

UNDERSTANDING THE DYNAMICS OF CAR OWNERSHIP: SOME UNANSWERED QUESTIONS

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Abstract

This discussion paper arises from the first year of a PhD study into household car ownership decisions. It begins by summarising explanations for the past (aggregate) increases in car ownership, reviewing research from the fields of economics, urban and transport planning, and social psychology. Car ownership trends have been examined in terms of consumer behaviour; changing land use patterns; changing social norms and the life-course.

Though there are convincing explanations for past increases in car ownership at the aggregate level, the paper goes on to draw together evidence suggesting that there are significant and perhaps counter-intuitive underlying variations. Previous analysis of the British Household Panel Survey by Dargay and Hanly has revealed that there are only a slightly larger number of households increasing car ownership (8.2 per cent) than there are households reducing car ownership (7.6 per cent) each year. Similarly, at the local level, a comparison for this present paper, of the 1991 and 2001 censuses reveals that car ownership levels per capita were either maintained or reduced in 8.6 per cent (688) of the electoral wards in England. Indeed, a significant minority – 6.2 million households in Great Britain, either choose, or are constrained to continue living without a car.

This underlying variation in (changing) car ownership levels has important implications for transport policy, and the paper concludes by posing a series of questions which may benefit from further research. While it seems that car ownership levels naturally tend to increase, are there (predictable) conditions under which the demand for privately owned cars might be reduced? If so, do these relate to macro or micro-level factors, to spatial planning or the transport system, or to the physical or the social environment? The paper explores such questions.

1. Introduction

While acknowledging the many benefits of the car to society, in recent years there has been a policy emphasis on encouraging behaviour change away from (low occupancy) car use. In the UK Government's latest consultation document on future transport strategy it is noted that "since two thirds of trips and over half of car journeys in the UK are less than five miles long, measures to change travel behaviour and reduce the need to travel in urban areas could bring significant benefits" (Department for Transport 2007a p.12). However, in examining future policy goals it is also recognised that "transport behaviours are amongst the most challenging to change... we know

that car use presents a significant challenge...[and that there] is a belief that all car journeys are 'necessary' and a perception that viable alternatives to the car simply do not exist" (Department for Transport 2008 p.6).

The policy objective to rationalise some aspects of car use is set against an expectation that private car ownership at the aggregate level in the UK will continue to rise over the next 25-30 years (Department for Transport 2004). This presents something of a policy paradox as it is perhaps axiomatic that private car ownership is a key determinant of household car use and wider travel behaviour. Indeed, the National Travel Survey (NTS) shows that in 2006, households with a car on average undertook 41 per cent more trips and travelled two and half times further than households without a car. Those without a car undertook more than four and a half times as many bus and coach trips than those with a car (Department for Transport 2006 p.33-34). It is therefore reasonable to suggest that the household decision to acquire or relinquish a car represents a possible transition point in travel behaviour. With this in mind, it is useful from a policy perspective to understand the circumstances under which household car ownership decisions (acquire or relinquish, keep or replace) arise and the factors that influence these decisions. Influencing ownership decisions may ultimately be a consideration for policy formulation, notwithstanding a previously stated government policy position that "we do not want to restrict car ownership" (Department for Transport 1998 p.5).

This discussion paper is concerned with addressing what is known (and crucially what is not known) about how car ownership changes over time with a particular focus on the UK context. The paper begins by summarising the macro scale factors that have been found to contribute towards the gradual increase in car ownership levels at the national level. This is followed by a review of how and why car ownership levels vary at the household level. Finally, the paper concludes with an open discussion of some of the processes through which household car ownership decisions might be made, suggesting hypotheses and identifying key questions which could benefit from further research.

2. Increasing car ownership at the national level

The observed trend of an increase in car ownership at the national level can be broadly outlined in terms of a set of feedback loops that exist between:

- consumer behaviour;
- changing land use patterns (growing car dependency); and
- changing social norms.

Consumer behaviour

In macro economic terms, rising car ownership is the expected result of increases in disposable income, reductions in motoring costs, and (subsequent) increases in the cost of public transport. Between 1987 and 2006 in real terms, disposable incomes (in the UK) increased by 60 per cent (Office for National Statistics 2008b), motoring costs reduced by four per cent (Office for National Statistics 2007), while the cost of travel by bus and rail increased significantly, by 39 and 27 per cent respectively (Office for National Statistics 2007). Given also that the car offers both instrumental and non-instrumental benefits to the consumer, it is not surprising that car ownership per thousand population increased (in Great Britain) by approximately 45 percent over this period (from around 310 to 450 cars per thousand population) (Department for Transport 2007b, Office for National Statistics 2008a).

A closer inspection of motoring costs reveals that car running costs actually increased in real terms over this period (with tax and insurance up by 45 per cent, maintenance costs up by 49 per cent and fuel and oil costs up by 36 per cent (Office for National Statistics 2007)). However, this was more than compensated for by a 44 per cent reduction in vehicle purchase costs, leading to the four per cent reduction overall (Office for National Statistics 2007). Such significant reductions in purchase costs have been driven by market forces with improvements in technology yielding production cost savings and competition between manufacturers driving down retail prices.

It is arguable that mass motorization has (indirectly) led to (and been reinforced by) the higher public transport fares seen in the UK. In relation to bus fares, a long term reduction in bus passenger numbers (which was catalysed by increasing car ownership) was followed by industry

deregulation in the 1980s. This was intended to reduce fares and government subsidies. However, fares have continued to rise, partly as a result of poorly coordinated services in the early years of deregulation which exaggerated the decline in patronage (Chatterjee, Dudley 2008).

With respect to rail fares, even following the Beeching service cuts in the 1960s and privatisation in the 1990s, the national rail network continues to be a significant burden on public finances - in 2003, fare box revenues only covered half the running cost of the railways (BBC 2003). However, while passenger numbers fell up to the mid 1990s, a decade of strong economic growth seems to have contributed towards increasing demand for rail travel, even in an era of rising fares (Chatterjee, Dudley 2008 p.48). Inevitably, strong demand coupled with capacity constraints, places a continued upwards pressure on rail fares, though many tariffs continue to be subject to government regulation.

Changing land use patterns

Increasing car ownership (and use) has influenced patterns of land use development and created a cycle of cause and effect that has yielded a growing car dependency in society. In recent years, UK planning policy has sought to slow this cycle by adopting land use policies that aim to reduce urban sprawl, increase population densities and encourage mixed use developments, ideally around public transport nodes (Communities and Local Government 2001, 2006). It is anticipated that mixed land uses reduce journey distances, while higher population densities improve the economic viability of public transport and local amenities and services. Such policies might therefore be expected to exert a downward pressure on car ownership.

However, whilst it is recognised that development planning has a role to play in managing the need to travel by car, the degree to which there are direct causal relationships between urban form and travel behaviour (including car use and car ownership) is difficult to establish. Lyons (2003 p.8) notes that “the amount by which (car) travel is reduced is ultimately governed by the land users – the location choices of business, the location and travel choices of individuals and the spatial patterns of daily activities they choose or seek to maintain”. Similarly, Cao et al. (2007a p.536) point out that the influence of the built environment on travel behaviour may be limited to a role of facilitation, which is constrained by the “sizeable share of households who favour suburban types of development”.

Changing social norms

Lastly in this section, it is suggested that changing social norms in response to motorization further reinforces the upward pressure on aggregate car ownership levels. As land use and activity patterns change in response to car availability, both the instrumental and social-psychological pressures to enter into car ownership are increased. Some (but by no means all) car-less individuals may feel less able to play a full part in a highly motorised society than their car owning peers, and as car use becomes the perceived “normal” way to travel, other modes, notably public transport, walking and cycling become less acceptable.

Travel behaviour research has in recent years drawn on a number of behaviour theories arising from the field of social psychology. Notably, Ajzen’s (1991) Theory of Planned Behaviour, which recognises the influence of social norms and attitudes, has been successfully and repeatedly applied to improve understandings of the motivations behind travel behaviour (see Anable (2005) and Thorgersen (2006) for examples of such studies).

3. Changing car ownership at the household level

Net changes in car ownership at the aggregate level can mask potentially much greater gross changes in car ownership. Indeed, examining the composition of net changes reveals that there is considerable variation occurring over time at the household level. Changing household car ownership is now considered in relation to the following themes:

- the life cycle profile;
- dynamics in household car ownership over time;
- the importance of life events;
- car ownership inertia at the household level
- the relationship between car ownership and car use; and
- econometric car ownership choice models.

The life cycle profile

By constructing a pseudo-panel data set from the UK Family Expenditure Survey, Dargay and Vythoukias (1999) analysed how household car ownership changes over time and revealed a typical life cycle profile: car ownership tends to increase as the head of the household reaches the age of 50, after which it declines. This mirrors household income profiles which also tend to increase as the head of the household reaches the age of 50 and thereafter decline. The household size was found to peak and fall a little earlier than car ownership and income, when the head of the household is around 45 years old: this reflects a time lag between offspring leaving home and a reduction in household car ownership, implying that adaptation to a change in household structure takes time.

Dargay and Vythoukias' (1999) analysis also revealed a generational affect, with successive generations each having on average, a higher level of car ownership than the last. This is indicative of a growing societal dependence on the car and is not unexpected given the higher disposable incomes and lower motoring costs available to successive generations as noted earlier.

Dynamics in household car ownership over time

Several researchers have independently analysed a number of European panel data sets to confirm that the familiar gradual monotonic rise in car ownership at the aggregate level consistently masks a much larger number of changes occurring at the household level (Goodwin 1988, 1993, Kitamura 1989, Dargay, Hanly 2007). This is a travel behaviour example of what has been termed asymmetric churn, whereby a small net change in behaviour overall results from a larger (and potentially unrecognised) number of positive and negative changes at the individual level cancelling each other out (Chatterjee 2001).

In a British context, Dargay and Hanly's most recent analysis of the British Household Panel Survey (BHPS) (Dargay, Hanly 2007) revealed that a very small net increase in car ownership at the aggregate level between two consecutive years (0.2 per cent) resulted from nearly 16 per cent of households changing car ownership overall: 8.2 per cent of households increased car ownership, while a smaller, yet significant 7.6 per cent of households reduced car ownership.

The largest proportion of car ownership changes were found to be between one and two cars (in either direction) and these changes also reflected an asymmetric churn in the positive direction: 4.2 per cent of households changed up from one to two cars, while 3.8 per cent of households changed down from two to one cars. Only 1.9 per cent of households gave up car ownership altogether.

The circumstances under which households reduce car ownership are specifically reported in Goodwin (1988) and Dargay et al. (2003). Both studies find that reductions are more common amongst households with high car ownership. Dargay et al. (2003) also note that a third of reductions are transitory, lasting for only one year. Goodwin (1988) suggested that building up a high level of public transport use was a precondition to giving up the car altogether, and that this was more likely in areas with an already good level of public transport provision.

The importance of life events

The analysis of the BHPS (Dargay, Hanly 2007) confirms that a significant number of household car ownership changes are associated with wider life events. For instance, a little more than a third (33.8 per cent) of households reduced car ownership when an adult left the household, while 30.5 per cent of households increased car ownership when an adult joined the household. Around a quarter of households changed car ownership between two consecutive years in association with a house or a job move. Unemployment and retirement were found to be associated with reductions in car ownership.

Though not a new idea (Salomon began researching life-style and travel behaviour in the early 1980s (Salomon 1983)), recent studies are increasingly emphasising the importance of life stage, life-style and life events on travel behaviour (Lanzendorf 2003, Prillwitz, Harms et al. 2006, Scheiner, Holz-Rau 2007). Building on Salomon's earlier work, Lanzendorf (2003) put forward a mobility biography approach for capturing and interpreting changing travel behaviour over an individual's life course in terms of what he calls their life-style, accessibility and mobility domains. Studies carried out using this approach confirm that changing car ownership is associated with changing income, moving house or changes in household structure (Prillwitz, Harms et al. 2006, Lanzendorf 2006).

Household car ownership decisions are also constrained and influenced by wider life decisions. For example, the decision to acquire a driving license is an obvious pre-condition to entering into personal car ownership. It is notable from a policy perspective that there has been a decline in the number of under 30 year olds obtaining a driving license in the last 10 years (Department for Transport 2007b). In Thomas (2008) Chatterjee and Dudley speculate that this perhaps presents an opportunity to encourage non-car based travel behaviours amongst this group. It might also be hypothesised that there is an age after which the probability of obtaining a driving license declines as alternative mobility patterns become established and habitualised. Long term decisions on where to live and work are also likely to interact with the household car ownership decision.

Car ownership inertia at the household level

Whilst it has been shown that the proportion of households changing car ownership level between two consecutive years is higher than might be expected (16 per cent according to the BHPS (Dargay, Hanly 2007)) given the much smaller net increase at the aggregate level, the great majority of households maintain their car ownership level year on year (84 per cent according to the BHPS (Dargay, Hanly 2007)). This stability or inertia in car ownership at the household level implies the existence of state dependence. State dependence refers to the degree to which a present state (in this case the present household car ownership level) is influenced by a past state (in this case the household car ownership level at a previous point in time).

Several studies, based on panel data analysis, have confirmed that household car ownership is highly state dependent (after taking into account changes in explanatory variables and unobserved heterogeneity) (Thorgeresen 2006, Hanly, Dargay 2000, Simma, Axhausen 2007). It seems that once an individual or household has acquired their first car, they are very likely to continue owning a car in future years. This is perhaps to be expected given that the purchase of a car requires a significant one off capital expenditure (in exchange for a relatively cheap marginal cost per car trip) and this decision in itself represents a personal (longer term) commitment to car use (Simma, Axhausen 2007).

Simma and Axhausen (2007) further point out that even large changes in personal circumstances are unlikely to motivate car owners to relinquish their vehicles. (This does not contradict the finding that household car ownership changes are associated with wider life events, but emphasises the fact that car ownership reductions are very much the exception rather than the norm.) This finding leads them to suggest that the following two questions are of particular relevance to understanding the demand for and dynamics of household car ownership:

- "when was the first car bought and what were the circumstances?" and
- "how often does it happen that a car owner again gives up this form of mobility?" (Simma, Axhausen 2007 p.30)

Returning to the issue of household motoring expenditure, Brög's (1982) comparison of perceived motoring costs to actual motoring costs confirmed that motoring costs are generally underestimated, that certain costs are not counted within the motoring budget (for example parking fees), while others may not even be acknowledged (depreciation for instance). Although there is a lack of up to date academic literature in this area, a more recent RAC report (RAC 2004) supports these general findings.

Furthermore, a review of evidence concerning public attitudes to transport reported that the cost of car use may not be "a decisive influence on travel choices" (Lyons, Goodwin et al. 2008 p.24). It is suggested that this may be due to an acceptance that car travel is a necessary (unavoidable) part of every day life (once a pattern of car use has been established) and thus motoring costs are an inevitable expense that must be borne. The review further reports a perception amongst the public that "the more the car was used, the better value it represented" (Lyons, Goodwin et al. 2008 p.28).

The suggestion then, that the large capital expense required to buy a car, itself encourages car use has implications for policy - it might be hypothesised that shifting the burden of cost from car ownership to car use could help to rationalise car use. Indeed, a growing number of car clubs are seeking to exploit this. Their members benefit from an alternative model of car access, which replaces the large capital expenditure required to purchase a car, with a higher marginal cost per car trip.

The relationship between household car ownership and car use

By investigating the relationship between household income and household car ownership, Dargay (2001) provides some evidence to support the premise that the acquisition of a car leads to some

extent, to a pattern of car use becoming entrenched: car dependence grows over time (Goodwin 1995a).

The study firstly confirms the expectation that car ownership tends to increase with household income and tends to fall in response to a reduction in income. Crucially, however, the car ownership response to an increase in income is revealed to be twice that of an equal fall in income. Thus car ownership has an asymmetric response to changes in income, implying that households prefer to maintain their car ownership level, even if their income is reduced to a prior, non-car owning level. This suggests that purchasing a car allows a set of mobility patterns to be acquired, which once established are difficult to relinquish (noting also the non-instrumental attachment to and association with an attained level of ownership).

A further finding of Dargay's study is that household car ownership takes time to respond to a change in income; re-affirming the influence of inertia (state dependence) and the fact that individuals take time to adapt to a change in circumstances.

At this point it is appropriate to draw together some key observations concerning car ownership churn, inertia and the importance of life events:

- buying (or having access to) the first car, encourages lifestyles and norms based around the car to form;
- as car based lifestyles and norms form, households become resistant to change, contributing to inertia (state dependence) in household car ownership levels;
- 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 gradual increase in aggregate 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, although adaptation to a new set of circumstances takes time; and
- this lends weight to the claim that key life events present opportunities for reassessment of life styles which may lead to longer term behavioural (including and induced by car ownership) change (Bamberg, Rölle et al. 2003, Fuji, Kitamura 2003, Stanbridge 2006, Goodwin 2008).

Econometric car ownership choice models

A large body of research has been dedicated to the development of econometric car ownership models. Although a detailed critique of such models is beyond the scope of this paper (see De Jong et al. (2004) for a comprehensive review), it is useful to briefly summarise how selected household car ownership choice models reflect the car ownership decision.

The UK Department for Transport's car ownership model relates the probable household car ownership state, to the utility of owning 0 to 3 cars. The utility of ownership is represented by a function of household income, household structure, the number of employed adults, area type (reflecting population density), motoring costs and company car availability. The model is also calibrated by an estimated car ownership saturation point, which also varies according to area type (Whelan 2007). This calibration parameter ensures that, for a given area type, the model returns (for example) no more than 80 per cent of households in the "2 or more cars" bracket.

The concept of an area saturation rate not only reflects the fact that aggregate car ownership levels vary according to degree of urbanisation, but also hints that transport and land use policies can act to influence car ownership levels in an area. For instance, the USA has a traditionally higher car ownership level than the Netherlands, but both countries experienced relatively low levels of growth in car ownership (compared to other countries) up to the mid 1990s (Department for Transport 1997). It could be speculated that the US market was nearing saturation at a comparatively high level of car ownership, while in the Netherlands, the car ownership saturation level had effectively been suppressed through the implementation of a successful long term transport strategy (Goodwin 1995b).

De Jong's car ownership choice model recognises the two way relationship between car ownership and car use (De Jong 1997). Households are assumed to "compare combinations of car ownership and car use with each other and choose the combination that gives them the highest utility" (De Jong, Fox et al. 2004 p.390) given their budgetary constraints. This model reflects the fact that a threshold level of car use is required to justify the capital outlay on a car. It further recognises that

opting into car ownership requires a trade-off and reduces the amount a household can spend on other goods.

Zhang et al. (2004) meanwhile have developed a model that recognises the intra-household interactions between household members and their relative influences over car ownership decisions.

4. Discussion

Having reviewed the existing knowledge base in relation to both understanding aggregate and household level changes in car ownership, the paper now offers a discussion which introduces and explores possible hypotheses and some unanswered research questions under the following four themes:

- household car ownership decisions as a time dependent process;
- life events as triggers for household car ownership decisions;
- the transition between one and two cars (and vice versa); and
- the idea of localised "car cultures".

Household car ownership decisions as a time dependent process

In attempting to understand how household (and indeed aggregate) car ownership levels might change in future years, it is important to recognise that household car ownership decisions reflect a process of action over time, rather than a single point decision to change travel behaviour. We have seen that household car ownership decisions are affected by time dependent processes such as life stage, the formation of car-based lifestyles and norms (resulting in the asymmetric response in car ownership level to income for instance) and wider life decisions. With this in mind, two general processes through which households might reach car ownership decisions are suggested here.

Firstly, there is clearly a feedback relationship between car ownership and car use. For each car purchase in the household, there is likely to be an expectation that a certain level of future usage will be reached in order to justify the initial capital outlay (notwithstanding instances in which cars are purchased for non-instrumental, material motives). Following the acquisition or relinquishment of a car, it is also likely that there is a period of adaptation through which new patterns of mobility are formed and become entrenched. This process of adaptation will itself influence future car ownership needs and desires (i.e. car ownership is state dependent). However, while cross sectional data supports the obvious claim that car ownership level is a key determinant of car use, there is a lack of longitudinal data to interrogate how usage patterns evolve following a car ownership transaction.

Secondly, it is posited that households periodically evaluate (or monitor) their car ownership requirements as their circumstances change over time. A car ownership decision may be triggered following a period in which the current car ownership position is recognised as being sub-optimal. For instance, a second car might be purchased after a period of inconvenience felt by car one being repeatedly in use elsewhere.

This process of reflective assessment of car ownership status is not well understood, and it might be that general frameworks such as the transtheoretical model of behavioural change (DiClemente, Prochaska 1982), cited in (Beatty, Meadows et al. 2002) may be a useful starting point for a better understanding of car ownership deliberations. This model outlines five stages through which a decision to change behaviour may be made:

1. *precontemplation* (e.g. "the thought of acquiring, selling or replacing a car had not occurred to me");
2. *contemplation* (e.g. "I am thinking of the possibility of acquiring, selling or replacing a car");
3. *preparation* (e.g. "I am preparing to acquire, sell or replace a car." – the decision could still go either way at this point);
4. *action* (e.g. "I am in the process of sourcing or selling a car." – a commitment has been made by this point);
5. *maintenance* (e.g. "I have considered my options and decided not to take any action for now" – the current state has been evaluated and accepted).

With these considerations in mind, three questions are put forward that may benefit from further research:

- what is the longitudinal nature of the relationship between household car ownership and car use?;
- how do households re-evaluate and monitor their car ownership requirements over time?; and
- can aspects of a generalised framework such as the transtheoretical model of behavioural change be applied to household car ownership deliberations?

Life events as triggers for household car ownership decisions

The notion that changes in household car ownership levels are often associated with life events was introduced earlier. It could be said that life events act as triggers or catalysts in the car ownership deliberation process. A life event brings the household car ownership position into a greater degree of deliberation, potentially moving a household into a higher stage in a stages of change style model (if indeed such a model applies) or ultimately tipping a household into acquiring or relinquishing a car.

The impact of life events as potential trigger points is now expanded upon in the context of household transitions between one and two cars.

The transition between one and two cars (and vice versa)

While the proportion of households in Great Britain with access to one car has remained relatively stable since the 1970s, the proportion of households with two or more cars has steadily increased and in 2005 stood at 31 per cent (Department for Transport 2007b). (Note that as a result of reductions in household size over time, the absolute number of households with 1 car increased from approximately 10 million to 11 million households between 1991 and 2005, while the absolute number of households with two or more cars increased from approximately five million to eight million households (Department for Transport 2007b, Office for National Statistics 2004).) The increase in multi-car households has therefore made a significant contribution to the overall increase in car ownership at the aggregate level.

We have also seen that the move between one and two cars (in either direction) makes up the greatest proportion of households *changing* car ownership between two consecutive years (Dargay, Hanly 2007). It is therefore of policy relevance to understand what motivates a household to move between one and two cars (and vice-versa).

In many cases, the rationale for acquiring a second car is likely to differ to the rationale for acquiring the first car. For instance, it might be typical for the second car to be a smaller “run around” which is less intensively used, while a higher quality household car is in use elsewhere. Indeed, the NTS reveals that in a two car household, the first car typically travels 14,000 miles in a year, while the second car travels 6,000 miles (Department for Transport 2005).

It is reasonable to suppose then, that in many cases, a household may be less dependent on the second car than they are on the first (though it should be noted that mileage may be a poor proxy for dependence, especially given the high proportion of journeys under five miles that are made by car as noted at the start of the paper). Household trips which may be undertaken by a second car are potentially more susceptible to substitution through the availability of public transport, virtual mobility, car sharing or car clubs, etc. (Centre for Transport Research on Environment and Health Impacts and Policy (TRIP) 2001). This (non-)availability of alternatives may have an (indirect) influence over the household decision to acquire or relinquish a second car. Transport for London ran a campaign in 2004 using the message that “My other car is a bus” (Transport for London 2004); car clubs also market themselves as an alternative to second car ownership (WhizzGo 2008). This avenue for travel behaviour change we suggest merits further attention from transport policy and associated initiatives and would benefit from an improved understanding of the transition between one and two cars. We post the following two questions that may benefit from further research:

- are there (predictable) triggers (events, ongoing circumstances or messages) that might tip a household into acquiring or relinquishing their second car?; and
- can such triggers be influenced by policy initiatives to rationalise car use through the (indirect) suppression of second car ownership?

The idea of localised "car cultures"

Lastly in this discussion, the impact of locale-related factors on household car ownership decisions is considered.

It is accepted that car ownership levels vary according to area type so that in a typical case, car ownership will be higher in a rural area than it is in a central urban area. However, it is also apparent (and perhaps statistically inevitable) that car ownership levels in some areas deviate from the expected level (taking into account factors such as incomes, household size and area type). Secondary analysis by the lead author of the 1991 and 2001 censuses reveals that car ownership levels per capita were either maintained or reduced in 8.6 per cent (688) of the electoral wards in England, counter to the national trend. Hass-Klau et al.'s (2007) own analysis of UK census data also revealed instances in which car ownership levels in proximity to bus and rail corridors grew at a faster rate than the surrounding area, as was found to be the case in Brighton. (This is perhaps surprising, although, it is notable that absolute car ownership levels remained lower and car free households were more prevalent in the public transport corridors.)

Although unravelling chains of cause and effect here is complex, it is suggested that these variations in (changing) local car ownership levels might indicate that the built and social environments can act together to encourage localised "car cultures". These may lean towards particularly high or particularly low levels of car ownership (seen relative to the statistical distribution of car ownership levels for a particular area type). A possible mechanism through which a local "car culture" might develop is set out below.

At the individual level, it is recognised that "people differ" (Goodwin 1995a p.1) and that travel behaviour is not just a function of socio-economic group or income (Anable 2005, Ryley 2006) : Attitudes play a key role in shaping travel behaviour and must also play a role in influencing the household car ownership decision. It is also apparent that the built environment plays a role in attracting a certain person type to particular residential areas (self-selection). This leads to some degree of geographic clustering of people, not just by socio-economic group, but also by attitude, amongst other things - for example households with many cars (or an aspiration for many cars) may typically prefer to live in a suburban location rather than a central residential area.

There is then a set of feedback relationships between the built and social environments which could act to reinforce certain behaviours and attitudes amongst a community: the local social environment is influenced by the type of person living in an area; the local built environment will in turn be shaped by the behaviour of the people living in the area (for instance, responding to the underlying demand for local shops or public transport, local acceptability of on pavement parking or the paving over of front gardens for parking); and in the opposite direction, the local built environment might also act to shape attitudes towards particular behaviours (for instance, living in a congested area may weaken pro-car attitudes).

While it seems reasonable to speculate that these relationships could influence household car ownership decisions over time, the evidence base in support of such an hypothesis is presently weak, though some insights are available. With respect to the potential impact of local social conditions on car ownership related behaviour, Meaton and Low's (2003) review of car clubs provided some evidence that the presence of a local champion in the community can go a long way to securing the success of a car club car. On a similar theme, in their study of rural areas, Gray et al. (2006 p.96) noted that in some (but not all) areas, privately owned cars were found to support communities by "confer(ring) mobility" on those without cars.

In relation to the impact of the built environment, Cao et al. (2007b) conclude that the built environment does exert a small, but nevertheless direct causal influence on car ownership levels (having controlled for residential self selection) and speculate that there may indeed be a further indirect influence acting via attitudes. Several other studies have arrived at similar conclusions (Naess 2006, Krizek 2003). However, the need to improve the evidence base with specific reference to household car ownership decisions is encapsulated by two remaining research questions which we now pose:

- to what extent do the interactions between the built and social environments influence household car ownership decisions over time?; and
- are there (predictable) conditions under which the demand for privately owned cars might be reduced?

5. Concluding remarks

It is clear from this review that there is already a depth of understanding of the factors affecting household and aggregate car ownership levels. However, we have argued and sought to identify that there remain a number of unanswered questions that could benefit from further research.

The PhD study from which this paper arises is seeking to apply a qualitative, life-course approach to understanding time dependent household car ownership decisions in order to begin to address these questions. It aims to complement and build on the studies reviewed here; providing a deeper understanding of the underlying process of household car ownership decisions and exploring how these are influenced by the local built and social environments. Given that private car ownership is clearly a key determinant of household car use, it is hoped that the study will provide policy-relevant insights and a further contribution to the debate surrounding travel behaviour change.

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