 dependent levels. Lifestyle choice is at the top level and represents the longest term decisions
 4 (e.g. family formation) below which is mobility choices (e.g. car ownership) with activity and
 5 travel choices at the lowest level. Lanzendorf (10) returned to the ideas of Salomon and Ben-
 6 Akiva and introduced the concept of mobility biographies, explicitly recognising the importance
 7 of the time dimension in people's lives. He proposed three biographical domains (lifestyle,
 8 accessibility and mobility domains) which are interlinked with events in one domain affecting
 9 the others. He noted that habitual behaviour forms in stable circumstances and can be interrupted
 10 by the occurrence of life events.

11 Miller (11) took a similar conceptual approach to Salomon and Ben-Akiva but with two
 12 levels of decision making with long run decisions determining spatial context and transport
 13 resources and short run decisions determining day to day travel choices. Short run decisions are
 14 governed by the resources and constraints set by long run decisions. He used the concept of
 15 household 'stress' which can occur where there is constraint from the spatial and mobility
 16 context which can motivate changes of different kinds (for example, change of mode or purchase
 17 of car). Clark (12) puts forward a process model for car ownership change which draws on the
 18 concept of stress. This model hypothesises that life events may produce a discrepancy between
 19 current car ownership needs and the actual car ownership state which may no longer be suitable,
 20 having been established to meet the needs of a past circumstance.

21

22 **2.2 Exploratory Studies on Role of Life Events**

23

24 We now review empirical evidence on the role of life events in travel behaviour change. Initial
 25 studies of the impact of life events sought to identify the most influential life events for travel
 26 behaviour. Van der Waerden and Timmermans (13) identified 90 key events and critical
 27 incidents with potential to influence travel behaviour and then conducted a detailed survey
 28 involving 173 respondents (14) on the effects of a short-listed set of 17 of the events. The events
 29 which had most impact were reported to be a residential move, starting first job, change of work
 30 situation, getting a driving licence and getting a new car.

31 Similarly, Klöckner (15) carried out an online survey of 91 participants in Germany and
 32 asked them to identify up to 10 life events that influenced a change in travel mode. The most
 33 commonly identified events were moving to a new town (mentioned by 61%), starting
 34 studies/apprentice (55%) and acquiring driving licence (54%). Looking at retrospectively
 35 recorded mode usage over the life course and the occurrence of life events, Klöckner concluded
 36 that the life events experienced and their significance for mode use varied across the sample.

37

38 **2.3 Studies of Specific Life Events**

39

40 A number of studies have focused on specific life events. Residential relocation and job changes
 41 have received the greatest attention. Stanbridge and Lyons (16) found that 27% of respondents to
 42 a survey of home movers in Bristol (England) reported changing commuting mode after moving.
 43 They found that respondents differed not only in the degree of consideration of transport in the
 44 moving decision but also in the stage in the move process where they considered transport.

45 Verplanken et al (17) studied university employees who had recently moved and found
 46 that those with environmental concern were more likely to have reduced car use after moving.

1 Scheiner and Holz-Rau (18) used retrospective data collected in Cologne to analyse how
2 residential relocations affect change in use of car, public transport, walking and cycling. They
3 found an effect from the change in built environment characteristics. Changes in household
4 structure occurring simultaneously to the move also were found to play a role, demonstrating the
5 importance of recognising interactions between different life events.

6 Lanzendorf (19) conducted retrospective interviews of 20 parents in Leipzig, Germany. It
7 was found that child birth events tended to increase levels of car use, but conversely there was
8 another group of mothers that reduced car use. Harms and Lanzendorf (20) conducted a survey
9 on the travel behaviour change of 1800 students who had graduated from university in Leipzig
10 and started employment. The survey revealed that the most decisive changes in mobility
11 behaviour occur when the first well-paid full-time job is started; before occurrence of this event,
12 individual needs, opportunities and abilities may change in short intervals.

13 Involvement in transport incidents might also influence travel behaviour. Lee et al (21)
14 obtained cycling histories of 54 residents of Davis (California) and used these to examine the
15 influence of cycling 'incidents' (accidents involving and not involving other vehicles) on cycling
16 attitudes, comfort and preferences. They found incidents in childhood had less serious impact
17 than those in adulthood.

18 One study has tested whether an intervention at the time of a life event influences travel
19 behaviour after the event. Bamberg et al (5) investigated changes in car use of people moving
20 home to Stuttgart, Germany, with half of the participants studied being given a public transport
21 information pack. They found that the move caused the participants to re-evaluate their
22 behaviour and that the group receiving the pack changed more to public transport use after the
23 move. This indicates that an intervention timed to coincide with a life event can achieve a shift
24 in travel behaviour.

26 **2.4 Travel Behaviour Change and the Role of Life Events**

27

28 Other studies have taken the opposite stance and focused on travel behaviour change and
29 investigated the role of life events. Dargay and Hanly (22) found using British Household Panel
30 Survey data that higher rates of car ownership change were noted for households who moved
31 home (27.2%), or where an individual changed employer (25.9%), than those where neither of
32 these events took place (13.8%).

33 Beige and Axhausen (23) carried out a 20 year retrospective biographical survey of
34 residents in the Zurich region (Switzerland). They observed that the lives of young adults are
35 subject to greater frequency of life events. They examined the relationship between changes in
36 car ownership and public transport season ticket holding and life events and other contextual
37 factors but did not distinguish between positive or negative changes in the behaviour and hence
38 the findings are ambiguous about direction of effect.

39 Oakil et al (24) used a 20 year retrospective life calendar grid to collect data from
40 residents of Utrecht region (Netherlands) on life events and change in car ownership. Cross
41 tabulations showed prevalence of car ownership changes in the same year as life events or one
42 year earlier or after. Childbirth and residential relocation were found to be associated with a
43 change in car ownership in advance of the event while job changes were associated with a
44 change in car ownership after the event. This is supported by Clark's (12) neighbourhood survey
45 which generated 184 qualitative household car ownership histories. Two thirds of car ownership
46 level changes recorded were found to be associated with life events (encompassing employment

1 changes, cohabitation, an adult joining or leaving the household, residential relocation, child
2 birth, offspring reaching driving age and retirement).

3 Commuting behaviour has also been a focus of interest. Dargay and Hanly (22) found
4 that whilst 14.0% of those who do not move home and do not change employer change commute
5 mode, this increases to 28.1% for those who move home, 32.7% for those that change employer
6 and 44.6% for those that change both home and employer. Prillwitz et al (25) used 1998-2003
7 German Socio-Economic Panel data to explore the factors associated with a change in commute
8 distance. They found that an increase in commuting distance was associated with a job change,
9 increase in car availability, move from an urbanised centre to peripheral area and move to single
10 family-house.

11 Goodwin (26) examined the role of life events (relating to life stage, employment status,
12 income and car ownership) for public transport use and found that those with life events
13 occurring are more likely to change public transport use. Chatterjee et al (27) investigated
14 turning points in cycling behaviour through in-depth interviews and found that turning points
15 were usually triggered by life events. Cases where participants started to cycle to work were
16 triggered by starting a new job, a change of workplace or an event provoking concern about
17 health.

18 Scheiner and Holz-Rau (28) used data from the German Mobility Panel for an analysis of
19 year-to-year changes in general use of travel modes and their relationship to life events, while
20 controlling for socio-demographics, spatial attributes and period effects. The results suggest a
21 modest effect of life events on travel mode use with behaviour appearing stable in the short term
22 after life events occur. This contradicts the other studies reported in this review and highlights
23 the need for further investigation examining more specific travel behaviour indicators (such as
24 car ownership and commuting mode).

26 **2.5 Inter-dependencies between Life Events and Travel Behaviour**

27
28 Some studies have examined inter-dependence between life events and travel behaviour in both
29 directions. They highlight that life events are not necessarily exogenous from travel behaviour
30 and can be partly stimulated by travel circumstances. Van Ommeren et al (29) found from an
31 analysis of Dutch panel data that every additional 10 kms of commuting distance decreased the
32 expected duration of the current job and current residence by more than two years. Rashidi et al
33 (30) modelled the inter-dependencies between vehicle transactions, residential relocation and job
34 change with long travel times being tested and shown to be one factor explaining the probability
35 of changing job and residence.

37 **2.6 Summary of Knowledge**

38
39 The review has shown that significant changes in travel behaviour are likely at the time of life
40 events, especially those involving a change in household composition, employment status or
41 residential or job location. However, the extent to which life events are triggers for travel
42 behaviour change has not been evidenced for large scale samples representative of the general
43 population. It has been shown that some life events can be stimulated by an unsatisfactory travel
44 situation (in particular home and job changes in response to long commutes) which suggests it is
45 important to consider the travel behaviour context alongside life events. It has not been
46 examined in much depth how spatial context and attitudes affect how people respond to life

1 events, or how the role of life events varies at different life stages. There is some indication that
2 certain life events cluster together (particularly in early adulthood) and that there is greater
3 impact on travel behaviour when this is the case.

4 5 **3. RESEARCH FRAMEWORK AND QUESTIONS** 6

7 The life course perspective provides a helpful framework for studying the inter-relationships
8 between life events and travel behaviour. Giele and Elder (31) state that in the life course
9 perspective it is assumed that “any point in the life span must be viewed dynamically as the
10 consequence of past experience and future expectation as well as the integration of individual
11 motive with external constraint”.

12 A generalised conceptual model, which draws on the life course perspective, is shown in
13 Figure 1. The hypothesis made is that turning points in travel behaviour are triggered by a
14 contextual change (a life event for the purposes of our research but this could also be a change to
15 the transport system). Life events can alter the roles that people perform within their family and
16 social networks, alter the values people hold, alter the resources available for travel and alter the
17 context for travel. These can create ‘transport stressors’, which entail discrepancies between the
18 current transport circumstances and a desirable alternative (11) and can change the travel mode
19 alternatives that are available, the characteristics of travel that are considered salient and hence
20 attitudes towards travel modes (14). Three types of mediating factor are assumed to play a role
21 in the outcome on travel behaviour of contextual change. These are personal history (for
22 example, experience in using travel modes), intrinsic motivations (for example, saving money or
23 improving health) and facilitating conditions (for example, public transport availability).

24 It should be acknowledged that behavioural responses to life events may take some time
25 to occur. For instance, a residential relocation to a new spatial context may be followed by a
26 long term process of behavioural adaptation. Moreover, it is self-evident that certain life events
27 will occur simultaneously. For example, cohabitation inevitably involves a residential relocation
28 for at least one household member and child birth is often accompanied by temporarily leaving
29 the labour market. In such cases, the two events will have a combined effect on travel behaviour
30 outcomes. Lastly, the notion of behavioural trajectories acknowledges that there may be complex
31 chains of cause and effect between life events and behavioural outcomes that develop over the
32 life course. For example, a residential relocation to a larger home may be prompted by
33 anticipation of having children, which in turn leads to changes in daily travel behaviours and/or
34 car ownership level. The framework also recognises that the relationship between travel
35 behaviour and life events may operate in the reverse direction. A household may seek to reduce
36 a lengthy commute (a ‘transport stressor’) by moving home, thus triggering a life event.

37 The paper now presents an empirical analysis that used UK Household Longitudinal
38 Study (UKHLS) data to examine specific aspects of the framework. The analysis addressed the
39 following research questions:

- 40
- 41 • To what extent are different life events associated with changes in travel behaviour (car
42 ownership level and commute mode)? and
 - 43 • Under what conditions are life events most likely to result in changes in travel behaviour
44 and why?
45

4. DATA SET GENERATION

The data set prepared for use in this study has been derived from the *first two waves* of the UKHLS. The UKHLS started in 2009 and captures a range of social, economic and attitudinal information (32) about the lives of members of 40,000 households.

Given restrictions in the availability of spatial context variables for all regions of the UK, the sample analysed incorporated adults that were interviewed and were resident in England at both waves. This constituted 32,151 adults living in 19,615 households. Where appropriate, results are weighted using the population weights provided in the UKHLS and are therefore, representative of the population living in England in 2009. This paper is limited to examining the extent to which travel behaviour changes and life events occurred concurrently between two consecutive waves. Longer term effects could not be explored given the reliance on two wave panel data (although it remains an objective to examine this when further waves become available). The extent to which travel behaviour changes occur in association with a comprehensive range of life events has not been shown before for a sample representative of the English population and this represents a novel contribution.

4.1 Transport Variables

The dependent variables of interest were increases and decreases in the number of household cars or vans between wave one and wave two and switches to and from commuting by car (which includes ridesharing). Analyses relating to car ownership were conducted at the level of the *household*, while analyses concerning commute mode were conducted at the level of the *individual*.

4.2 Life Transition Variables

Table 1 lists the variables derived to indicate whether an individual had experienced a particular life transition between wave one and wave two.

4.3 Spatial Context Variables

It is well established that the characteristics of the built and social environments in which an individual resides may affect travel behaviour. Accordingly, several neighbourhood context variables were also prepared. These were included in multivariate models to reflect the influence of the baseline (starting) condition in wave one, while the life transition variables reflect changes to this condition by wave two. The spatial variables were derived from other secondary data sources and are listed in Table 2. Settlement type was coded as a three level ordinal variable. The three categories are: London and metropolitan areas; urban areas (3k-250k+); and rural areas. These categories were selected (from a more detailed set of seven categories) after identifying that they explained well differences in cross sectional car ownership rates.

5. DESCRIPTIVE ANALYSIS

The prevalence of travel behaviour changes and life transitions across the sample is summarised in Table 3. Around nine per cent of households in the sample changed car ownership level (in

1 either direction) while five to six per cent of employed individuals switched commute mode
2 from and to car (respectively) between waves one and two. The most commonly experienced life
3 transitions relate to employment and residential location.

4 Cross tabulations of households gaining or losing a car with at least one household
5 member experiencing each life transition are presented in Table 4. For each of the life transitions
6 examined, the proportion of households experiencing a change in car ownership level is higher
7 (in one or both directions) when the life transition has also been experienced. Chi-square tests
8 confirm that these differences are all statistically significant.

9 The direction of car ownership level changes associated with life transitions is in line
10 with expectations. Gaining employment is associated with vehicle acquisitions, while losing
11 employment (including retirement) is associated with vehicle relinquishments. Gaining a driving
12 licence is very strongly associated with acquiring a vehicle. Partnership formation and
13 dissolution reflect changes in the number of adults in the household in being associated with
14 increases and decreases in the number of household cars respectively. Having children and
15 residential relocations appear to be associated with both increases and reductions in the number
16 of household cars. The observation that a greater proportion of households reduced car
17 ownership in conjunction with a residential relocation relates to an inevitable feature of the panel
18 sample rather than to a characteristic of the population at large. The panel survey tracks
19 individuals leaving wave one households (which involves both a residential relocation and a
20 change in household structure). Closer inspection reveals that these newly formed households in
21 the panel are smaller in size, explaining in part the reason why a higher proportion of residential
22 relocations recorded in the survey are associated with reductions in car ownership.

23 Commute mode switches are found to be more prevalent in conjunction with life
24 transitions (compared to a stable situation), except for child birth. However, this result is likely
25 to relate to the two-wave nature of the commute mode sample which excludes parents that are
26 yet to return to the workforce following child birth. Employment changes, residential relocations
27 and gaining a partner are equally associated with both switches to and from car commuting. It is
28 notable that stopping cohabitation is associated with switches from car commuting. This
29 suggests a tendency towards a reduction in access to household cars following the loss of a
30 partner.

31 **6. MULTIVARIATE ANALYSIS**

32 The paper now presents the results of two binary logistic regression models of car ownership
33 level change, estimated on *household level* data. The dependent variables reflect whether the
34 household gained one or more cars (Model 1) or lost one or more cars (Model 2) between waves
35 one and two.

36 As noted previously, certain life events are likely to coincide. The effects of coincident
37 events can be examined through the inclusion of interaction terms. Although a number of
38 interaction terms were tested in model development, most were insignificant and only those that
39 aid interpretation have been retained. First, the household car ownership level is closely related
40 to the number of adults in the household. Thus cohabitation and separation life events (which are
41 likely to coincide with a change in the number of adults in the household) are interacted with
42 changes in the number of adults in the household. Second, child birth has been interacted with
43 exiting the employment market (observed as occurring concurrently for 20 per cent of
44 individuals that parented a child in that year).

1 The results for Model 1 and Model 2 are presented in Table 5 and Table 6 respectively.
2 Note that the emphasis in this paper is on elucidating the influence of a comprehensive range of
3 life events on car ownership, rather than on suggesting advances in car ownership modelling.
4 There is a comprehensive body of research dedicated to car ownership modelling and we
5 acknowledge that more sophisticated modelling frameworks have been employed elsewhere
6 (33).

7 Firstly, the models indicate that a range of baseline conditions have a significant effect
8 on changes in car ownership. Having fewer cars in the household (in wave one) and being a
9 larger household increases the odds of a household increasing the number of cars owned. The
10 converse is true for reductions in car ownership. Together these factors show that households
11 with more household members per car are more likely to gain cars and less likely to lose cars
12 over time. The models also reveal evidence of expected life stage effects suggested by Dargay
13 and Vythoukas (7). Households with oldest members aged over 60 are less likely to acquire
14 additional cars compared to households with oldest members aged between 45 and 59. Very
15 young households (with oldest members aged between 16 and 24) are the most likely to have
16 reduced their household car ownership level. This suggests that young adults leave the parental
17 home and start independent adult life in lower car owning household units. Having children
18 present in the household in wave one reduces the odds of a household gaining a car, while
19 having very young children in the household (aged 0 to 2) appears to increase the odds of a
20 household losing a car.

21 Being in a 'small employers and own account' occupation increases the odds of a
22 household increasing the number of cars owned compared to not being employed (over and
23 above other occupations, including 'management and professional'). The converse is true for
24 reductions in car ownership. This suggests that these occupation types involve greater need for
25 automobility compared to other occupations. Similarly, higher qualifications, which may
26 indicate upwardly mobile lifestyles, are associated with increased odds of gaining cars and
27 reduced odds of losing cars.

28 With respect to the built environment, car ownership increases are more likely and
29 decreases less likely in areas of higher population density. This confirms that proximity to
30 activity centres suppresses the need to acquire cars. Furthermore, higher journey times to
31 employment centres by public transport are shown to increase the odds of a household increasing
32 the number of cars owned, but does not change the odds of a household decreasing number of
33 cars. This suggests that high quality public transport connections to employment centres could
34 suppress the rate at which car ownership grows in a local area.

35 Finally, it is notable that living in a more deprived area (after controlling for income,
36 education, occupation and built environment) increases the odds of a household reducing the
37 number of cars owned. This suggests that there may be physical, lifestyle or attitudinal
38 characteristics of living in such neighbourhoods that reduce reliance on or opportunity for car
39 oriented mobility.

40 In line with expectations, life transitions that change the composition of the household
41 are the strongest predictors of changes in car ownership level. Households that gain (lose) an
42 adult and/or a new cohabiting relationship are more likely to also gain (lose) cars. A household
43 member acquiring a driving licence is also a very strong predictor of households gaining cars,
44 confirming that licence acquisition demonstrates a strong commitment to car ownership. Having
45 children is not found to increase the odds of gaining cars, but is found to increase the odds of

1 decreasing cars. This is counter to expectations and might relate to households having reduced
2 income available for transportation.

3 With respect to residential relocations, urbanising moves are confirmed to be associated
4 with households decreasing cars, while ruralising moves are associated with households
5 increasing cars. Moves within London/metropolitan and urban areas are also associated with
6 decreasing cars. One hypothesis is that this relates to households intentionally seeking less car
7 dependent lifestyles, and is a finding that is worthy of further examination. Overall, the model
8 offers evidence of the behavioural process through which the cross-sectional relationship
9 between built environment and car ownership arises, i.e. households are shown to adjust to the
10 new built environment in association with the move, rather than moving to the new environment
11 with the prevailing behaviour already established.

12 Finally, moves into and out of employment (including retirement) are associated with car
13 increases and decreases respectively. Switching employer increases the odds of increasing cars,
14 but is not a significant predictor of decreasing cars.

15 16 **7. CONCLUSIONS**

17
18 The analyses presented in the paper offer strong evidence (for a nationally representative survey
19 sample) that travel behaviour changes are more likely to occur around the time of a life transition
20 than when circumstances are stable. In particular, residential relocations, employment changes
21 and changes in household structure are found to be associated with both car ownership level
22 changes and commute mode switches. The regression models provide tentative evidence of the
23 relationship between life stage and car ownership level change as observed by Dargay and
24 Vythoulkas (7). In this respect, we acknowledge that different car ownership transitions (0 to 1
25 car and 1 to 0 car and so on) are likely to involve quite different decision processes and may
26 occur at different life stages. In further research we are investigating models of each of these car
27 ownership transitions separately. Subsequent to car ownership modelling, we will develop
28 models of commute mode switching in a similar way. In these we will seek to recognise inter-
29 relationships between car ownership and commuting and also have the potential to examine the
30 influence of attitudes (which cannot be easily aggregated to the household level).

31 The conceptual framework presented in Figure 1 recognises the complex two way
32 relationships between life events and travel behaviour. With two wave data, we have examined
33 one aspect of this in confirming a strong association between life transitions and coterminous
34 behavioural changes. As further waves become available, we will examine whether responses to
35 life events are observable after a greater length of time than the concurrent year. Using duration
36 models, we will examine the stability of travel behaviour and whether longer durations in a
37 behavioural state affect the likelihood of changing behaviour in response to a life event. We
38 acknowledge that it remains a challenge to operationalize the hypothesised longitudinal
39 relationships in quantitative modelling frameworks. An approach advocated by Mohktarian and
40 Cao (34) is the application of structural equation models to panel data to examine two way
41 relationships that act over time (as employed by Scheiner and Holz-Rau (18)). This appears to be
42 a method that is worthy of further application in the longitudinal domain. We would further
43 advocate the use of complementary longitudinal qualitative methods to provide deeper insights
44 into the mechanisms through which travel behaviours evolve over the full life course.

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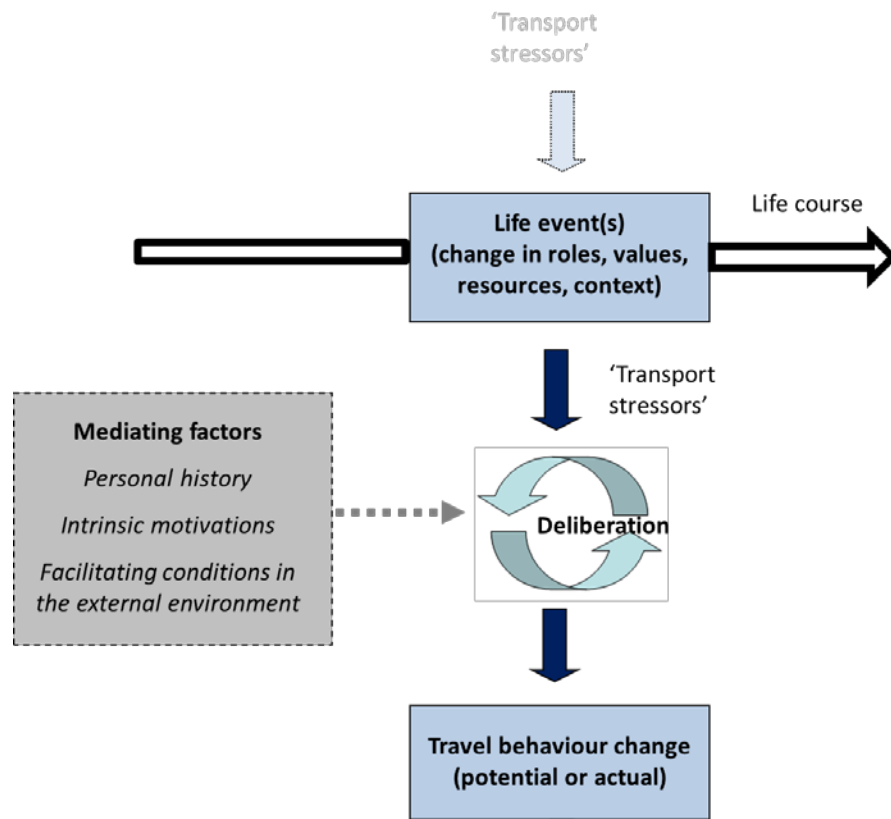
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FIGURE 1 Conceptual model for explaining turning points in travel behaviour.

1 **TABLE 1 Life Transition Variable Definitions**

Life transition	Hhold/ Ind	Variable description
Mobility changes		
Acquired a driving licence	I	Respondent has a driving licence in wave 2 but not in wave 1
Household composition changes		
Began cohabiting with a partner	I	Respondent is cohabiting in wave 2 but not in wave 1
Stopped cohabiting with a partner	I	Respondent is cohabiting in wave 1 but not in wave 2
Gave birth to or parented a child	I	Respondent reported giving birth to or fathering a child between wave 1 and 2
Number of adults (17+) in the hhold increased	H	None required
Number of adults (17+) in the hhold reduced	H	None required
Employment changes		
Entered employment from non-employment	I	Respondent is employed or self-employed in wave 2 but is out of the employment market in wave 1
Entered non-employment (excluding retired) from employment	I	Respondent is employed or self-employed in wave 1 but is out of the employment market (excluding retirement) in wave 2
Retired from employment	I	Respondent is employed or self-employed in wave 1 but reports being retired in wave 2
Changed employer	I	Respondent has switched between self-employed and employed, or is in employment in both waves but reports not having been in continuous employment, or reports being in continuous employment, but working for a new employer
Residential location changes		
Moved home	H/I	UKHLS interview is being conducted at a different address in wave 2 compared to wave 1
Moved from London/metropolitan areas to an urban area	H/I	Hhold address switches from London/metropolitan areas to an urban area
Moved from London/metropolitan areas to a rural area	H/I	Hhold address switches from London/metropolitan areas to a rural area
Moved from an urban area to London/metropolitan areas	H/I	Hhold address switches from an urban area to London/metropolitan areas
Moved from an urban area to a rural area	H/I	Hhold address switches from an urban area to a rural area
Moved from a rural area to London/metropolitan areas	H/I	Hhold address switches from a rural area to London/metropolitan areas
Moved from a rural area to an urban area	H/I	Hhold address switches from a rural area to an urban area
Moved with London/metropolitan areas	H/I	Hhold has moved home, but remained within London/metropolitan areas
Moved within an urban area	H/I	Hhold has moved home, but remained within an urban area
Moved within a rural area	H/I	Hhold has moved home, but remained within a rural area

3

1 **TABLE 2 Spatial Context Variables**
2

Neighbourhood variable	Source data set	Definition
Settlement type (London & Metropolitan, Other urban, Rural)	UK National Travel Survey categories	Degree of urbanity of area of residence
Population density	UK Census 2001	Population density in area of residence
Proportion of population economically active	UK Census 2001	
Travel time to the nearest employment centre with at least 100 jobs by PT/Walk (mins)	DfT accessibility indicators 2009	Time taken by public transport to reach closest employment centre
Number of employment centres with at least 100 jobs accessible by PT/walk (weighted by distance decay function)	DfT accessibility indicators 2009	Ease of access by public transport to major employment opportunities
Travel time to nearest town centre by PT/walk (mins)	DfT accessibility indicators 2009	Time taken by public transport to reach closest commercial centre
Number of food stores accessible by PT/walk (weighted by distance decay function)	DfT accessibility indicators 2009	Ease of access by public transport to food shops (indicator of mixed land use)
Overall Index of Multiple Deprivation (IMD)	Indices of Multiple Deprivation 2010	Overall level of social deprivation
Living environment IMD	Indices of Multiple Deprivation 2010	Index combining measures of poor quality housing, numbers of road casualties and air pollution
Note: All variables measured at Lower Super Output Area level (typically population of 1500), except population density measured at Medium Super Output Area level (typically population of 7000)		

3

1 **TABLE 3 Prevalence of Travel Behaviour Changes and Life Transitions**

2

Travel behaviour change					
Event	Yes	No	Total	Percentage	Weighted Percentage
No. of households gaining a car	1752	17793	19545	8.96%	N/A
No. of households losing a car	1769	17776	19545	9.05%	N/A
No. of employed individuals that switched from car commuting	818	14382	15200	5.38%	5.42%
No. of employed individuals that switched to car commuting	931	14269	15200	6.13%	6.17%
Life transitions					
(no. of individuals experiencing the transition)					
Event	Yes	No	Total	Percentage	Weighted Percentage
Residential relocation	2032	30097	32129	6.32%	6.85%
Had child	939	28655	29594	3.17%	3.13%
Gained a partner	473	31678	32151	1.47%	1.61%
Lost a partner	395	31756	32151	1.23%	1.33%
Entered employment from non-employment	1621	30522	32143	5.04%	5.09%
Lost employment (excl retirement)	1065	31078	32143	3.31%	3.27%
Switched employer	1770	28388	30158	5.87%	6.23%
Retired	380	31763	32143	1.18%	1.18%
Gained a driving license	836	31191	32027	2.61%	2.46%

Notes: N/A: Not Applicable - Longitudinal weights are not available at the household level

3

1 **TABLE 4 Co-occurrence of Travel Behaviour Changes with Life Transitions**
2

Life transition	n	% increasing cars ^a		% decreasing cars ^b	
		with transition	with no transition	with transition	with no transition
Residential relocation	1445	14.26	8.54	23.32	7.92
Had child	626	11.34	8.54	11.82	8.72
Gained a partner	453	38.63	8.26	14.57	8.92
Lost a partner	374	6.95	9.00	42.78	8.39
Entered employment from non-employment	1545	15.02	8.44	9.84	8.98
Lost employment (excl retirement)	1038	9.44	8.94	14.55	8.74
Retired	361	6.65	9.01	12.74	8.98
Gained a driving license	797	34.13	7.88	5.65	9.18

Life transition	n	% switching to non-car commute ^c		% switching to car commute ^d	
		with transition	with no transition	with transition	with no transition
Residential relocation	1026	8.87	5.12	9.65	5.87
Had child	585	5.81	5.37	7.35	6.08
Gained a partner	279	8.96	5.31	8.24	6.09
Lost a partner	185	10.27	5.32	5.41	6.13
Switched employer	1617	11.07	4.61	11.50	5.26
Gained a driving license	287	4.18	5.41	25.78	5.74

a. Percentage households increasing no. of cars owned with or without a life transition. n~19545

b. Percentage households decreasing no. of cars owned with or without a life transition. n~19545

c. Percentage employed individuals switching to non-car commute with or without a life transition. n~15,200

d. Percentage employed individuals switching to car commute with or without a life transition. n~15,200

Source: Understanding Society, Waves 1 and 2, 2012, linked with neighbourhood indicators at LSOA level.

3

1 **TABLE 5 Model 1 – Increase in Household Car Ownership Level (yes or no)**
2

LIFE TRANSITIONS	Coef	Std. Err.	z	Odds Ratio
Residential relocation: London/met to urban	1.41	0.38	3.69	4.10
Residential relocation: London/met to rural	1.35	0.53	2.53	3.86
Residential relocation: Urban to London/met	0.20	0.52	0.38	1.22
Residential relocation: Urban to rural	0.62	0.32	1.94	1.86
Residential relocation: Rural to London/met	-0.09	0.84	-0.11	0.91
Residential relocation: Rural to urban	0.22	0.35	0.64	1.25
Residential relocation: London/met to London/met	-0.27	0.21	-1.31	0.76
Residential relocation: Urban to urban	0.05	0.17	0.29	1.05
Residential relocation: Rural to rural	0.13	0.35	0.37	1.14
Remained within London/met	-0.15	0.11	-1.31	0.86
Remained within urban [Ref: remained within rural]	-0.06	0.09	-0.60	0.95
Householder gained partner	1.08	0.24	4.51	2.95
Householder gained partner & household gained 1+ adult	-0.15	0.29	-0.50	0.86
Householder lost partner	0.90	0.35	2.60	2.47
Householder lost a partner & household lost 1+ adult	-1.32	0.49	-2.72	0.27
Householder entered employment from non-employment	0.32	0.09	3.73	1.38
Householder lost employment (excl retirement)	-0.18	0.13	-1.38	0.83
Householder retired	-0.01	0.23	-0.04	0.99
Householder switched employer	0.36	0.08	4.35	1.43
Householder had child	0.15	0.16	0.94	1.16
Householder had child & householder lost employment	-0.46	0.36	-1.28	0.63
Householder acquired driving licence	1.55	0.09	17.27	4.70
Householder turned 17	-0.84	0.22	-3.76	0.43
No. of adults increased	1.75	0.12	15.08	5.77
No. of adults reduced	-0.47	0.15	-3.05	0.62
Wave 1 household has divided by wave 2	-0.32	0.19	-1.67	0.73
Wave 2 household income - Wave 1 household income	0.06	0.01	5.62	1.06
BASELINE HOUSEHOLD STRUCTURE & LIFE STAGE	Coef	Std. Err.	z	Odds Ratio
No. of household cars	-0.61	0.04	-14.02	0.54
Household size: 1 person	-0.67	0.11	-6.24	0.51
Household size: 3 people	0.60	0.09	6.43	1.81
Household size: 4+ people [Ref: Household size: 2 people]	1.09	0.11	10.23	2.98
Cohabiting relationship present in household	0.01	0.08	0.11	1.01
Child present in household	-0.44	0.11	-4.03	0.64
Eldest householder 16-24	-0.03	0.16	-0.21	0.97
Eldest householder 25-29	0.01	0.12	0.07	1.01
Eldest householder 30-44	-0.10	0.07	-1.40	0.90
Eldest householder 60-74	-0.34	0.09	-3.74	0.71
Eldest householder 75+ [Ref: Eldest householder 45-59]	-0.96	0.16	-6.09	0.38
Child 0-2 present	-0.23	0.11	-2.19	0.79

Child 3-4 present	-0.21	0.11	-1.89	0.81
Child 5-11 present	-0.34	0.09	-3.67	0.71
Child 12-15 present	-0.28	0.10	-2.80	0.76
Offspring aged 16 present	-0.81	0.21	-3.90	0.44
BASELINE HOUSEHOLD SOCIO-DEMOGRAPHIC	Coef	Std. Err.	z	Odds Ratio
Monthly household income (£1000)	0.08	0.01	6.33	1.08
Highest household qual: degree	0.20	0.11	1.84	1.22
Highest household qual: other higher	0.32	0.11	2.79	1.37
Highest household qual: A level	0.31	0.10	2.99	1.37
Highest household qual: GCSE [Ref: Other or no qualification]	0.19	0.11	1.76	1.21
Highest SEC: Management & professional	0.30	0.10	3.09	1.35
Highest SEC: Intermediate	0.36	0.11	3.20	1.43
Highest SEC: Small employers & own account	0.71	0.12	5.79	2.04
Highest SEC: Lower supervisory & technical	0.62	0.14	4.55	1.85
Highest SEC: Semi routine, routine & unemployed [Ref: No employment status]	0.25	0.10	2.51	1.28
BASELINE NEIGHBOURHOOD CONTEXT	Coef	Std. Err.	z	Odds Ratio
Travel time to nearest employment centre by PT/walk (mins)	0.01	0.01	2.51	1.01
No. of emp. centres with 100+ jobs accessible by PT/walk	-0.01	0.05	-0.23	0.99
Travel time to nearest town centre by PT/walk (mins)	0.00	0.00	-0.24	1.00
No. of foodstores accessible by PT/walk	0.06	0.05	1.27	1.06
Overall Index of Multiple Deprivation	-0.01	0.00	-1.94	0.99
Living environment Index of Multiple Deprivation score	0.00	0.00	-1.36	1.00
Population density (persons/HA)	-0.01	0.00	-4.59	0.99
Proportion economically active	0.27	0.43	0.63	1.31
Ethnic minority boost sample household	0.13	0.09	1.46	1.14
Intercept	-2.51	0.47	-5.32	0.08

Notes: Grey shading indicates statistical significance

Source: Understanding Society, Waves 1 and 2, 2012, linked with neighbourhood indicators at LSOA level.

Weighting not applied.

n=19,344 pseudo R²=0.1532

1 **TABLE 6 Model 2 – Decrease in Household Car Ownership Level (yes or no)**
2

LIFE TRANSITIONS	Coef	Std. Err.	z	Odds Ratio
Residential relocation: London/met to urban	-0.15	0.61	-0.24	0.86
Residential relocation: London/met to rural	1.01	0.80	1.26	2.74
Residential relocation: Urban to London/met	1.17	0.55	2.13	3.22
Residential relocation: Urban to rural	0.11	0.39	0.28	1.12
Residential relocation: Rural to London/met	1.61	0.71	2.28	5.01
Residential relocation: Rural to urban	0.97	0.35	2.75	2.63
Residential relocation: London/met to London/met	0.72	0.23	3.08	2.06
Residential relocation: Urban to urban	0.89	0.17	5.15	2.44
Residential relocation: Rural to rural	0.59	0.35	1.72	1.81
Remained within London/met	0.22	0.12	1.75	1.24
Remained within urban [Ref: remained within rural]	0.00	0.10	0.00	1.00
Householder gained partner	-0.67	0.27	-2.47	0.51
Householder gained partner & household gained 1+ adult	0.15	0.50	0.31	1.17
Householder lost partner	1.79	0.39	4.55	5.98
Householder lost a partner & household lost 1+ adult	-0.75	0.43	-1.74	0.47
Householder entered employment from non-employment	-0.13	0.11	-1.18	0.87
Householder lost employment (excl retirement)	0.61	0.12	4.91	1.85
Householder retired	0.46	0.19	2.40	1.59
Householder switched employer	0.00	0.10	-0.02	1.00
Householder had child	0.43	0.19	2.19	1.53
Householder had child & householder lost employment	-0.73	0.34	-2.16	0.48
Householder acquired driving licence	-0.46	0.19	-2.36	0.63
Householder turned 17	0.64	0.32	1.99	1.90
No. of adults increased	-0.64	0.21	-3.11	0.53
No. of adults reduced	1.88	0.12	15.48	6.58
Wave 1 household has divided by wave 2	0.82	0.15	5.59	2.26
Wave 2 household income - Wave 1 household income	-0.11	0.02	-7.03	0.90
BASELINE HOUSEHOLD STRUCTURE & LIFE STAGE	Coef	Std. Err.	z	Odds Ratio
No. of household cars	1.90	0.06	32.72	6.70
Household size: 1 person	0.11	0.12	0.86	1.11
Household size: 3 people	-0.23	0.10	-2.22	0.80
Household size: 4+ people [Ref: Household size: 2 people]	-0.35	0.13	-2.77	0.70
Cohabiting relationship present in household	-0.73	0.09	-7.69	0.48
Child present in household	0.07	0.12	0.61	1.08
Eldest householder 16-24	0.77	0.21	3.71	2.16
Eldest householder 25-29	0.23	0.16	1.41	1.25
Eldest householder 30-44	0.12	0.09	1.38	1.13
Eldest householder 60-74	-0.17	0.09	-1.78	0.85
Eldest householder 75+ [Ref: Eldest householder 45-59]	0.15	0.14	1.11	1.16
Child 0-2 present	0.28	0.12	2.31	1.32

Child 3-4 present	0.14	0.13	1.06	1.15
Child 5-11 present	0.13	0.11	1.18	1.14
Child 12-15 present	-0.06	0.12	-0.50	0.94
Offspring aged 16 present	0.12	0.28	0.44	1.13
BASELINE HOUSEHOLD SOCIO-DEMOGRAPHIC	Coef	Std. Err.	z	Odds Ratio
Monthly household income (£1000)	-0.13	0.02	-7.69	0.88
Highest household qual: degree	-0.44	0.11	-3.96	0.64
Highest household qual: other higher	-0.44	0.12	-3.71	0.65
Highest household qual: A level	-0.40	0.11	-3.64	0.67
Highest household qual: GCSE [Ref: Other or no qualification]	-0.30	0.11	-2.61	0.74
Highest SEC: Management & professional	-0.29	0.11	-2.74	0.75
Highest SEC: Intermediate	-0.29	0.13	-2.30	0.75
Highest SEC: Small employers & own account	-0.49	0.14	-3.59	0.61
Highest SEC: Lower supervisory & technical	0.07	0.15	0.46	1.07
Highest SEC: Semi routine, routine & unemployed [Ref: No employment status]	-0.07	0.11	-0.63	0.93
BASELINE NEIGHBOURHOOD CONTEXT	Coef	Std. Err.	z	Odds Ratio
Travel time to nearest employment centre by PT/walk (mins)	0.00	0.01	-0.16	1.00
No. of emp. centres with 100+ jobs accessible by PT/walk	0.02	0.05	0.40	1.02
Travel time to nearest town centre by PT/walk (mins)	0.00	0.00	0.09	1.00
No. of foodstores accessible by PT/walk	0.02	0.05	0.45	1.02
Overall Index of Multiple Deprivation	0.02	0.00	4.77	1.02
Living environment Index of Multiple Deprivation score	0.00	0.00	0.34	1.00
Population density (persons/HA)	0.00	0.00	3.16	1.00
Proportion economically active	0.41	0.50	0.81	1.50
Ethnic minority boost sample household	0.29	0.11	2.71	1.34
Intercept	-5.33	0.54	-9.86	0.00
Notes: Grey shading indicates statistical significance				
Source: Understanding Society, Waves 1 and 2, 2012, linked with neighbourhood indicators at LSOA level.				
Weighting not applied.				
n=14,862 pseudo R ² =0.2826				