

---

## Exploring the interactions between life-events, neighbourhood choice and car ownership transitions: Insights from a retrospective longitudinal survey

Ben Clark  
Research Associate  
Centre for Transport & Society, University of the West of England, Bristol

Professor Glenn Lyons  
Professor of Transport and Society  
Centre for Transport & Society, University of the West of England, Bristol

Dr Kiron Chatterjee  
Senior Lecturer in Transport Planning  
Centre for Transport & Society, University of the West of England, Bristol

### Abstract

A great deal has been written about the factors associated with cross-sectional variations in household car ownership. For example, observing that car ownership levels tend to increase with increasing distance from urban centres. However, much less has been discovered about the time dependent processes through which household car ownership states arise. Accordingly, this paper presents a study which addressed how and why household car ownership changes over time.

Noting the lack of an agreed theory relating to the dynamics of household car ownership, the paper first puts forward a new framework depicting a life event driven process of car ownership change. The framework emerged through a qualitative analysis of 15 biographical interviews and was tested through a survey of 248 households located in one inner-urban and one outer-urban neighbourhood in Bristol.

The results confirm the importance of life events and life stage to car ownership level change. Younger households have a tendency to increase car ownership level from zero to one or more cars as they move towards middle age. Vehicle relinquishments are more likely to occur in older age following retirement in association with health and income constraints. Over 70 percent of car ownership level changes recorded by the survey were associated with either a change in working circumstances, cohabitation, an adult joining or leaving the household, residential relocation, child birth or offspring reaching driving age. The survey also reveals a process of population churn in the two neighbourhoods and suggests that this acted to maintain both a stable population composition (in terms of life stage characteristics) and a stable aggregate car ownership level in the period since the 2001 census.

### Introduction

A great deal has been written about the factors associated with cross-sectional variations in household car ownership. However, much less has been discovered about the *time dependent* processes through which household car ownership states arise. This paper presents one such study which addressed how and why household car ownership changes over time. By way of introduction we offer a briefly argued case for the need for longitudinal approaches to the study of car ownership by considering some of the limitations of cross-sectional analyses. Whilst recognising the valuable contributions of cross-sectional studies, their limitations are most easily demonstrated with recourse to a selection of examples.

First, a study by Hass Klau et al (2007) used the 2001 UK census data to perform a cross-sectional analysis of the relationship between car ownership and proximity to a high quality public transport corridor (heavy rail, underground, tram or high quality bus). Their analysis demonstrated that “good public transport access reduces local car ownership, having controlled for population and socio-economic structure” (Crampton, 2006 p.9). However, the extent to which good public transport *causes* lower car ownership cannot be established

---

from a cross-sectional analysis alone. Households with a *pre-existing* preference for lower car ownership might simply choose to live in areas with better public transport.

This effect is termed *residential self-selection*; a phenomenon that has been explored by others seeking to understand the well known *association* between urban form and car ownership. Car ownership rates are typically lower in higher density, central urban areas than they are in lower density outer urban and rural areas. However, to what extent do people with a *pre-existing* preference for car oriented lifestyles choose to live in car oriented developments? A number of studies have applied increasingly sophisticated techniques to control for the effects of residential self selection. For instance, using both cross-sectional and quasi-panel modelling approaches, Cao et al (2007) conclude that the built environment *does* exert a marginal influence on car ownership *independently* of attitude. However, they also comment that further insights are required to explore the degree to which the built environment itself influences attitudes *over time*.

As a final example, cross-sectional comparisons reveal that UK households *with* a car undertake more trips and travel further overall than households *without* a car (Department for Transport, 2006 pp.33-34). From this observation it would seem self-evident that the household car ownership level is an important determinant of car use. Yet this cannot be inferred from cross-sectional data alone. In this case it is not possible to establish the extent to which car owning households have a higher *pre-existing* travel demand before acquiring a car than non-car owning households. Moreover, such cross-sectional analyses reveal little about the pathway of evolution towards current patterns of car use that occur following the acquisition of a car.

The general limitations of cross-sectional analyses and the need for complementary *longitudinal* approaches are well recognised within the transport studies field. In discussing issues of cause and effect, Mokhtarian and Cao (2008 p.205) suggest that four types of evidence are required to “robustly infer causality”. These they identify as: “association (a statistically significant relationship), non-spuriousness (a relationship that cannot be attributed to another variable), time precedence (cause precedes effect), and causal mechanism (a logical explanation for why the alleged cause should produce the observed effect)”. They suggest that *longitudinal* studies “offer substantial improvement over cross sectional designs” in this respect.

Chatterjee (2011) explains that cross-sectional studies may lead to over-estimation of the relationship between observed behaviour and current circumstances. He shows using panel data that a higher value is estimated for a level of service parameter from the baseline survey wave (cross-sectional data) than from all four waves of the panel data.

Others (Dargay and Vythoulkas, 1999, Goodwin, 1998) offer a critique of the assumption made in cross-sectional studies, that individuals have reached *equilibrium* (stable) behavioural states. The problem with this assumption is best illustrated again with recourse to an example: consider a cross-sectional cohort comparison of the car ownership states of couples with children to those of couples of the same age without children. Arguably, some behavioural adjustments to the event ‘having children’ (including possible car ownership changes) may take some time, potentially years to take place and it would be unknown how far through this process of adjustment the couples with children are. Indeed, it has been suggested that in practice, true equilibrium behavioural states may never be reached (Dargay and Vythoulkas, 1999, Goodwin, 1998). A cross-sectional comparison of the two cohorts, assuming that both groups had reached equilibrium states, would therefore risk under-estimating the longer term influence of the event ‘having children’. Furthermore, a cross-sectional study would reveal no insights into the process of evolution associated with the two alternative states (have children, do not have children). There may be characteristics of these different pathways (unobserved in cross-sectional data), which have an important influence on eventual car ownership outcomes.

These arguments support the case for the longitudinal study of how household car ownership changes over time, which is now presented. The study involved two stages of primary research, both conducted in the city of Bristol, UK: (i) a set of 15 in-depth interviews; and (ii) a survey of households located in one inner urban and one outer urban neighbourhood. The paper first briefly summarises the former (this is presented in detail in (Clark et al, 2010)), before focusing on the latter.

---

---

### Conceptual insights into the dynamics of household car ownership

A wide ranging literature review (Clark et al, 2009) revealed a lack of an agreed theoretical framework to underpin a study of the dynamics of car ownership. Accordingly, the first phase of research required a *qualitative exploration* of the most salient concepts drawn from the existing literature, summarised as follows.

- Buying (or having access to) the first car, encourages lifestyles and norms based around the car to form. Car dependence grows over time (Goodwin, 1995).
- As car based lifestyles and norms form, households become resistant to change (Dargay, 2001), contributing to inertia and state dependence in household car ownership. State dependence implies that past car ownership levels are a strong determinant of current car ownership levels (Hanly and Dargay, 2000, Thorgersen, 2006, Simma and Axhausen, 2007).
- Although the majority of households maintain car ownership levels from one year to the next, a higher than might be expected number of households do change their car ownership level. The British Household Panel Survey indicated that 16 per cent of households change car ownership year on year with 8.2 per cent of households increasing car ownership, while a smaller, yet significant 7.6 per cent of households reduce car ownership (Dargay and Hanly, 2007). Thus the gradual increase in national car ownership levels results from a much larger churn (gross change) at the household level.
- Household car ownership changes are often associated with key life events (Dargay and Hanly, 2007, Mohammadian and Miller, 2003), although adaptation to a new set of circumstances takes time (Dargay, 2001).
- This lends weight to the claim that *key life events* present opportunities for reassessment of lifestyles or indeed may mark a change in lifestyle (for instance the birth of the first child). Such life events may lead to longer term behavioural (including and induced by car ownership) change (Bamberg et al, 2003, Fujii and Kitamura, 2003, Stanbridge, 2006, Goodwin, 2008).
- Finally, a pseudo panel analysis of national UK data reveals a typical car ownership life-cycle profile. Household car ownership tends to increase as the head of the household reaches the age of 50, after which it declines (Dargay and Vythoulkas, 1999).

#### *Car ownership as a non-equilibrium state*

In addition to these insights from the literature, a further mediating concept, labelled the household's *car access imbalance* was developed prior to conducting the primary research. This was to capture the notion that while a household's car ownership *state* (car ownership level and vehicle type) may change at *discrete* points in time (the day that the household acquires, relinquishes or replaces a vehicle), the extent to which the current car ownership state meets the household's desires may fluctuate in a more *continuous* fashion over time. This reflected the important conceptual notion that car ownership states may not represent an equilibrium position at a given point in time.

This notion of *car access imbalance* was considered to draw parallels with the concept of *stress* which has been applied elsewhere in the study of car ownership (Oakil et al, 2011, Roorda et al, 2009). Miller (2005 p.183) explains that "stress arises when one's current state deviates from some alternative desired / expected / optimal state. The larger this deviation, it is hypothesized, 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".

This is of relevance to understanding the *process* through which household car ownership changes. It is clearly not possible for households to make marginal adjustments to their car ownership state. A household can opt to own zero, one or two or more cars, but cannot (at least under current typical models of ownership) make a marginal adjustment to their car ownership level, to own 1.4 cars say. Similarly, a household cannot make a marginal adjustment to change the *type* of car that they own.

---

This inability to make marginal adjustments to car ownership states relates to the concepts of state dependence and inertia highlighted before. 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 stress, or as postulated here a car access imbalance, becomes too large, will the household be tipped into an active search for an alternative, preferred state (if resources allow).

### **The inductive development of a theoretical framework**

Given the lack of an agreed theoretical basis for researching the dynamics of car ownership, the first phase of primary research required a qualitative exploration of these concepts identified through the literature. Accordingly, 15 in-depth interviews with members of zero, one and two car owning households were conducted. The interviews utilised Lanzendorf’s (2003) Mobility Biography framework and generated *retrospective* accounts of how the current car ownership position had arisen over time, in relation to past car ownership changes and wider changes in the household’s circumstances. An inductive thematic analysis of the interviews (reported in detail in (Clark et al, 2010)) led to the development and refinement of a more concise theoretical framework depicting the process of car ownership change. This framework is illustrated in Figure 1 and its key elements are summarised as follows.

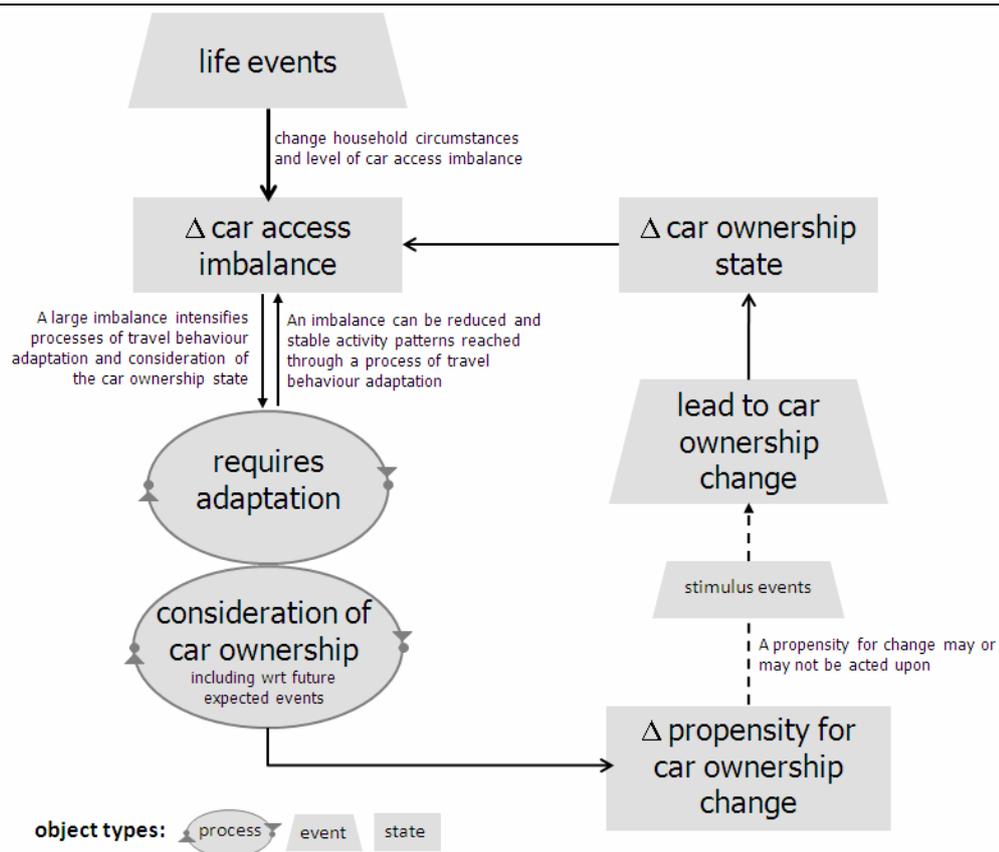
The interviews suggested that car ownership level changes are indeed driven by *life events*. Life events mark a distinct change in the household’s circumstance, altering one or more of: the resources available to the household (e.g. income); the relationships between individuals within the household (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; and the consequent spatial and temporal distribution of the activity centres that are visited by the household.

The interviews provided empirical evidence for the complex mediating concept of ‘car access imbalance’ introduced theoretically in the preceding section. Imbalances between an existing car ownership state, and a desirable alternative were found to arise as circumstances change over time in response to life events.

The interviews also illustrated how efforts to reduce imbalances, without first changing car ownership state, were made through a process of trial and error *adaptation* to the new circumstances. The form of the local built environment is one factor (in addition to existing preferences towards alternative modes) that influences the transport options that a household feels able to ‘try out’ during adaptation. In some cases, individuals within households had developed a new propensity to use alternative modes (bicycles or adequate public transport) through this process of adaptation. This had acted to suppress the subsequent need for an additional car. In other cases, following an unsatisfactory period of adaptation and through *consideration* of the car ownership state, a latent *propensity to change car ownership state* had developed.

Households were however, demonstrably resistant to change - car ownership was found to be subject to *inertia*. This contributed to time lags (of up to several years) between a propensity to change car ownership state emerging and the household taking action. It was revealed that further stimulus events (such as the receipt of an insurance renewal) may be required to prompt the household into taking action.

Lastly, exploring the influence of residential location on car ownership change revealed that some interviewees had developed particular lifestyle preferences over time based on past experience. These lifestyle preferences were realised at a subsequent residential relocation event - for instance, moving to within walking distance of work in order to avoid a previously experienced commute by car. In some cases this was a key factor in influencing a later, not necessarily foreseen, change in car ownership level.



**Figure 1: A framework depicting the process of car ownership change**

The framework depicting the process of car ownership change appeared reflective of the differing accounts of car ownership change elicited from the interviews. However, given the limited sample size and composition, its wider applicability had not been tested.

### The neighbourhood survey

This sets the context for the remainder of the paper which reports the method used and substantive findings from a neighbourhood survey also undertaken in the city of Bristol, UK. The purpose of the neighbourhood survey was to test for the wider applicability of the framework emerging from the in-depth interviews and to explore the interaction between neighbourhood choice, wider life-events and the process of car ownership change.

#### Survey methodology

The survey sample comprised 100 per cent coverage of one inner-urban (Bishopston) and one outer-urban (Bradley Stoke) census output area, containing 120 and 128 households respectively. The 2001 census was used to identify census output areas that contained a similar demographic so that the influence of residential location could be explored holding all else equal. Accordingly, the selected output areas were both classified as 'young families in terrace homes' in the 2001 census.

The locations of the surveyed output areas are shown in Figure 2. The Bishopston output area is situated approximately 1.5 miles from the city centre and also benefits from proximity to a wide range of local shops, bars and restaurants. The Bradley Stoke output area was developed in the late 1980s and is situated in close proximity to the M4 and M5 motorway interchange on the outskirts of the city (approximately seven miles from the city centre). While Bradley Stoke had few, if any local amenities when it was first constructed, it is now quite self contained with a range of supermarkets and a local (within walking distance) shopping / leisure centre having been developed.

The output areas exhibited the expected differences in travel behaviour between an inner-urban and outer-urban location – in 2001, compared to Bishopston, Bradley Stoke had a higher average car ownership rate (1.31 cars per household compared to 1.27 cars per

household) and a higher car use commuting modal share (73 per cent compared to 54 per cent) (Census Dissemination Unit, 2011 Key Statistics Tables).



**Figure 2: Location of the survey neighbourhoods**

The survey instruments were designed to generate qualitative accounts of how the car ownership level had changed since household formation. Household formation was defined as the point at which the head(s) of the household began living alone or residing together with other household members. To reduce recall burden, the survey focused on generating an account of the *most recent car ownership level change* for the household. The survey also tested for the presence of current *car access imbalances* (non-equilibrium states) by asking participants whether their household owned too few, too many or just the right number of cars for their needs. Lastly, the survey explored prospects for the next expected car ownership change.

Given the relative complexity of the data requirements and the recall burden on participants, the survey involved both a self completion questionnaire and in some cases a follow-up telephone call. A 'drop and collect' method of survey administration was employed to boost response rates. This achieved a response rate of 74 per cent - 184 questionnaire returns (96 from Bishopston and 88 from Bradley Stoke). In total, 125 follow-up telephone calls were completed (71 in Bishopston and 54 in Bradley Stoke).

### Survey findings

The substantive findings from the survey are now presented in terms of four themes: (i) how household car ownership levels had arisen across the sample; (ii) how neighbourhood car ownership levels had changed since the 2001 census; (iii) how patterns of car ownership and use varied between the two neighbourhoods; and (iv) investigating the prevalence of car access imbalances and prospects for future changes.

#### *How household car ownership levels had arisen across the sample*

Given the study's focus on car ownership dynamics, the surveyed households were first categorised according to the *transaction pathway* towards the current car ownership state since household formation. Through this process 12 car ownership transaction pathways were identified - see Table 1. A qualitative analysis of the accounts of car ownership change established the common features of each car ownership pathway as well as the differences between them. The full systematic descriptions are provided in Clark (2011). In summary it was observed that a household's pathway type tended to relate to the household's *life stage* at the time of the survey. Indeed, the pathways could be associated with the typical car ownership life cycle pattern observed by Dargay and Vythoulkas (1999) and reflected, in order of life stage as shown in Box 1.

The qualitative analysis of the car ownership transaction pathways also revealed 14 common reasons for undertaking car ownership level changes - listed, in order of prevalence, in Table 2. The reasons are consistent with the process of car ownership change framework (Figure

1) emerging from the analysis of the in-depth interviews, in often representing *life events* which trigger a change in circumstance which in turn linked to a change in car ownership level. Indeed 82 per cent of respondents describing level changes in the questionnaire indicated that the level change was associated with a life event. Over 70 percent of car ownership level changes recorded by the survey were associated with either a change in working circumstances, ability to relinquish a second car after cohabitation, an adult joining or leaving the household, residential relocation, child birth or offspring reaching driving age.

**Table 1: Car ownership transaction pathways**

Pathways to:	Pathway type	No. of cases	%
no cars	0 to 0 cars	14	7.6
	0 to 1 to 0 cars	1	0.5
	1 to 0 cars	5	2.7
one car	0 to 1 car	21	11.4
	1 to 1 car	56	30.4
	2 to 1 car	23	12.5
	1 to 2 to 1 car	4	2.2
two cars	0 to 1 to 2 cars	3	1.6
	1 to 2 cars	18	9.8
	2 to 2 cars	25	13.6
	2 to 1 to 2 cars	2	1.1
three+ cars	x to 3+ cars	12	6.5
<b>Total</b>		<b>184</b>	<b>100.0</b>

*Non-car owners:*

- Young single adults that were yet to move into car ownership for the first time
- A small number of longer term voluntary non-car owners who appeared content with this position

*One and two car owners:*

- Couples or families with young children that had acquired first or second cars

*Three or more car owners:*

- Older families with adult offspring that had acquired their own vehicles (leading to multiple vehicle ownership)

*One and two car owners:*

- Older families that had lost vehicles when adult offspring had left home

*Non-car owners:*

- A small number of older households that had relinquished vehicles due to constraints (health and income) arising during the ageing process

**Box 1. Typical sequence of car ownership states through a life course**

A further observation is that the tendency for individuals to experience particular types of life event changes as individuals move through the life course. This links the process of car ownership change framework to the notion of a car ownership life cycle. For instance, in early adulthood individuals are moving into the labour market for the first time; in later adulthood individuals are retiring. Between these two extremes individuals may be experiencing partnership formation or dissolution.

*How neighbourhood car ownership levels had changed since the 2001 census*

Given that census geography had been used to identify the survey sample, it was possible to explore in some detail how the aggregate car ownership levels and demographic characteristics in both output areas had changed since the 2001 census. The demographic composition of both output areas had remained relatively stable since 2001 and could still be categorised as 'young families in terrace homes'. This implied that younger households

moving into the neighbourhood had replaced older households moving out of the neighbourhood. It was also observed that households moving into the neighbourhood tended to gain cars as they moved through their life course in accordance with the car ownership life cycle. Nevertheless, the aggregate car ownership level in both neighbourhoods had remained relatively stable.

**Table 2: Reasons for car ownership level changes**

Reason for undertaking a car ownership level change	No. of instances	%age of all car ownership level changes
change in working circumstances	20	18.3
able to manage with one car after moving in together	12	11.0
a change in household structure	11	10.1
residential relocation	10	9.2
child birth	9	8.3
company car acquisition or relinquishment	8	7.3
offspring reaching driving age	8	7.3
Leisure	5	4.6
bought a first car when financially able to	3	1.8
Retirement	3	2.8
Opportunism	2	2.8
partner learns to drive for independence	2	1.8
declining health in older age	2	1.8
a change in public transport attractiveness	1	0.9
Other	5	4.6
Unknown	8	7.3
<b>Total</b>	<b>109</b>	<b>100</b>

These empirical observations concerning aggregate and household level changes could be synthesized as follows:

- Population turnover has acted to maintain a stable population composition in the neighbourhoods over time.
- Consistent with notions of a car ownership lifecycle (Dargay and Vythoukaskas, 1999), young households moving into the neighbourhoods had a tendency to gain cars following the move.
- The further finding that aggregate car ownership levels had remained relatively stable since 2001 *implies* that some of the older households leaving the neighbourhood had *higher* car ownership levels at the time of the move than some of the younger households moving into the neighbourhood. This again could be attributed to the older households being further on in their car ownership life cycle than the younger households moving into the neighbourhood (Dargay and Vythoukaskas, 1999).
- The process of population turnover then acted to suppress the extent to which car ownership increases at the household level following a move into either neighbourhood, translated into car ownership increases at the neighbourhood level.

*How patterns of car ownership and use varied between the two neighbourhoods*

While there appeared to be some differences in the distribution of car owning states between the two neighbourhoods (Table 3), the variation was not statistically significant according to a chi-square test ( $\chi^2 = 2.126$ ,  $df=3$ ,  $p=0.547$ ). Hence the composition of the vehicle fleets in the two neighbourhoods, in terms of the aggregate number of cars owned and the distribution of zero, one, two and three or more car owning households, was broadly the same.

However, there was evidence of differing patterns of *travel behaviour* adaptation following a move to either the inner-urban or outer-urban neighbourhood. As expected, cars were used less frequently and other modes used proportionately more in the inner-urban neighbourhood. Bradley Stoke residents reported a 13 per cent higher car use modal share than Bishopston residents. This was counter-balanced by Bishopston residents on average reporting higher walking, cycling and public transport modal shares (these differences were statistically significant). *In the case of the survey neighbourhoods then, the built environment influenced car use more strongly than car ownership.*

**Table 3: Household car ownership in the survey neighbourhoods**

No. of cars	Bishopston		Bradley Stoke		Total Sample	
	No. of households	%	No. of households	%	No. of households	%
Zero	12	12.5	7	8.0	19	10.3
One	50	52.1	54	61.4	104	56.5
Two	28	29.2	21	23.9	49	26.6
Three or more	6	6.3	6	6.8	12	6.5
Total	96	100.0	88	100.0	184	100.0
Average car ownership rate	1.31 cars per household		1.31 cars per household		1.31 cars per household	
Chi-square test: $\chi^2 = 2.126$ , $df=3$ , $p=0.547$						

*Investigating the prevalence of car access imbalances and prospects for future changes*

An important feature of the survey was establishing whether the concept of non-equilibrium car ownership states (labelled a car access imbalance in the theoretical framework) was first meaningful and second detectable. To reiterate, this concept had been operationalised in the survey by asking respondents to consider whether they felt they owned too few, too many or just the right number of cars for their needs.

The majority of the sample, nearly three quarters of respondents, reported that they had just the right number of cars for their needs – most people were satisfied with their current car ownership level (Table 4). However, this also implied that one quarter, a significant minority, felt that they had either too few or too many cars for their needs. *This confirms that the car ownership level can represent a non-equilibrium position at a given point in time.*

A statistically significant relationship was also detected between prevalence of household car access imbalances and neighbourhood ( $\chi^2 = 8.447$ ,  $df=2$ ,  $p=0.015$ ). The majority of respondents reporting ownership of too many cars resided in the inner-urban neighbourhood. Given also the lower car use modal share, this indicated a *greater unrealised potential for car ownership reductions in the inner-urban than in the outer urban neighbourhood.*

**Table 4: Car access imbalance by neighbourhood**

Car access imbalance	Bishopston		Bradley Stoke		Sample	
	No. of h'holds	%	No. of h'holds	%	No. of h'holds	%
Too few vehicles	18	18.9	15	17.0	33	18.0
Too many vehicles	13	13.7	2	2.3	15	8.2
Just the right number of vehicles	64	67.4	71	80.7	135	73.8
Total	95	100.0	88	100.0	183	100.0
Chi-square test: $\chi^2 = 8.447$ , $df=2$ , $p=0.015$						

The relationship between car access imbalance and expectations for the next car ownership change was also in line with expectations. Reporting ownership of too few cars was associated with also reporting an expectation to increase car ownership level. Conversely reporting ownership of too many cars was associated with reporting an expectation to decrease car ownership level. Nevertheless, it was also apparent that not all respondents

reporting a car access imbalance also expected to change car ownership level. Similarly, some respondents reported being satisfied with the current position, but expected to make a car ownership level change in the future in response to a future expected event.

This supports the proposition put forward in the process of change framework: that *the presence of a car access imbalance is distinct from a propensity to change car ownership level*; and that the difference is mediated through a process of consideration of the current and potential future situations. For instance, a car access imbalance may exist as an assessment of 'I have too few cars'. Through consideration ('I have thought about it'), this may or may not manifest itself as a propensity to change car ownership state ('I am / am not able and intend / do not intend to acquire a further car').

Further insights into the relationship between car access imbalance and future intentions were gained through an analysis of the qualitative data. Through this the following four groupings of households were identified:

1. 66 per cent of households were satisfied with the current car ownership position and had no intention to change car ownership level in the future. Such households were in a stable position, consistent with notions of car ownership state dependence (Sirma and Axhausen, 2007).
2. 8 per cent of households were satisfied with their current car ownership, but expected to change car ownership level in the future - respondents indicated planning to make a change in response to a *future expected life event* such as retirement, or child birth.
3. 13 per cent of households were dissatisfied with the current car ownership position, but had no intention to change car ownership level in the future. These households were either constrained from making a change or the level of dissatisfaction was not great enough for them to contemplate making a change. *This supported the notion that only when a car access imbalance becomes too large will the household be tipped into an active search for an alternative, preferred state.*
4. 13 per cent of households were dissatisfied with the current car ownership position and intended to change car ownership level in the future. These households considered that the current situation would be improved by the acquisition or relinquishment of a car.

*Future vehicle relinquishments:* Only eight respondents expected to next relinquish a vehicle. All of the respondents were couples or families that owned *two or more cars*, the majority (seven out of eight) of whom resided in Bishopston, again suggesting a greater potential for car ownership reductions *amongst second car owners* in the inner-urban neighbourhood. Consistent with the process of change framework, in seven cases *circumstances had already changed* in response to a specific life event and the second car was no longer required for a previous 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 (meaning a camper van would be sold); and the acquisition of a company car. The remaining household of retirement age expected to relinquish the second car when the second partner also retired.

*Future vehicle acquisitions:* A larger proportion, 17 per cent of respondents, from 30 households, expected to *increase* car ownership level. Consistent with notions of a car ownership lifecycle, this related to an aspiration amongst young non-car owners to acquire the first car, couples sharing one car between them expecting to acquire a second car or multi-vehicle households with offspring approaching driving age. Reasons given for wanting a *first car* included: frustration with using public transport; wanting to keep the driving skill having just passed the driving test; needing a car more in future for work; helping with child care; and re-acquiring a car when a revoked license was returned. Reasons for acquiring a *second car* included being better able to meet obligations relating to: employment (finding or getting to work more easily); child care; or leisure pursuits.

## Conclusions

This paper began by making the case for longitudinal studies of household car ownership to complement the body of cross-sectional studies conducted by others. In furthering this argument it was posited conceptually that household car ownership states may reflect a non-

equilibrium condition at a given point in time. The existence of so called car access imbalances (non-equilibrium positions) was confirmed by the neighbourhood survey. Over one quarter of survey respondents reported owning too few or too many cars for their needs. Such imbalances can lead to a process of adaptation to establish a more satisfactory position and in some cases ultimately to the decision to change car ownership level.

Nevertheless, the findings of the study also reveal a tension between notions of car ownership as either a stable or unstable state: Table 1 demonstrates that 52 per cent, over half of the surveyed household had not changed car ownership level since household formation – evidence that household car ownership levels tend to reflect stable states. On the other hand 48 per cent of households, nearly half the sample, had experienced at least one car ownership level change – evidence that car ownership levels can also be unstable. This tension was also apparent in the reviewed literature, through the detection of car ownership churn (Dargay and Hanly, 2007) on the one hand and observations of car ownership state dependence (Hanly and Dargay, 2000) on the other.

It is suggested here that the tension between household car ownership as either a stable or unstable state is resolved when viewing car ownership level changes as the outcome of a continual process of change and adjustment to change over time. That is to say that car ownership can change from a stable to an unstable state over time. This adds further support to longitudinal conceptions of household car ownership. In returning to the title of the paper, the study has generated robust evidence that *life events* are the drivers of this process of car ownership change as depicted in Figure 1. The study also supports the notion of a car ownership life cycle which acts to strengthen the tendency for car ownership to increase (in younger age) or decrease (in older age) as people age.

The residential location choice is an example of one such life event that can have a direct, if unintended, influence on subsequent car ownership outcomes. The longitudinal and cross-sectional insights generated by the in-depth interviews and neighbourhood survey would suggest that the process through which the built environment influences household car ownership acts as follows.

- Life stage governs the household's position in the car ownership life cycle, influencing the tendency for the household's car ownership level to increase or decrease over time.
- Life stage and past experience influences the preference towards (and ability to afford properties in) particular residential location types and transport modes. Households at a common life stage and with some shared lifestyle preferences become clustered in neighbourhoods.
- The selected residential location (and the form of the local built environment) influences the opportunity to use alternative transport modes and reinforces preferences towards the use of alternative transport modes. This acts to strengthen or weaken the tendency for car ownership to increase or decrease over the household car ownership life cycle.

In the case of the survey neighbourhoods, residents of the inner-urban neighbourhood reported lower levels of car use and a greater *potential* for vehicle relinquishments. Nevertheless, this had not translated into lower car ownership rates overall. This is perhaps to be expected given that reducing the number of cars owned has not been an objective of national transport policy or indeed local policy in the surveyed areas. It would suggest that, were this to become a future policy goal in some congested areas, stronger measures are required to encourage vehicle relinquishments than simply proximity to urban centres; for instance: reducing parking availability, implementing parking permit schemes and making flexible car sharing schemes more widely available.

By way of a final conclusion it is lastly suggested that the findings of the study are strongly supportive of a proposition which is becoming better evidenced over time as understanding of travel behaviour deepens. Namely, that transport policies and interventions concerned with changing the number and type of vehicles owned (and indeed wider travel behaviour) should consider life events as significant opportunities for change.

## References

Bamberg, S., Rölle, D. and Weber, C. (2003) Does habitual car use not lead to more resistance to change of travel mode? *Transportation*. 30, 97-108.

- 
- Cao, X., Mokhtarian, P. and Handy, S. (2007) Cross-sectional and quasi-panel explorations of the connection between the built environment and auto ownership. *Environment and Planning A*, 39, 830-847.
- Census Dissemination Unit (2011) *Casweb* [online] Available from: <http://casweb.mimas.ac.uk/> [Accessed 18<sup>th</sup> November 2011].
- Chatterjee, K. (2011) Modelling the dynamics of bus use in a changing travel environment using panel data. *Transportation*. 38, 487-509.
- Clark, B. (2011) *Understanding how household car ownership changes over time*. PhD, University of the West of England.
- Clark, B., Lyons, G. and Chatterjee, K. (2010) The process of household car ownership change: A qualitative analysis of real world accounts. *Proc. 42nd Annual Universities' Transport Study Group Conference, Plymouth, 5-7 January*.
- Clark, B., Lyons, G. and Chatterjee, K. (2009) Understanding the dynamics of car ownership: Some unanswered questions. *Proc. 41st Annual Universities' Transport Study Group Conference, London, January*.
- Crampton, G. (2006) Impact on car ownership of local variation in access to Public Transport. In: Anon. *European Regional Science Association 2006 Conference, Volos, Greece August 2006*. European Regional Science Association, 1-18.
- Dargay, J. (2001) The effect of income on car ownership: evidence of asymmetry. *Transportation Research Part A*, 35, 807-821.
- Dargay, J. and Hanly, M. (2007) Volatility of car ownership, commuting mode and time in the UK. *Transportation Research Part A*. 41 (1), 934-948.
- Dargay, J. and Vythoulkas, P. (1999) Estimation of a dynamic car ownership model: A pseudo-panel approach. *Journal of transport economics and policy*. 33 (3), 287-302.
- Department for Transport, (2006) *National Travel Survey 2006*. London: Department for Transport. (SB (07) 21).
- Fujii, S. and Kitamura, R. (2003) What does a one-month free bus ticket do to habitual drivers? An experimental analysis of habit and attitude change. *Transportation*. 30 (1), 81-95.
- Goodwin, P. (2008) Life cycles, shocks and travel behaviour. *Local Transport Today*. 502, p.17.
- Goodwin, P. (1998) The end of equilibrium. In: T. Gärling, T. Laitila and K. Westin, eds. *Theoretical Foundations of Travel Choice Modelling*. Oxford: Pergamon, 103-132.
- Goodwin, P. (1995) Car dependence. *Transport Policy*. 2 (3), 151-152.
- Hanly, M. and Dargay, J., (2000) *Car ownership in Great Britain - A panel data analysis*. London: University College London.
- Hass-Klau, C., Crampton, G. and Ferlic, A. (2007) *The effect of public transport investment on car ownership: The results for 17 urban areas in France, Germany, UK and North America*. 1st ed. Brighton: Environmental and Transport Planning.
- Lanzendorf, M. (2003) Mobility biographies. A new perspective for understanding travel behaviour. *Proc. 10th International Conference on Travel Behaviour Research, Lucerne, August*. The International Association for Travel Behaviour Research.
- Miller, E. (2005) An integrated framework for modelling short and long run household decision making. In: H. Timmermans, ed. *Activity Based Analysis*. 1st ed. Oxford: Elsevier Ltd, 175-201.
- Mohammadian, A. and Miller, E. (2003) Dynamic modelling of household automobile transactions. *Transportation Research Record*. 1831, 98-105.
- Oakil, A., Ettema, D., Arentze, T. and Timmermans, H. (2011) Dynamics in car ownership and life cycle events: A longitudinal analysis. *Proc. Transportation Research Board 90th Annual Meeting, Washington D.C., USA, 23-27 January*. Transportation Research Board.
- Roorda, M., Carrasco, J. and Miller, E. (2009) An integrated model of vehicle transactions, activity scheduling and mode choice. *Transportation Research B*. 43, 217-229.
- Simma, A. and Axhausen, K. (2007) Commitments and modal usage - Analysis of German and Dutch panels. *Transportation Research Record*. 1854 (2003), 22-31.
- Stanbridge, K. (2006) The Residential Relocation Timeline of travel considerations. *Proc. Universities' Transport Study Group Annual Conference, Dublin January*.
- Thorgersen, J. (2006) Understanding repetitive travel mode choices in a stable context: A panel study approach. *Transportation Research Part A*. 40, 621-638.
-