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Understanding the process that gives rise to household car ownership level changes



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ABSTRACT

Quantitative studies have revealed that changes to the number of cars owned by households are more likely to occur at the time of life events. However, causal explanations of such relationships are either absent or lacking evidence. To address this knowledge gap, this paper presents a qualitative study which enabled the development of a new conceptual framework to explain the process through which the number of cars owned by households changes over time. The framework emerged through an inductive analysis of 15 in-depth biographical interviews and was validated through a mixed methods survey of 184 households located in Bristol (UK). The following mechanisms of the process are identified: *Life events* alter roles, relationships, spatial contexts and lifestyle preferences. This can lead to a condition of *stress* which relates to a discrepancy between satisfaction with the current car ownership level and a more desirable alternative. Attempts to adjust to the new situation are made through processes of *travel behaviour adaptation* and *consideration* of whether the car ownership level ought to be altered. A *propensity to change car ownership level* can emerge from this. However, given the effort involved in taking action, households tend to *resist* making changes to their car ownership level in the short term. Action to change car ownership level is found to often be prompted by another *external stimulus* such as the receipt of a maintenance bill. A key message from the analysis is that changes in household car ownership level should be considered as the outcome of a continuous *process* of development over the life course, rather than as discrete decisions.

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1. Introduction

The acquisition or relinquishment of a car reflects a significant change in a household's mobility resources. It can therefore be expected to provide an impetus for a change in the mobility practices of household members - involving either greater or reduced levels of car use. It is of value then, in developing understanding of wider travel behaviours, to examine *when and why households change the number of cars they have at their disposal* - the focus of this paper.

Cross-sectional studies of car ownership have confirmed a number of well-known statistical associations. For example, owning more cars is associated with: higher incomes; a greater number of driving licence holders and employees in the household; and more ruralised residential locations (Whelan, 2007). More recent analyses have moved on to examine *dynamic relationships* and to identify factors associated with *changes* in household car ownership over time (e.g. Clark et al. (2015)). This has been made possible by the increasing availability of large scale panel data sets.

Panel studies have revealed: (i) a household life-cycle effect - the number of cars owned tends to increase as the head of the household

reaches the age of 50 and thereafter declines (mirroring the traditional family life cycle of cohabitation, parenthood and offspring leaving home) (Dargay and Vythoulkas, 1999); (ii) the presence of state dependence - the number of cars owned in the previous time period is a strong predictor of the number of cars owned in the next time period, indicating that household car ownership is stable for much of the time (Dargay and Hanly, 2007); and (iii) association with life events - the likelihood of car ownership level changes occurring is increased at the time of life events such as moving home, having children or changing jobs.

It is hypothesised that life events disrupt behavioural patterns (such as the daily commute) and prompt people to reconsider and potentially alter their behaviour and resources, including the number of cars owned. This has been evidenced through a succession of panel studies. An early panel analysis by Dargay and Hanly (2007) demonstrated a greater prevalence of car ownership level changes amongst households who had experienced a life event from one year to the next compared to households that had not experienced a life event. Clark et al. (2015) analysed data from the UK Household Longitudinal Study (n = 19,334) and confirmed that different life events are associated with different *types* of car ownership level change (noting that the transition from one to two cars is very different in nature to the transition from one to zero cars). For example, moving into the labour market was found to be associated with transitions from zero to one and from one to two cars. Other relationships were less obvious. In particular, having

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a child was shown to be associated with both transitions from one to two cars and in the reverse direction from two to one car.

Retrospective quantitative data collection techniques have also been employed to understand car ownership changes. Oakil et al. (2014) collected 21-year event histories for 312 households in Utrecht (Netherlands) to examine the *timing* of car ownership change in relation to life events (whether it occurred simultaneously, before or after life events). Having a child was found to be associated with car acquisitions in anticipation of the event, while changes in employer were associated with car relinquishments simultaneously or after the event. Zhang et al. (2014) also collected retrospective life history data for 1000 Japanese households. In contrast to Clark et al. (2015), car ownership changes were shown to be more strongly influenced by residential moves than by employment or educational changes.

It has been acknowledged, that evidence of statistical association on its own does not explain “the underlying reasons for...travel changes” at the time of life events (Van Acker et al., 2016). Qualitative approaches are advocated as these have the potential to reveal in-depth explanatory insights into processes of behaviour change (Müggenburg et al., 2015). For example, Lanzendorf's (2010) qualitative examination of the impact of the birth of a child on parental travel behaviour, highlighted that child birth should not be treated as an isolated ‘key event’ but unfolds over a period of time involving pregnancy, parental leave and ‘continuously changing travel and activity needs’. Some new mothers were shown to decrease their reliance on the car, challenging the assumption that car use universally increases following child birth. Stanbridge's (2007) qualitative study of the travel behaviour impacts of residential relocations, revealed home moves as an eight stage *process* that unfolds over time. People were shown to contemplate the impact of relocating on their transport routines at different stages in this moving sequence, both before and following the move.

This sets the context for the study presented in this paper which aimed to *explain the process* through which household car ownership levels (the number of cars ‘owned’ by the household, including company or leased cars) change over time. We argue that this required an exploratory, qualitative approach involving three steps:

- (i) The development of a high level conceptual framework based on theoretical insights;
- (ii) The inductive refinement of this framework through the conduct and analysis of in-depth biographical interviews; and
- (iii) Examination of the wider validity of the refined framework through a mixed methods neighbourhood survey.

In the next section we discuss the theoretical insights on behavioural dynamics that were identified to be of relevance at the study outset (step one). These were initially drawn together into the preliminary conceptual framework (Fig. 1) which underpinned the primary research design. The data collection and analytical methods (steps two and three) are explained in Section 3. Findings are then presented in Section 4 with reference to the refined conceptual framework (presented as Fig. 2). This depicts the overall process that we suggest gives rise to household car ownership level changes. Finally, the paper concludes with a discussion of the implications of the conceptual framework for research and policy.

2. Theoretical insights

It is well established that long-term decisions concerning, for instance, residential location, employment or family life influence medium term decisions concerning car ownership and daily decisions concerning transport routines (Salomon and Ben-Akiva, 1983). Lanzendorf's (2003) mobility biography framework proposes that travel behaviour changes may arise, over time, in association with events occurring in one or more of three related life domains: (i) the lifestyle domain (family formation, employment type, leisure

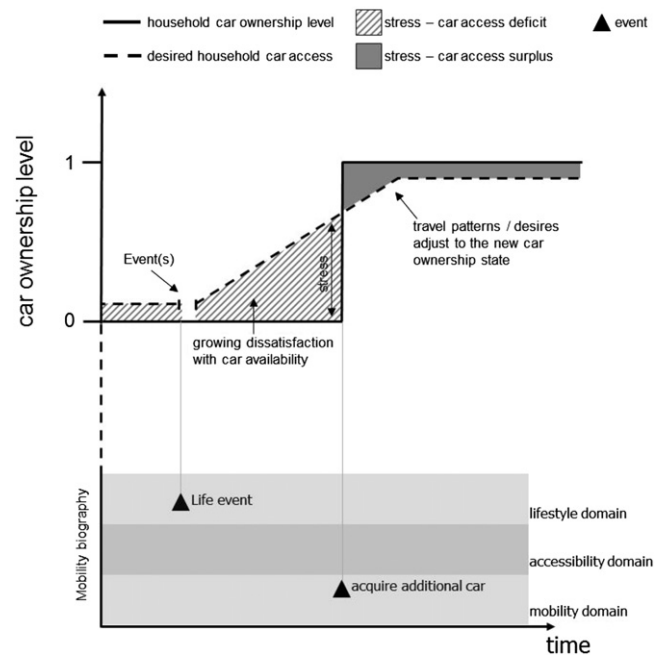


Fig. 1. Preliminary conceptual framework.

preferences); (ii) the accessibility domain (relative spatial locations of home, work place and other activity centres); and; (iii) the mobility domain (car availability, public transport season ticket purchases, daily travel routines). The implication of this dynamic perspective is that a full explanation of a car ownership level change requires an understanding of what events/decisions also preceded and followed that change. That is, car ownership level changes should be viewed in the context of a more continuous *process* of life development. As Dey (1993 pp. 37–38) notes, “the idea of *process* [emphasis added] is bound up with the idea of change, and the circumstances, conditions, actions and mechanisms through which change comes about”.

To our knowledge at the study outset, there were no empirically supported theoretical conceptions of the process that gives rise to car ownership level changes (as suggested by Goodwin and Mogridge (1981) and later by Golounov et al. (2001)). We hypothesised that a changing level of satisfaction with the household's vehicle fleet could be an important (but to date, unobserved) factor in understanding how car ownership level changes arise over time.

This notion of satisfaction with the current car ownership level is aligned with the theoretical concept of ‘stress’, initially developed by Rossi (1955). Working within the travel behaviour field, Miller (2005 p. 183) explains that “stress arises when one's current state deviates from some alternative desired...state. The larger this deviation...the more likely one is to act in some way that attempts to reduce that stress.” He also posits that “in many situations, people do not make continuous marginal adjustments to their state so as to maintain themselves at their ‘optimal’...state”, as is implied by utility maximising conceptions of decision making.¹

¹ We acknowledge that the notion of dissatisfaction with a circumstance, state or choice outcome relates to several other theoretical constructs discussed in the literature on decision making and utility oriented frameworks in particular. For example, Kahneman and Thaler (2006) contrast ‘experienced utility’ (satisfaction with the outcome of a choice) with the more commonly analysed ‘decision utility’ (the ‘wantability’ of something in advance of a decision, which is usually inferred from observations of choice outcomes). Utility oriented frameworks have tended to be employed to analyse choices in isolation from longer term behavioural processes. By contrast, our interest in this study was in understanding inter-relationships between long term (e.g. life events), medium term (e.g. car ownership changes) and short term (e.g. daily travel) choices and processes of adjustment between discrete state changes that cannot be ‘optimised’ at the margins. Hence we refer to the notion of ‘stress’ in this paper which has also been adopted in other studies of the dynamics of car ownership (e.g. Roorda et al., 2009; Oakil et al., 2014).

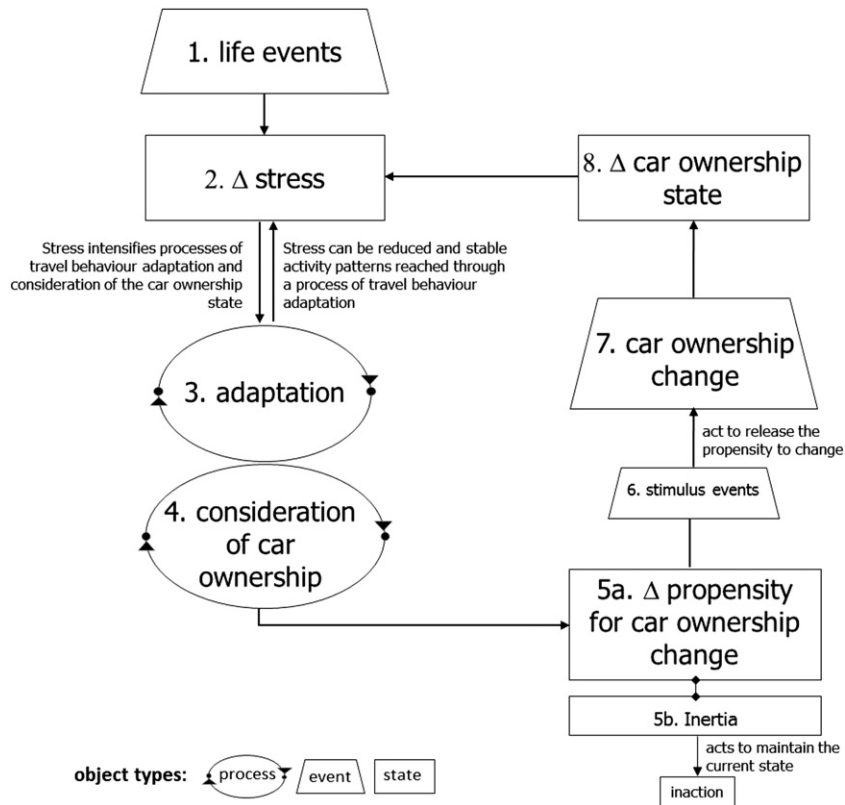


Fig. 2. Enhanced framework depicting the process of car ownership level change.

This is relevant to understanding household car ownership levels. Conventionally, households arrange private (or company provided) ownership of a discrete number of cars (zero, one, two or more cars) and this cannot be adjusted at the margins (i.e. fractional levels of car ownership are not possible). In such circumstances, Miller (2005 p. 183) notes that it is “reasonable to hypothesize that people will tend to remain in their current [car ownership] state when stress is low, and will only actively seek to change this [car ownership] state when stress exceeds some threshold value.” That is, only when the level of dissatisfaction with the household car ownership level (stress) becomes too large will the household be tipped into an active search for an alternative, preferred car ownership level (if resources allow).

These theoretical insights are drawn together in the preliminary conceptual framework shown in Fig. 1. To summarise, in the context of household car ownership, stress can be thought of as representing a discrepancy between the current household car ownership level and a desirable alternative. The desire for an alternative level of car ownership is related to both the instrumental need for access to cars by household members and from the affective desire for cars as a material possession, following Steg (2004). With reference to the mobility biography framework (Lanzendorf, 2003), a change in instrumental need for car access may arise from a change in household circumstances, triggered by a life event such as a home move or an employment change. This may require a higher or lower degree of access to cars compared to that which is provided by the current car ownership level. Increased or reduced affective desire for cars may arise from a change in resources e.g. increased income prompting a greater desire for a ‘better’ car. Affective desire may also arise from social influence such as social norms or ‘role beliefs’ which may change as an individual moves through the life course (Oakil et al., 2014). The discrepancy between the current car ownership level and a changing need or desire for access to cars (stress) is labelled in the conceptual framework as a deficit or surplus

in car access,² referring respectively to a need/desire for greater or reduced levels of car access.

3. Methods

3.1. In-depth interviews

This preliminary framework did not present sufficiently structured concepts concerning the process of car ownership change that could be operationalised in ‘closed’ questions of the form used in questionnaires or other survey instruments. Thus the first stage of the empirical study required a qualitative (to enable flexible exploration of high-level concepts) and retrospective approach (to examine change over time), in the form of in-depth biographical interviews.

The interviews were conducted in March to June 2009 with 15 households (in which 20 licence holding individuals took part) in Bristol, UK. The sample composition (Table 1) reflects an even gender balance, a range of working ages, household structures, and car ownership states. The majority of households included professionals and knowledge workers.

In the first part of the interview, participants were guided through the development of a timeline which captured life events, car ownership level changes and changes in the household’s daily travel routines from the point of driving licence acquisition. Such event histories are cognitively challenging to produce using a self-completion format and it is argued that reliable retrospective accounts can be generated through mobility biography interviews: firstly since the collocation of

² We suggest that in this dynamic framework, it is helpful to view the level of car access required by household members as a continuously varying construct to reflect a process of adjustment over time. This is not captured through observations of the car ownership level alone which changes in discrete steps.

Table 1
Socio-economic characteristics of interviewees.

Characteristic	Cases	
	Individuals ^a	Households ^a
Gender	Male	10
	Female	10
No. of cars in household at time of interview	0	1
	1	11 ^b
	2	3
Age	20–29	7
	30–39	3
	40–49	9
	50–59	1
Household type	Single	1
	Couple, no children	6
	Single parent, living with children	2
	Both parents, living with children	6
	Distance from home to city centre	
<3 km	8	
3 km to 6 km	4	
>6 km	3	

Notes: All participants were professionals (employment roles included secretary, administrator, team manager, teacher, IT worker, other knowledge worker).

^a 20 individuals took part in the interviews across 15 households (five interviews included both partners).

^b Six households had previously experienced second car ownership.

events in time has been shown to aid the generation of chronological accounts (Belli, 1998); and secondly, since areas of uncertainty can be recognised and revisited during the interview.

The timeline then provided a visual reference for more focused discussions around the motivations for specific car ownership level changes. Participants were asked to reflect on: (i) their travel routines in the period preceding a car ownership level change; (ii) their recollections concerning why they began to contemplate changing the car ownership level at that time (exploring the nature of car ownership 'stress' in the period preceding the change) and (iii) their reasons for finally undergoing the car ownership change. Participants were also asked to consider the prospects for changing car ownership in the future. Hence the current car ownership state could be fully examined in the context of past changes and future prospects. All of the interviews were recorded and transcribed.

3.1.1. Analysis of the interviews

The interviews were subjected to a thematic analysis following Braun and Clarke (2006). Transcripts were iteratively reviewed and key themes relating to household car ownership level changes were allowed to emerge inductively and were also investigated in relation to the preliminary conceptual framework. A strength of the biographical interviews was the ability to examine complex sequences of events over the longer term with reference to the respondents' own explanations, providing insight into cause and effect. The outcome of the analysis was a refined conceptual model identifying the key elements in an overall process of car ownership change, presented as Fig. 2, and which is discussed in detail in Section 4.

3.2. Neighbourhood survey

To examine the broader validity of the findings from the in-depth interviews, a mixed methods (quantitative and qualitative) neighbourhood survey was designed to generate a wider set of accounts of household car ownership level changes. The survey was administered through a self-completion questionnaire and follow-up telephone call. Quantitative data was captured from the questionnaire on the current car ownership state (number of cars owned), and satisfaction with this (a measure of stress), level of car use, and expectations for future car ownership changes. An open response question asked for a description of the most recent

car ownership level change. The follow up telephone interview was employed to generate further qualitative insights into the household's car ownership history.

The survey was administered to all households in two census 'output areas' in Bristol (one outer urban and one inner urban neighbourhood, see Fig. 3), hence the sample is fully representative of these two areas. The neighbourhoods were expected to house a similar demographic (based on the UK census 2001 data available at the time) but have differing spatial characteristics - the outer urban neighbourhood is lower density and is proximal to the inter-urban road network (further details of the selection procedure are available in Clark (2012)). A 'call and collect' method of survey administration³ was employed to achieve the necessarily high response rate required for a representative sample. In total, 184 completed questionnaire responses were received (a response rate of 74%) and 125 follow-up telephone interviews were completed. The socio-economic characteristics of survey respondents are summarised in Table 2.

4. Findings

The discussion of findings that follows has been structured to examine evidence relating to each element of the enhanced conceptual framework (Fig. 2) in sequence, drawing together depth insights from the interviews and broader insights from the survey. While reporting the findings in this way is a departure from the natural sequence of research tasks, this structure has been adopted to avoid dealing with each element of the framework twice. It also enhances the narrative around car ownership level change as a process.

The car ownership level changes recorded through both the interviews and survey are summarised by level change type in Table 3.

4.1. The role of life events as triggers for car ownership level changes

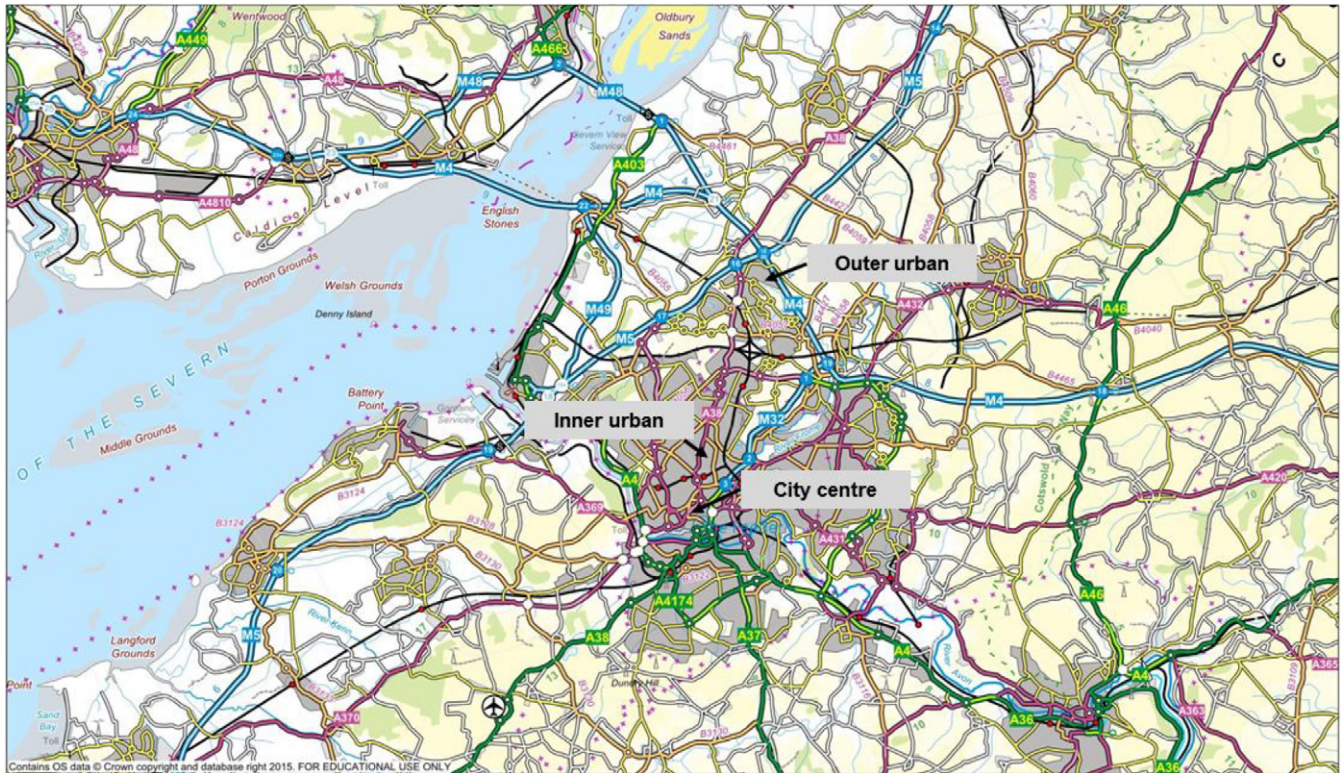
We start the discussion of the process that gave rise to these changes, with an examination of the role of life events. Evidence from the survey is examined first to indicate the extent to which life events were observed as an important factor across the wider survey sample. We then discuss why life events influence car ownership states drawing on the explanatory insights from both the interviews and the open responses from the survey.

4.1.1. Prevalence of life events as triggers for car ownership level changes

The sample of 102 car ownership level changes recorded in the survey was subjected to a coding exercise to identify the principal reasons given for these changes by respondents. For example, the open response "The extra car was bought because of a change of job, which wasn't easy to get to by public transport (previous job was). I was also pregnant at the time so having the extra car was going to be useful for the future" [Female survey participant, age unknown] for a one to two car level change was categorised as 'employment change'. In many cases, including this one, it was evident that individual car ownership level changes were associated with several factors that had acted over time. While acknowledging this underlying complexity, the coding exercise enabled the key themes present in the qualitative survey data to be identified. It revealed 17 principal reasons for undertaking car ownership level changes, listed in order of prevalence in Table 4.

65% of car ownership level changes recorded by the survey were associated with employment change, cohabitation, residential relocation, child birth, offspring reaching driving age, an adult joining or leaving the household or retirement. This supports the argument that life events are usually the prompts for car ownership level changes. We now examine

³ Questionnaires were handed to and collected from participants in person. This provided an opportunity to explain the nature of the survey to participants. Establishing a personal relationship with participants has been shown to increase participation as was demonstrated by the high response rate (Walker, 1976).



Contains Ordnance Survey data © Crown copyright and database right 2015.

Precise neighbourhood locations have been obscured to preserve anonymity of participants

Fig. 3. Map of Bristol, UK indicating locations of survey neighbourhoods.

the role of employment change (including retirement), residential relocation, cohabitation and child birth as these were the most prevalent.

4.1.1.1. Employment change. Employment changes are likely to alter the options available for the journey to work. This arises from both changes to the location of the workplace relative to home and also changes to the scheduling of work journeys. One female interviewee described weekend working as the ‘final straw’ which prompted her household to consider acquiring a second car:

“...I often had to work on a Saturday because...we had to cover the weekends which meant, if he [her partner] wanted the car on the weekend, he'd have to drive me there...come home and then come back at 11 or four or whatever time it was to pick me up. So it was like, this is getting silly, we need another car. And I was earning more, so I was like we can afford another car.”

[Female interview participant, aged 50–59]

This illustrates how changes in household income in association with employment changes may facilitate increases (or prompt reductions) in household car ownership level.

Employment changes may also introduce the requirement to have personal access to a car during the working day and some respondents also explained that changing from a single to multiple work locations (perhaps in association with self-employment) had prompted a need for additional household cars to service their transport needs.

Moves into or out of the labour market alter the roles performed by individuals in their daily lives. Although only a small number of cases were observed, retirement had, perhaps surprisingly, prompted vehicle acquisitions in two cases. The loss of the work role with an associated fixed work location that could be accessed by non-car means and the

introduction of new, more flexible leisure routines had led to the acquisition of additional cars. As one respondent noted:

“my wife is [now] at home with her own life to lead”.

[Male survey participant, aged 70–79]

Several survey and interview respondents explained acquiring their first car on entering the labour market for the first time.

4.1.1.2. Residential relocation. Residential relocations alter the options available for journeys to different centres of household activity, including the workplace. In the following case this affected opportunities for trip chaining, prompting the acquisition of a second car:

“Moving further away from [the] workplace (10 miles +) meant that we now needed two cars to manage [the] commute into Bristol and drop off of two children in two different schools”.

[Female survey participant, aged 40–49]

In another case, a second car was relinquished because the: “new house was convenient for bus to work for one of [the] family” [Male survey participant, age unknown].

The importance of change of access to transport was further demonstrated by moves from London to Bristol prompting two young couples to acquire their first cars. London offers multi-directional public transport which is not available in Bristol.

The underlying relationship between residential location choice, car ownership preferences and daily transport routines is clearly more complex than these examples might initially suggest. The ‘self-selection hypothesis’ posits that people may choose residential locations to meet a lifestyle preference, which may include a preference for more or fewer cars (Cao et al., 2007). However, there are many other constraints that

Table 2
Socio-economic characteristics of survey respondents.

		Inner urban		Outer urban		Total	
		N	%/SD ^a	n	%/SD ^a	N	%/SD ^a
Respondent gender	Male	34	35.4	38	43.2	72	39.1
	Female	62	64.6	50	56.8	112	60.9
	Total	96	100	88	100	184	100
Age of the oldest householder	Average age	48	15.6 ^a	39	12.4 ^a	44	14.8 ^a
	Total	89	–	80	–	169	–
Car ownership	0 car	12	12.5	7	8.0	19	10.3
	1 car	50	52.1	54	61.4	104	56.5
	2 cars	28	29.2	21	23.9	49	26.6
	3+ cars	6	6.3	6	6.8	12	6.5
	Total	96	100	88	100	184	100
Household structure	Single occupancy	15	15.6	23	26.1	38	20.7
	Shared housing	9	9.2	1	1.1	10	5.4
	Single parent with children	6	6.3	13	14.8	19	10.3
	Couple	16	16.7	22	25.0	38	20.7
	Parents with children	46	47.9	27	30.7	73	39.7
	Other	4	4.2	2	2.3	6	3.3
	Total	96	100	88	100	184	100
Highest level of educational attainment	Compulsory	2	2.1	5	6.0	7	3.9
	GCSE ^b	2	2.1	10	11.9	12	6.7
	'A' level ^c	7	7.4	7	8.3	14	7.8
	Vocational	4	4.2	23	27.4	27	15.1
	Degree	32	33.7	18	23.5	50	27.9
	Post graduate	44	46.3	17	28.6	61	34.1
	Other	4	4.2	4	4.8	8	4.5
	Total	95	100	84	100	179	100
Income	<£15,000	11	11.8	6	7.1	17	10
	£15,001–£30,000	20	21.5	23	27.1	43	24
	£30,001–£50,000	17	18.3	32	37.6	49	28
	£50,001–£70,000	16	17.2	9	10.6	25	14
	> £70,001	18	19.4	1	1.2	19	11
	Did not say	11	11.9	14	16.5	25	14
	Total	93	100	85	100	178	100

Notes: Not all categories sum to 184 responses due to missing values in the data set.
^a SD - standard deviation shown in italics for age.
^b GCSE: General Certificate of Secondary Education (taken at 16).
^c A Level: Advance Level (taken at 18).

are major considerations in residential location choices. Indeed, in the first example given above, the follow up telephone call indicated that the move from an inner to an outer urban location, was in part motivated by homes of the required size being more affordable in the outer urban location. Transport convenience was sacrificed as a result of the move.

In relation to this, earlier research by Stanbridge (2007) revealed that people differ in the extent to which the transport implications of a move are considered. This was also evident in the in-depth interviews. In one case, a family was motivated to move within walking distance of work following a change of employment and previous experience of an unpleasant daily commute by car. Selecting a property within walking distance of work subsequently resulted in the household relinquishing

Table 3
Observed car ownership level changes.

Car ownership level change	Interviews		Survey	
	n	%	n	%
0 to 1+	18	42.9	27	26.5
1 to 2+	9	21.4	30	29.4
2 to 3+	3	7.1	11	10.8
3 to 4+	0	0.0	1	1.0
3 to 2–	2	4.8	2	2.0
2 to 1–	7	16.7	27	26.5
1 to 0	3	7.1	4	3.9
Total	42	100.0	102	100.0

Table 4
Principal reasons for car ownership level changes amongst survey respondents. Source: Neighbourhood survey.

Reason for undertaking a car ownership level change	No. of instances	Increase in no. cars	Decrease in no. cars
Employment change	20	16	4
Cohabitation (providing opportunity to relinquish second car)	12	0	12
Residential relocation	10	9	1
Child birth	9	7	2
Company car being provided or removed	8	6	2
Offspring reaching driving age	8	8	0
Leisure (e.g. acquisition of camper van)	5	5	0
An adult joining or leaving the household	4	1	3
Bought a first car when financially able to	3	3	0
Retirement	3	2	1
Household member learns to drive for independence	3	3	0
Opportunism	2	2	0
Declining health in older age	2	0	2
A change in public transport attractiveness	2	2	0
Driving licence revoked	1	0	1
Car vandalised	1	0	1
Replaced car with motorbike	1	0	1
Unknown (no open response data)	8	5	3
Total	102	69	33

their first and only car as their level of car use gradually reduced over time after the move. This had not been planned at the time of the move and indeed the vehicle relinquishment occurred some nine years following the move – indicating the potential significant time lags between life events and associated behaviour changes occurring (see Box 2).

4.1.1.3. Cohabitation. Cohabitation presents an opportunity for car owning individuals previously living separately to share household resources, including cars. The interviews and surveys revealed multiple instances of the cohabitation event being instrumental in two car owning individuals later agreeing to share a single household car. One surveyed couple explained:

“We each had one [car] before marriage. When the cars ‘died’ we bought one decent car. We couldn’t afford two, found we didn’t need two, and that situation remained.”

[Female survey participant, aged 30–39]

The longer term process of adjustment to cohabitation was evident in the in-depth interviews. The female partner from one interviewed couple explained how initially:

“we’d both kind of come into it [cohabitation] with our own cars, which had whatever value attached to them for ourselves, so you kind of didn’t want to give that up”.

[Female interview participant, aged 30–39]

This example illustrates how car ownership level changes are subject to forces of *inertia* (discussed later), which can contribute to significant time lags between life events occurring and action being taken to change car ownership level. In this case, the couple noted there was a period of about three years where they did not really ‘need’ two cars (instrumental need), but the cars were retained due to personal attachment to their cars (affective desire).

4.1.1.4. Child birth. Child birth and the birth of the first child in particular, has multiple impacts on household activity patterns: the child care role is introduced; often one partner initially reduces work commitments (with associated reductions in income); and there is the new

requirement to transport the child. One interviewee described how the birth of the first child later prompted him and his wife to replace their two (beloved) sports cars with a single estate car. This was motivated by a temporary reduction in income during the period of maternity leave and initial attempts to carry baby equipment during a family holiday in a sports style car. The male partner explained:

“we went on a family holiday and when you've got youngsters you end up taking a load of stuff, sterilisers, prams and stuff. And that was quite a challenge to the [sports car]...so when we came back from holiday, it was just like you know we're going to have to get rid of these cars. Both of us rather reluctantly put our cars up for sale”.

[Male interview participant, aged 40–49]

This case also illustrated how the priority to own a certain *type* of car that reflects identity and preferences can be lowered after becoming a parent. Life events may alter values and preferences.

In contrast, the majority of examples relating to child birth recorded in the survey had prompted car ownership increases. One respondent noted how she “passed [her] driving test which was prompted by being pregnant and wanting easier transport options” [Female survey participant, aged 20–29].

4.1.1.5. Moving from the specific to the general. The specific cases presented above demonstrate that life events alter one or more of the following household attributes:

- the resources available to the household (e.g. income and cars);
- the relationships between individuals within the household (cohabitation or non-cohabitation) and their ability to share resources (including cars);
- the roles performed by individuals in the household (at work and at home) and the activity patterns that are undertaken in order to fulfil those roles (e.g. employee, partner, parent);
- the spatial and temporal distribution of the activity centres that are visited by the household (and the transport links available); and
- individual values and lifestyle preferences.

Interaction *between* life events has also been highlighted. For example, child birth is likely to be accompanied by a (temporary) change in employment patterns for one or more parents.

4.2. Processes linking life events to car ownership level changes

We now move on to discuss evidence of the *mechanisms* through which life events influence car ownership level changes.

4.2.1. Life events as sources of 'stress'

It was suggested in our earlier review of theory that a change in circumstances can lead to a condition of 'stress' with respect to the household car ownership status i.e. a discrepancy between satisfaction with the current car ownership position and a desirable alternative. Stress is a challenging concept to operationalise in empirical research and one which has received little attention to date in transport research, other than in theoretical discussions. The interviews confirmed that stress could be meaningfully observed, for example, through participant comments such as:

“we hardly ever used it [the car]. We used to say we have a car that sits on the street for six days out of every seven at the most frequent use” (in respect of an under-utilised vehicle which was later relinquished).

[Female interview participant, aged 40–49]

Stress was operationalised in the self-completion questionnaire survey by asking respondents to evaluate whether they had too few or too

many cars for their needs.⁴ This closed response was necessarily reductive and was designed to simply examine whether the prevalence of households in a 'stressed' state could be measured. A further question asked whether the next expected car ownership change would be a vehicle replacement, an increase or a decrease in the number of cars owned. This enabled an examination of the relationship between the level of 'stress' with respect to the current car ownership position and future intention to change car ownership level. The result is presented as a cross tabulation in Table 5.

46 out of 177 respondents (representing 26% of households) reported owning either too many or too few vehicles – interpreted as being in a condition of stress. Those respondents reporting too few or too many vehicles were more likely to be expecting to adjust their car ownership level (23 out of 46 cases) than those reporting just the right number of vehicles (15 out of 131 cases).

4.2.1.1. Determinants of car ownership 'stress' and future intentions. Survey respondents were asked to reflect on their reasons for their current satisfaction ratings and future intentions in the follow-up telephone calls. The following four possible stress-related states were identified:

- A. **Those with too few cars and no intention to change car ownership level** (16 cases in Table 5, including six in the no change and ten in the vehicle replacement categories) - This group included non-car owners (six out of 16 cases) that recognised the benefits of car ownership but did not intend to acquire a car; either due to specific (e.g. health) constraints (e.g. in older age) or owing to a preference for non-car ownership. It also included one-car owning couples (seven out of 16 cases) that felt an occasional need for an additional car. These participants mentioned strategies or preferences to avoid second car ownership including: making a 'conscious' (respondent's words) effort to manage with one car; having replaced a second car with a motorbike; and occasionally hiring a car when the other car was in use elsewhere for the weekend. A further three participants (parents with adult offspring) reported conflicts over access to two household cars arising from the second car being stored in another city for work or there being more adults of driving age than cars available in the household.
- B. **Those with too many cars and no intention to change car ownership level** (seven cases in Table 5, including one in the no change and six in the replacement categories) - This group was characterised by expressing feelings of guilt relating to car ownership or a latent desire to relinquish one car, albeit that obligations (relating to work or family) dictated that this was not a realistic possibility.
- C. **Those with too few cars and an intention to gain a vehicle** (15 cases in Table 5) - This group included young non-car owners (seven out of 15 cases): with aspirations to acquire their first car given frustration with public transport; wanting to keep the driving skill having just passed the test; expecting to need a car more in future for work; or helping with child care. There was a further (one out of the 15 cases) example of a non-car owning family expecting to re-acquire a car after a revoked licence was returned. There were also (seven out of 15) cases of one or two car owning families that expected to acquire an additional car to better meet obligations relating to employment, child care or leisure pursuits.
- D. **Those with too many cars and an intention to relinquish a vehicle** (seven cases in Table 5) - These all related to two car owning couples or families that intended to relinquish underutilised second cars. In all cases, circumstances had already changed in response to a specific life event and the second car was no longer required for a previous

⁴ Respondents could choose one of five options, worded: “it often feels like we have too few cars or vans for our needs”; “it sometimes feels like we have too few cars or vans for our needs”; “it often feels like we have too many cars or vans for our needs”; “it sometimes feels like we have too many cars or vans for our needs”; “we have just the right number of cars or vans for our needs”.

Table 5

Relationship between car ownership stress and intention to change car ownership level.
Source: Neighbourhood survey.

Next expected change	Too few vehicles		Too many vehicles		Just the right no. of vehicles		Totals	
	n	%	n	%	n	%	n	%
Replacement	10	5.6	6	3.4	111	62.7	127	71.8
Increase	15	8.5	1	0.6	14	7.9	30	16.9
Decrease	0	0.0	7	4.0	1	0.6	8	4.5
No change	6	3.4	1	0.6	5	2.8	12	6.8
Totals	31	17.5	15	8.5	131	74.0	177	100.0

purpose. The specific life events identified included: a change in working circumstances, moving in together and being able to manage with one car, child birth and the acquisition of a company car.

4.2.1.2. Conceptual insights. States A and B imply that the condition of stress is *distinct* from an intention to change car ownership level (a similar finding to that of Rossi (1955) for home move intention) - evidenced by the finding that one half of those reporting too few or many vehicles were *not* expecting to change car ownership level. Where stress does not translate into an intention to change car ownership level, participants were shown to either: (i) use behavioural strategies that do not require private car ownership when managing a deficit in car availability; or (ii) persist with a manageable level of dissatisfaction with the car ownership state. This is consistent with the conceptual notion that there is a threshold level of stress beyond which action to change car ownership level becomes necessary.

Table 5 also illustrates that an intention to change car ownership level can exist in the absence of stress - 15 out of 131 respondents who stated that they owned just the right number of cars for their needs (suggesting no stress) expected to change car ownership level in the future. Inspection of these cases showed that respondents

anticipated making a change in response to a future expected life event such as retirement, child birth, moving out of the city to be closer to better secondary schools or offspring reaching driving age. This reinforces the argument that stress is distinct from intention and relates to the current circumstance rather than being 'experienced' in anticipation of a future need.

4.2.2. Adjusting to new circumstances following a life event

We now turn to examine the complex processes that govern whether dissatisfaction with the current car ownership level (stress) translates into an intention to change car ownership level. This section draws primarily on the longer history insights from the in-depth interviews which illustrated how people adjust to changes in circumstances (following life events) through concurrent processes of behavioural *adaptation* (as suggested by Cullen (1978)) and *consideration* of whether the car ownership position should be changed.

4.2.2.1. Adaptation. It was observed that stress and a related intention to change car ownership level following a life event could be reduced if household members were able to adapt satisfactory daily transport routines around their current mobility resources, including cars, and the transport system available to them outside of the home. It has been theorised that human adaptation involves a process of trial and error through which the potential ways of organising daily life, including how, where and when to travel, are learnt and compared (Dargay and Vythoulkas, 1999; Parker et al., 2007; Fried et al., 1977 cited by Goodwin (2009), Campbell (1963) cited by Jackson (2004)). Such a trial and error process of adaptation over time is illustrated through the case study presented in Box 1.

In this case the intention to acquire a second car diminished, partly due to one individual in the household developing a positive attitude towards cycling, which was prompted by a poor public transport service and which was facilitated by a fully segregated cycle path into the city centre. This indicates that attitudes and the form of the built environment exert an influence over how individuals adapt to changing circumstances.

Box 1

Illustrative example of adaptation following a life event.

A couple described how they successfully adapted travel routines around an existing single car, following a move from the city centre to the outer suburbs. Having established that parking in the city centre would be expensive, the male partner explained:

"When we first moved here we used to get the bus [to work in the city centre]...Not for very long, only for a few months. Oh it was awful...And that was one of the things that got me into cycling. The buses being so bad...And I suppose I must have got the bike out and thought: 'Oh this has got to be better than doing the bus hasn't it...?'"

[Male interview participant, aged 40–49]

The process of transition from bus to bicycle was explained to be gradual:

"I started off doing it [cycling to work] just one or two days a week...And then I'd do the bus the other days and built up".

[Male interview participant, aged 40–49]

The couple later described how they had considered at one point buying a second car [given that the first car was used for the female's commute] as the male partner had nearly been knocked off his bike on the way to work. The female partner recalls how:

"...we did consider either another car or a motorbike, but then decided that a motorbike wasn't really any safer than the push bike".

[Female interview participant, aged 40–49]

The husband responds:

"and you don't get the fitness thing which is you know, half of what I like about being out in the fresh air on a push bike."

[Male interview participant, aged 40–49]

4.2.2.2. Consideration of alternative car ownership states. The case study also shows that the couple considered altering their car ownership position during the process of adapting to the new circumstance, but chose not to alter it. The survey confirmed that stress leads to heightened consideration of the car ownership state. Survey respondents were asked to rate the extent to which they were considering changing car ownership level on a scale of one to five (five being serious consideration, one being no consideration). Stressed respondents scored an average of 3.15 compared to an average of 2.25 for satisfied respondents ($t = -3.634$, $df = 165$, $p < 0.000$).

People may also be considering their car ownership options pending an expected life event. For instance, a young couple explained how they were contemplating getting a second car, when the female partner started a new job:

“We have talked about getting a [second] little car but we're going to wait until we've settled down here and the incomes have levelled out...And we might get a company car [with his partners new job] so that would be quite good.”

[Male interview participant, aged 30–39]

4.2.2.3. Inertia and stimulus events. We have so far demonstrated that a *life event* followed by a period of *adaptation* and *consideration* may create a ‘stored up’ propensity to change car ownership level – evidenced by the observation that 21% of survey respondents were anticipating changing car ownership level. However, households may or may not immediately act on their intentions. The interviews indicated that typically a series of one or more smaller ‘stimulus events’ are subsequently required to prompt a household into taking action. The interviews support the notions that: (i) people are resistant to change (Goodwin and Mogridge, 1981); (ii) car ownership changes are subject to *inertia*⁵ (Dargay, 2001, Dargay and Hanly, 2007); and (iii) in addition to life events, smaller stimuli may be required to overcome the inertia.

The following reasons for inertia (i.e. not acting on a desirable car ownership change) were identified in the interviews.

- **Familiarity or risk aversion** – As described by a female interviewee: “I know it's a reliable, good car, so do I trade that in for...I won't know its history, I won't know how reliable it's gonna be...So I'll just stick with what I've got” [Female interview participant, aged 50–59].
- **Depreciation of the car asset and assessing the costs and benefits of a change** – A couple described why they delayed selling one of their two cars when they formed a household together: “how much would you get for it...you know is it worth selling it or would you just keep it? ...because we won't get much money for it anyway, so you might as well just have it” [Female interview participant, aged 30–39].
- **Apathy** – Changing cars may not be a priority and there may be no desire to spend time thinking about it as described by a female interviewee “So the idea was to get a four door car and sell the two door car. But we never quite got around to selling...the SEAT” [Female interview participant, aged 30–39].
- **The search costs associated with buying or selling a car** – One female interviewee described her conundrum on what to do with her existing car when she acquires a newer (temporarily second) car from her parents: “What am I going to do with the old car anyway? You know, I've got to go to the effort now of finding some way of getting rid of it” [Female interview participant, aged 40–49].
- **Indecision, maintaining fairness in the household or personal attachment to a car** – A couple described how when they moved in together, having realised that they only needed one car, they had a dilemma as to whose car they should sell first.

4.2.2.4. Prompting action to change car ownership level. It was also possible to identify a number of types of *stimulus events* that prompted a household to take action, overcoming the inertia. These included financial signals such as insurance renewal notices or the receipt of a large maintenance quote. In one case an incentive scheme offered by an employer prompted a couple to buy the second car they had craved for some time: “They were offering employees the opportunity to buy brand new cars at a reduced rate. And...we had been thinking about a new car, and because this offer came along we said ‘well really it's an offer we can't really turn down’” [Female interview participant, aged 50–59].

4.3. Summary of the overall process of car ownership level change

The overall process that gives rise to car ownership level changes, as depicted in Fig. 2, may be summarised as follows:

Life events (1) change household circumstances by altering roles, relationships, spatial contexts and lifestyle preferences. This can lead to a discrepancy between satisfaction with the current car ownership level and a desirable alternative – labelled a condition of stress (2). This then triggers processes of adaptation (3) to the new situation, and heightened consideration (4) of whether the existing car ownership state is appropriate. Households may also consider required car ownership changes in anticipation of future life events. It is through processes of consideration and adaptation that a propensity to change car ownership level (5a) may arise. It was observed that there is a tendency for households to resist acting on desirable car ownership level changes, given the effort involved in taking action – household car ownership is subject to inertia (5b). During the interviews some respondents revealed that smaller stimulus events (6) had finally prompted them into changing car ownership level (7). Lastly, following a change in car ownership state (8), the condition of stress with respect to the car ownership position is altered (it may be relieved but not always) and a process of adaptation to the new car ownership position ensues.

It is not suggested that household car ownership level changes always follow this process in a deterministic, sequential fashion (indeed see Box 2). Rather, the intention of putting forward the framework is to highlight the *key elements* of the process through which car ownership level changes arise over the course of people's lives. It is intended to aid research into the dynamics of car ownership, and is complementary to behavioural theories from the field of social psychology that explain decision making in detail (e.g. as summarised in Van Acker et al. (2010)).

Three annotated case studies from the interviews, illustrating how the framework helps to explain different types of car ownership level changes, are provided in Box 2.

5. Concluding discussion

Quantitative studies have confirmed a strong statistical association between life events and increased likelihood of car ownership level changes occurring. By adopting an inductive, qualitative approach, this study has enabled the development of a new conceptual framework, supported by case examples, that provides causal *explanation* of the process through which life events lead to car ownership level changes.

The theoretical concept of ‘stress’ has been adopted to explain the state in which households may become dissatisfied with their current car ownership position over time, relative to a more desirable alternative. To our knowledge, there have been no previous attempts to observe whether and how such hypothesised car ownership stress arises. The neighbourhood survey showed that many households (26% of our sample) consider they have ownership of too few or too many cars for their needs. In the preliminary conceptual model, we theoretically defined such situations respectively as a car access surplus or a car access deficit. Further research could examine whether a surplus in household car availability ‘induces’ a degree of excessive car use,

⁵ “The tendency of a body to preserve its state” (Collins, 1982).

Box 2

Illustrative examples of the process of car ownership level change.

Case 1: Interview account of a one to zero car transition in association with moving home

A one car owning family with young children relocated to a different city. During the relocation process, they sought to avoid the unpleasant shared car commute they had experienced previously and selected a house that was within walking distance of their work places. On moving to Bristol [life event], their new home was convenient for walking to work, local amenities and the children's school. Their reliance on the car reduced over this period [adaptation] and they recalled observing that their car was rarely used [stress] although they had no intention to relinquish it at this stage. It was only when the car was vandalised (nine years later) and written off [stimulus event] that the costs of running the car became apparent [consideration] and they decided not to replace it [a car ownership level change]. On losing access to the household car, the family learnt new ways of managing trips for which the car had previously been useful [adaptation]. They explained that they had discussed whether to re-acquire a car in the future [stress/consideration].

Case 2: Interview account of a one to two car transition in association with employment change

A one car owning couple lived together with their young daughter. The female partner returned to work after a period out of the labour market looking after their daughter [life event]. They used the car to get to both work places [adaptation], but they were finding it increasingly difficult to manage work journeys using the single household car [stress], particular when working different shift patterns. Weekend working was described as the 'final straw' which prompted them to contemplate buying a second car [consideration and a propensity to change car ownership level]. The male partner's work place later offered employees a favourable deal to purchase a new car from a local dealership [stimulus]. This prompted the couple to buy the second car they desired [car ownership level change].

Case 3: Interview account of a two to one car transition in association with child birth

A young couple lived together as a two car owning household. The female partner did not like driving her husband's old and large car and had her own smaller, two door car to use for work. The couple were expecting their first child [life event]. This prompted them to (temporarily) acquire a third, four-door car in anticipation of having the baby [consideration and a car ownership level change]. The four-door car was intended to be a replacement for the female's two-door car. However, it took them six months to 'get around' to selling the two-door car [inertia] and they were finally prompted to do so by imminent maintenance costs [stimulus event]. After having the baby, the female's working hours reduced [life events] and the couple realised that their two cars were rarely used at the same time [stress]. In the meantime, they had also updated the larger of their two cars with one that the female partner felt comfortable driving [adaptation]. This led them, through consideration, to finally sell their second car [car ownership level change].

[Source: Interviews]

following Handy et al. (2005). It would also be beneficial to further understand how households with 'too few cars' manage their travel routines. The implications of this may for instance include: (i) re-timing of car oriented travel (through negotiation with other household members); (ii) household members using alternative means of transport (with potential opportunities for car sharing to meet the 'deficit' in car availability); (iii) not travelling (reducing the opportunity to take part in activities) and (iv) finally adjusting their car ownership level in line with needs/desires. We found that those in a condition of stress were considering altering their car ownership position to a greater extent than those that were satisfied with the current car ownership position.

5.1. Implications for policy and practice

The observation that respondents acknowledged ownership of too many cars - but were either not considering or were delaying the relinquishment of the car for reasons of inertia - would suggest opportunities for alternative models of car access (such as car rental and sharing). Households were shown to respond to smaller stimuli (like insurance renewals or maintenance bills) that finally prompted them into changing car ownership level. Marketing messages that present scenarios familiar to certain target groups ('people like you...') may be effective here. Car sharing organisations already present comparisons of the cost of car sharing membership with the cost of running an underutilised second car. They could also emphasise that new cohabitants may take some time to realise that they no longer need the second car (for instance by asking 'how often do you use both cars on the same day?'). A further observation is that households may be reluctant to relinquish second hand cars, partly as a result of the search costs and small monetary reward involved in selling the vehicle. Car sharing organisations could incentivise membership through facilitating the easy and cost effective relinquishment of a vehicle (in the same way

that housing developers offer part exchange to incentivise the purchase of a new build home).

The study is also supportive of the proposition, which is now being exploited in UK transport policies, that life events are important 'moments of change' during which people may be encouraged to adopt 'socially desirable' behaviours - greater use of non-car commuting in urban areas for example. With respect to home moves in particular, the level of access to transport resources and amenities outside of the home has been shown to influence how people adapt to new residential locations. This can have later consequences for car ownership outcomes, e.g. vehicle relinquishments in cases where accessibility is improved and vehicle acquisitions where accessibility is worsened. This serves as an important reminder of the need for well-balanced, multi-modal transport systems in urban areas (offering comfortable walking and cycling conditions and adequate public transport) to moderate the number of cars that households need.

5.2. Opportunities for further research

The study has demonstrated the potential for qualitative, longitudinal approaches to provide causal explanations of why car ownership levels change over time (addressing some of the knowledge gaps identified by Muggenburg et al. (2015)). Although the samples involved in this study are limited in size and are not representative of the UK population, our intention has been to develop a generalised framework. Nevertheless, further evidence is required to test the wider applicability of the processes suggested here. In this respect similar qualitative approaches could be employed to consider the relationship between specific life events and car ownership in detail - for example, examining the motivations for different forms of residential relocation and identifying how these influence car ownership decisions; or identifying the circumstances under which the birth of a child prompts the acquisition or

relinquishment of a car (as observed quantitatively in Clark et al. (2015) and as examined by Lanzendorf (2010)).

It was also apparent that interview/survey participants tended to offer functional rather than affective reasons for changing car ownership level. This may potentially be associated with the research instruments which drew attention to biographical events and transport 'needs' at different points in time. An alternative line of questioning and analysis would be beneficial to shed light on the extent of emotional and symbolic attachment to vehicles (Steg, 2004).

The insights from the qualitative research presented here are potentially valuable to the transport modelling community. Micro-simulation models of travel behaviour, in which individual household units are represented and their behaviour simulated over time, are being developed to inform land use and transportation policies (Feldman and Simmonds, 2007; Salvini and Miller, 2005). The framework put forward in this paper (Fig. 2) provides a conceptual basis for 'decision rules' that could be incorporated in dynamic, micro-simulation models of household car ownership. For instance, models could simulate the number of households (with a given structure, life stage and car ownership status) moving into and out of different neighbourhoods each year. Econometric models could then estimate the proportion of households in the neighbourhood experiencing particular events relevant to car ownership such as having the first child. Based on existing evidence of transition probabilities following life events (see Clark et al. (2015)), car ownership transaction models could calculate the proportion of households in each neighbourhood experiencing a particular car ownership transaction. Such models could build in sensitivity to different policy scenarios (improving or worsening public transport for example).

As a key concluding message from the paper, we re-iterate that the decision to acquire, relinquish or to replace a car must not be viewed as a discrete, isolated decision. Changes in household car ownership levels should instead be considered as the outcome of a continuous process of adjustment over the life course.

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References

- Belli, R., 1998. The structure of autobiographical memory and the event history calendar: potential improvements in the quality of retrospective reports in surveys. *Memory* 6 (4), 383–406.
- Braun, V., Clarke, V., 2006. Using thematic analysis in psychology. *Qual. Res. Psychol.* 3, 77–101.
- Campbell, D., 1963. Social attitudes and other acquired behavioural dispositions. In: Koch, S. (Ed.), *Psychology: A Study of a Science*, sixth ed. McGraw Hill, New York, pp. 94–172.
- Cao, X., Mokhtarian, P., Handy, S., 2007. Cross-sectional and quasi-panel explorations of the connection between the built environment and auto ownership. *Environ. Plan. A* 39, 830–847.
- Clark, B., 2012. Understanding How and Why Household Car Ownership Changes Over Time (PhD) University of the West of England, Bristol.
- Clark, B., Chatterjee, K., Melia, S., 2015. Changes in level of household car ownership: the role of life events and spatial context. *Transportation* 43 (4), 565–599. <http://dx.doi.org/10.1007/s11116-015-9589-y>.
- Collins, 1982. *Collins English Dictionary*. Collins, London.
- Cullen, I., 1978. The treatment of time in the explanation of spatial behaviour in cities. In: Carlstein, T., Parkes, N., Thrift, N. (Eds.), *Human Activity and Time Geography. Timing Space and Spacing Time 2*. Arnold, London, pp. 27–38.
- Dargay, J., 2001. The effect of income on car ownership: evidence of asymmetry. *Transp. Res. A* 35, 807–821.
- Dargay, J., Hanly, M., 2007. Volatility of car ownership, commuting mode and time in the UK. *Transp. Res. A* 41 (1), 934–948.
- Dargay, J., Vythoulkas, P., 1999. Estimation of a dynamic car ownership model: a pseudo-panel approach. *J. Transp. Econ. Policy* 33 (3), 287–302.
- Dey, I., 1993. What is qualitative analysis? In: Dey, I. (Ed.), *Qualitative Data Analysis: A User-Friendly Guide for Social Scientists*. Routledge, London, pp. 30–54.
- Feldman, O., Simmonds, D., 2007. Household Location Modelling: Final Report, Part 1, Model Design. Department for Transport, London.
- Fried, M., Havens, J., Thall, M., 1977. Travel Behaviour - A Synthesized Theory. Transportation Research Board, Washington DC, USA (Project 8–14 final report).
- Golounov, V., Dellaert, B., Timmermans, H., 2001. A dynamic lifetime utility model of car purchase behaviour using revealed preference consumer panel data. In: Anon (Ed.), 81st Annual Meeting of the Transportation Research Board, Washington D.C., USA 13th–17th January 2002. Transportation Research Board.
- Goodwin, P., 2009. Invited to a tea party - but did we miss the boat? *Local Transp. Today* 514, 13.
- Goodwin, P., Mogridge, M., 1981. Hypotheses for a fully dynamic model of car ownership. *Int. J. Transp. Econ.* 8 (3), 313–326.
- Handy, S., Weston, L., Mokhtarian, P., 2005. Driving by choice or necessity. *Transp. Res. A* 39A (2–3), 183–204.
- Jackson, T., 2004. Motivating Sustainable Consumption - A Review of Evidence on Consumer Behaviour and Behavioural Change. University of Surrey, Guildford.
- Kahneman, D., Thaler, R.H., 2006. Anomalies: utility maximization and experienced utility. *J. Econ. Perspect.* 20 (1), 221–234.
- Lanzendorf, M., 2003. Mobility biographies. A new perspective for understanding travel behaviour. In: Anon (Ed.), 10th International Conference on Travel Behaviour Research, Lucerne 10th August 2003. The International Association for Travel Behaviour Research.
- Lanzendorf, M., 2010. Key events and their effect on mobility biographies: the case of childbirth. *Int. J. Sustain. Transp.* 4 (5), 272–292. <http://dx.doi.org/10.1080/15568310903145188>.
- Miller, E., 2005. An integrated framework for modelling short and long run household decision making. In: Timmermans, H. (Ed.), *Activity Based Analysis*, first ed. Elsevier Ltd, Oxford, pp. 175–201.
- Müggenburg, M., Busch-Geertsema, A., Lanzendorf, M., 2015. A review of the achievements and challenges of the mobility biographies approach and a framework for further research. *J. Transp. Geogr.* 46, 151–163.
- Oakil, A., Ettema, D., Arentze, T., Timmermans, H., 2014. Changing household car ownership level and life cycle events: an action in anticipation or an action on occurrence. *Transportation* 41, 889–904.
- Parker, J., Harris, L., Chatterjee, K., Armitage, R., Cleary, J., Goodwin, P., 2007. Making Personal Travel Planning Work: Research Report. Department for Transport, London.
- Roorda, M., Carrasco, J., Miller, E., 2009. An integrated model of vehicle transactions, activity scheduling and mode choice. *Transp. Res. B Methodol.* 43, 217–229.
- Rossi, P.H., 1955. *Why Families Move*. Free Press, Glencoe, Illinois, USA.
- Salomon, I., Ben-Akiva, M., 1983. The use of the life-style concept in travel demand models. *Environ. Plann. A* 15, 623–638.
- Salvini, P., Miller, E., 2005. ILUTE: an operational prototype of a comprehensive microsimulation model of urban systems. *Netw. Spat. Econ.* 5 (2), 217–234.
- Stanbridge, K., 2007. Residential Relocation and Travel Behaviour Change (PhD.) University of the West of England, Bristol.
- Steg, L., 2004. Car use: lust and must. Instrumental, symbolic and affective motives for car use. *Transp. Res. A* 39 (1), 147–162.
- Van Acker, V., Van Wee, B., Witlox, F., 2010. When transport geography meets social psychology: toward a conceptual model of travel behaviour. *Transp. Rev.* 30 (2), 219–240.
- Van Acker, V., Goodwin, P., Witlox, F., 2016. Key research themes on travel behavior, life-style, and sustainable urban mobility. *Int. J. Sustain. Transp.* 10 (1), 25–32.
- Walker, R., 1976. Social survey techniques: a note on the 'drop and collect' method. *Area* 8 (4), 284–288.
- Whelan, G., 2007. Modelling car ownership in Great Britain. *Transp. Res. A* 41, 205–219.
- Zhang, J., Yu, B., Chikarishi, M., 2014. Interdependences between household residential and car ownership behaviour: a life history analysis. *J. Transp. Geogr.* 34, 165–174.