
MOBILITY VERSUS COMMUNITY? EXPLORING THE SOCIAL IMPLICATIONS OF CAR-REDUCED HOUSING.

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Abstract

By restricting car access and infrastructure, car-reduced and car-free housing schemes have recently sought to create socially conducive spaces which limit the need to travel through proximity to mixed land uses and public transportation. In so-doing, such developments have provided a means to approach environmental, social and economic sustainability agendas and have thus become the subject of widespread interest. However, research into the social implications of such housing is limited and it is not clear whether the mobility needs of a fully representative community can be met. This paper examines the rationale for car-reduced housing and proposes a tripartite research framework upon which the results of two pilot studies into social and mobility aspects are discussed. Several strong lines for research emerge from the pilot studies. The next stage of empirical work will seek to build on these findings in order to assess the extent to which car reduction measures can combine universally acceptable levels of mobility with enhanced levels of community development.

1. Introduction

By prioritising public transportation over the personal automobile and using a community rather than an individual household-orientated approach, car-reduced housing offers an alternative to conventional residential development practices. Such developments, which are usually underpinned by social and/or environmental rationale, have been created in a number of European countries on sites that range from small inner city infill to large urban extensions. Environmental objectives commonly seek to reduce congestion, noise and emissions-producing energy consumption by curbing car use, whilst the creation of health and community-strengthening pedestrian and child-friendly streets frequently forms a significant part of social agenda. However, in spite of continued widespread interest - as exemplified by the adoption of car-reduced principles into guidance for the UK's proposed 'eco towns', empirical research into the social and socio-economic implications of residential car reduction measures remains limited.

The objectives of this paper are, firstly, to explore the case for car-reduced development; and secondly, to examine whether the social and environmental objectives of these developments can be met without significant negative consequences, particularly to individual mobility. The first part of this paper therefore attempts to trace the history of car-reduced residential development in the context of long-standing concerns over the social and environmental impacts of automobiles in residential areas. A tripartite relationship between social interaction, individual mobility and residential design serves as the basis of an original research framework through which the implications of car-reduced living are considered in the second part of the paper. This section draws on both the existing literature and preliminary questionnaire and interview-based research on travel and community interaction, conducted in three different types of development; namely, 'car-free', car-reduced' and 'conventional'. Although the initial findings show that car-reduction can impact negatively on individual mobility, the paper concludes by pointing the way forward for further empirical research.

2. Transport, Housing & Car-Reduced Development

In the UK, advances in transport technology since the beginning of the Industrial Revolution have radically altered development patterns due to a widespread spatial reorganisation of housing in relation to employment, services and recreation. Spurred by the forces of economic growth, population change and societal aspirations, cities have been fundamentally reshaped by a transport-based geographical dislocation of the home and the workplace. This trend of housing-employment dislocation is conceptualised below in figure 1 depicting at the outset, the tightly integrated and pedestrian-based pre-industrial towns. The

advent of rail-based urban mass transportation spawned a new type of transit-oriented suburban development by the late nineteenth century, typified by London's 'metroland' and San Francisco's 'streetcar suburbs' enabling, in particular, an inner-city locked working class to escape the squalor and shift to the relatively spacious suburbia on a promise of a cheap tram or train fare to the city centre workplace.

Thus, suburban housing developed around the growing urban rail networks in the early twentieth century, assisting the Garden City movement in its quest to promote the 'best' aspects of the town and the countryside such as in new suburbs at Hampstead and Letchworth. By the middle of the twentieth century, however, the mass-produced automobile had become the new transport mode of choice for many. Housing decisions began to be made with reference to a radius of travel time by car from the workplace (and vice versa) rather than with proximity to fixed public transport lines. Increasing car dependency saw dispersal and low density become the norm as new-build housing pushed and dissolved urban boundaries, while inner cities began to lose their traditional employment, shopping and recreational functions to edge-of-city development. In spite of some radical traffic plans, older conurbations soon became traffic-choked and public-transport deprived as branch lines were shut and urban tramways disappeared.

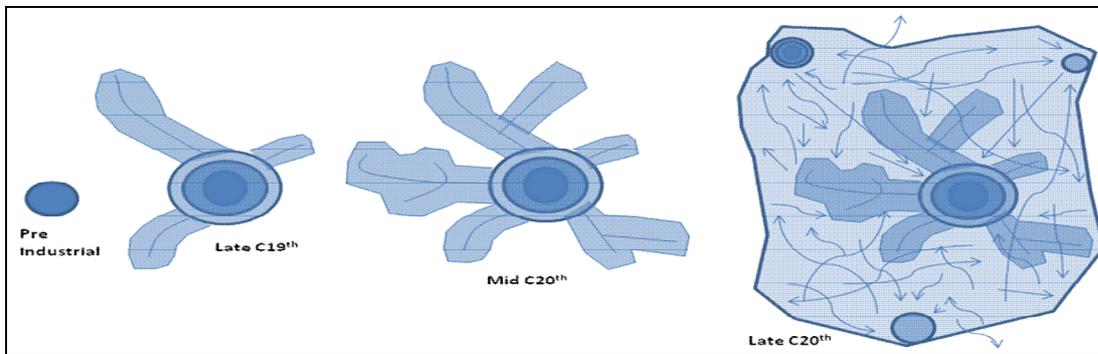


Fig. 1 Transport & urban form

Automobile dependency has been the subject of considerable recent attention as the economic, social and environmental implications have begun to be understood and 'sustainability' has moved up the policy agenda. Concerns cover the three intersecting fields of sustainability (Fig.2) from the environmental ramifications of land-consuming and transport emission-producing low density housing, the social effects - such as on health and community and more recently, the economic implications of road congestion and oil dependency.

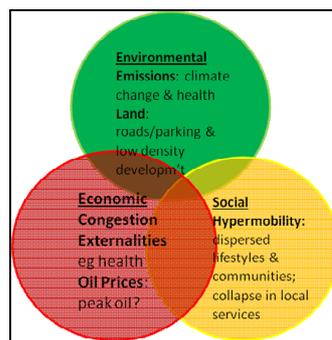


Fig.2 The sustainability effects of automobile dependence.

3. Car-Reduced Development

By prioritising public transportation over the private car and by using a community rather than an individual household-oriented approach to neighbourhood design, car-reduced development offers a radical departure from standard development practices. A number of different terms have been adopted to describe different types of car-reduced housing including 'car-free', 'car parking space free', 'optically car free' and 'car-reduced' (Heller, 2005 & 2008, Morris, 2005 and Melia, 2006). The term 'car-reduced' is employed in this

study to encompass all housing in which: (i) automobile accessibility and car-parking have been reduced below 'normal' levels in their locality, (ii) the development is of a sufficient scale to create a traffic free neighbourhood environment, and (iii) the development is oriented towards public transport and local shops and services.¹ Scheurer (2001) asserts that the first modern developments pitched as a positive lifestyle choice were built in the North German city of Bremen in 1992. Car-reduced housing developments have since been built across Europe on sites ranging from the 120-unit urban infill at Slateford Green in Edinburgh to a 2000 home suburb at Vauban, Freiburg. Continuing interest in the UK is exemplified by the adoption of car-reduced principles into the design guidance for the proposed eco-towns. For its advocates, car-reduced development represents a 'holistic' approach to sustainability – confronting head-on the detrimental effects of automobile reliance summarised in figure 2.

Although several authors have commenting that pre-automobile age residential housing is, by definition 'car-reduced' (e.g. Morris, 2008, Crawford 2000), it is well worth noting that treatment of traffic in residential areas has presented a vexing problem for planners and decision makers since Ancient Rome. Tired of the incessant din, Caesar reportedly banned chariots and carts from entering Rome between sunset and sunrise and turned the streets around the Roman forum into culs-de-sac. This apparently neat solution found much later favour in North America with Clarence Stein's 1920s design of Radburn which, along with street-end gardens and a separate pedestrian network, aimed to create 'a town in which people could live peacefully with the automobile – or rather in spite of it' (Stein 1958:37, quoted in Hass-Klau, 1990). Radburn principles spread across the Atlantic and in so-doing began to mutate into the patterns of the modern housing estate, with travel-inducing consequences quite unlike those that Stein had originally intended. At around the same time Alker Tripp – a former Assistant Commissioner of the Metropolitan Police and founder of the modern road hierarchy foresaw the negative impact of traffic on daily life in the late 1940s. Tripp proposed that development should take place around pedestrian precincts with different precincts for residential housing, shopping and leisure. Only the shopping precinct has survived in its original form today, however Tripp's residential precinct idea reportedly inspired Colin Buchanan to argue for traffic-reduced residential 'environmental areas' – or 'living rooms' as he liked to call them - in his 1963 *Traffic in Towns* report.

It is clear that in the UK developing interest in car-reduced housing is rooted in a long-established struggle to balance the mobility needs of society with the social needs of local residents. Since the 1960s, the balance has been firmly tipped towards automobile-based mobility resulting in a residential street environment that has become dominated by highway engineering (Marshall, 2005) and a 'hyper-mobile' society used to few constraints on its travel (Adams, 2000). Therefore, in spite of all of the perceived social, environmental and economic benefits of car-reduced housing, an essential question remains over the wider viability of this form of development in a society which is more or less physically and socially organised around automobile transport generally, and in particular groups with specific mobility needs including the elderly, less able bodied and young families. In a recent newspaper article, Sarah Vine provides a timely reminder of the place of the automobile for one group – working women - in British society:

in the overcrowded, time-pressured, work/life balance nightmare that is the average female's life, the motor car is a girl's best friend...For those of us with children, it's also a nappy-bag extension, a mobile crèche, a soft play centre and, in times of extreme need, a breast-feeding cubicle... Crippling fuel tax won't solve this problem; slowly and sensibly restructuring our lives so that we come to rely less on the car will. But that takes time and careful planning, something that the Government, on the whole, would rather avoid.

The Times (31 May 08)

¹ These criteria closely match Melia's (2006) definition of 'car-free' development; however, it was found that the term 'car-free' was frequently misunderstood and was in itself a slightly misleading term.

4. Community Versus Mobility

The remainder of this paper aims to lay out a research framework through which two key social aspects – mobility and social interaction- can be examined in the context of reduced automobile provision, and to report some preliminary findings that will help to guide future research. Social interaction is of interest due to its importance in local community development and because of its relationship with traffic and urban design. Research on the social effects of traffic in San Francisco led by Donald Appleyard in the 1960s unveiled a stark inverse correlation between levels of traffic on different streets and community relations that have since been replicated and confirmed elsewhere.² Appleyard *et al* (1981) reported significantly weaker community ties on streets with high levels of traffic for a multitude of reasons including a less convivial street environment, higher population turnover and an unsafe play environment for children. Such social contact may be considered in terms of ‘social capital’ or networks of social relations within a community. Mobility issues centre on travel accessibility; namely, the way in which mobility impacts on residents’ lives, acts as a control on the characteristics of the resident population and the accessibility of residents to others who may be automobile reliant.

This study is essentially an exploration of the relationship between mobility and community development at the neighbourhood scale and in the context of automobile reduction. Adams (2000) has employed the term ‘hyper-mobility’ in questioning whether levels of mobility (Fig. 3) have reached undesirable levels in relation to the detrimental environmental and social effects of advances in transport technology and particularly with the rise of the automobile. As technology has enabled lives – indeed *communities* to become spread over widening geographical space (Fig.1), the resulting erosion of ‘traditional’ community, has led to what Adams describes as a ‘society of strangers’. Beyond simple nostalgia, Adams’ critique has a number of stark and measurable outcomes including the self-reinforcing demise of neighbourhood services and facilities, the erosion of *social capital* leading to increasing levels of crime, mental health problems and diminishing educational attainment (Putnam, 2000 & 2002), and the consequences of the loss of children’s independence (Hillman *et al*, 1995; and Putnam, 2000). Conversely, Adams uses the phrase ‘hypo-mobility’ to describe the negative consequences of insufficient mobility leading to inaccessibility and consequently the loss of opportunities. Such tension and ‘trade-off’ between mobility and community forms the core of this work in the car-reduced design of different housing schemes.

A tripartite relationship is therefore proposed to summarise this theoretical relationship between social interaction, mobility and design in figure 4, in which the ‘design’ represents the level of automobile provision in a particular development and the alternative uses of would-be automobile space.

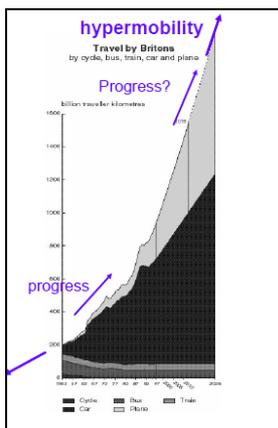


Fig. 3 Increasing Mobility
(Source: Adams, 2006)

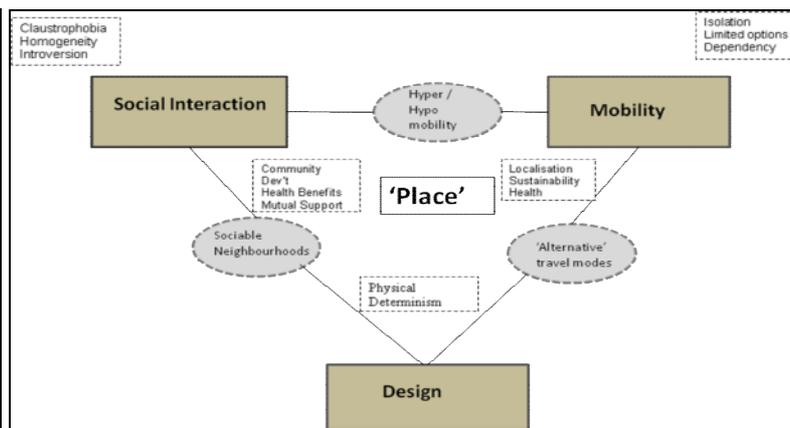


Fig.4 Theoretical Framework

² By this author and will be examined later in this work, and in Bristol by a postgraduate student at the University of the West of England in 2007.

Figure 4 shows a theoretical trade-off between mobility and community development. Here, a simple example would be the ability of a 'regular' resident to access a vehicle parked on the driveway outside, versus a 'car-reduced' resident whose vehicle, if available at all, is parked on the edge of the site. The trade-off resides in the theoretically 'socially conducive' environment that the car-reduced resident lives in as a result of the automobile restrictions.

The main body of empirical work, to follow the pilot studies presented here, will consist of questionnaire, interview and observational based comparative research in three different forms of development: (i) 'Car-free', (ii) 'Car-reduced', and (iii) 'regular', where contextual factors such as public transport links, local shops and services, geography, socio-economic and demographic factors are broadly similar (Fig.5).

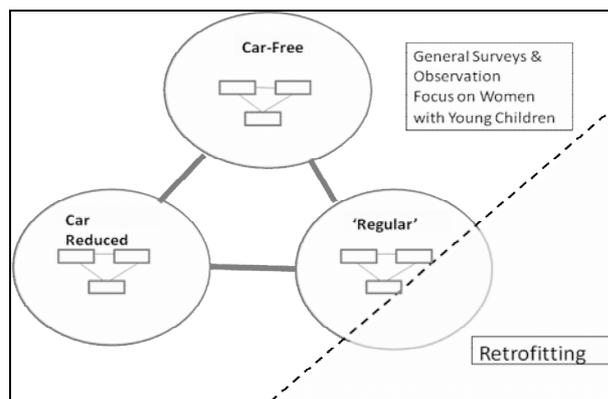


Fig. 5 Research Design

The point of this study is to examine whether a balance can be found in meeting the 'three-dimensional' sustainability objectives of car-reduced development in reducing car use and setting conditions for stronger community relations, whilst meeting the mobility needs of a fully representative resident population. If such a balance cannot be achieved then it could be argued that car-reduced housing schemes as new-build concepts or retrofitting strategies will not progress beyond being niche developments for the few.

5. Pilot Studies

Two pilot studies were undertaken to assist in the design of an extensive field research programme into the social implications of car-reduced development, which will form the next step of this research project. The first pilot investigated mobility constraints at the Slateford Green car-free development in Edinburgh and draws upon a recent consultancy study, semi-structured interviews conducted by this author and secondary material. The second pilot study consisted of a comparative questionnaire survey of residents' opinions and behaviour in four streets in Hackbridge, South London. The chosen streets ranged from car-free to a busy main road. Three different types of housing are therefore represented in the two studies: 'car-free' at Slateford Green, 'car-reduced' at BedZed, and 'regular' housing in Hackbridge.

5.1 Study One: Slateford Green

This pilot study took place at the 120 home Slateford Green car-free development in the West of Edinburgh. The development was completed in 2000 to a design inspired by the traditional Scottish tenement. Six car parking spaces are available for disabled residents and visitors and there are two spaces reserved for the City Car Club. Vehicle access to the doorstep is regulated to pick-ups and drop-offs, controlled by barrier access and monitored by the concierge by CCTV. Housing tenure is a mixture of approximately 70% housing association rental, 20% shared ownership and 10% privately owned although a 2005 survey found that 40% of residents were without an independent income. The development's car-free design allowed would-be parking and road space to be alternatively used – for recreation, wildlife habitat, allotments and shared surfaces (Scheurer, 2001). Off-site parking is not regulated and unlike schemes elsewhere in Europe, car ownership is not regulated.

Unlike the Hackbridge study detailed later, this pilot study did not attempt to measure community development, but considered *community versus mobility* in terms of the development's car-free but socially orientated design. This study concentrated on mobility issues following a 2008 travel survey undertaken by Eastwood (2008). Their study, which received a 22.5% response rate, found that up to 40% of residents owned a car – double the level reported in a 2002 study, but significantly below the 70% level for Edinburgh generally. Travel patterns reflect those which emerged at BedZed in the previous study. Table 1 shows that 10% of Slateford Green residents use automobiles as their usual mode of transport, although the questionnaire used did not specifically detail the work commute. This compares with 48% car commuting in Edinburgh overall. 42% of residents used the bus and 37% walked as their main mode of transport, corresponding with the proximity of frequent bus services and the availability of local shops and services, respectively.

Mode	Walk	Cycle	Bus	Train	Car/van Passenger	Car/van Driver	Car/van Total	Other	Total (%)
National	13	2	12	4	7	60	67	2	100
Edinburgh	18	3	27	2	5	43	48	2	100
Slateford Green ³⁷	37	5	42	0	5	5	10	0	100

Table 1: Journey to Work Data (Source: Eastwood, 2008)

Residents were asked about the factors that would encourage greater public transport use. 35% of respondents selected 'subsidised or cheaper fares', whilst nearly a quarter chose 'greater reliability' and the same proportion called for a greater frequency of service. However it is clear whether this question of encouraging greater public transport usage implied public transport in preference to other modes, or just simply more travel altogether.

Against the backdrop of the Slateford Green transport survey, this author attempted to conduct semi-structured interviews with mothers of young children at a weekly 'Mums and Tots' group held in the on-site community centre to identify some of the issues associated with a traditionally transport vulnerable group (DfT, 2006). In the event, just one out of the nine attendees of the group transpired to be a resident of the development, and whose travel difficulties were negated by car ownership – a change from her previously car-free existence on the development until the arrival of children. The single greatest issue that emerged from the group overall was a decision by a local bus operator to introduce a ban on child buggies due to a conflict of space with wheelchair users; a policy now in the process of being reversed with the introduction of new vehicles following considerable local opposition and considerable media coverage. A local newspaper summarised the effects:

The impact of the ban – and the latest move to effectively start lifting it – should not be lightly written off. For many, the city's buses are the only way to readily access vital services, and to stay in touch with family and friends at a vulnerable time.

Edinburgh Evening News, 24 March 2009

Car-free developments generally seek to reduce automobile necessity by design, firstly by orientation towards mixed land uses that aim to reduce the need to travel in the first instance, and secondly by proximity to public transport services. The actions of a local bus operator here have undermined the accessibility of transport services to a significant and potentially vulnerable sector of the population (DfT, 2006) which dramatically underlines Sarah Vine's earlier depiction of the motor car as a 'girl's best friend'. As the Edinburgh Evening News suggests this issue may linger in public consciousness for a while yet; certainly until a new bus fleet is fully introduced.

With car ownership levels possibly as high as 40%, the Eastwood report notes that '[t]he availability of car parking in the vicinity is...a significant factor in undermining the effectiveness of Slateford Green as a car-free development'. Their report proposes a number of policies including liaising with local landowners and businesses for the introduction of parking restrictions that would 'minimise the risk of undermining the aims of the development by providing unrestricted parking in close proximity' (*ibid*). The bus company's buggy ban

and spiraling levels of car ownership have contributed to what could be described as a sustainability dilemma at Slateford Green. On the one hand is the option of upholding the scheme's environmental credentials through further parking controls. On the other hand, such restrictions could adversely affect the social and economic needs of a considerable proportion of residents. Central in this apparent dilemma is the confidence-eroding ability of local bus operators to rapidly alter their *modus operandi*; a situation suggesting that tighter contractual safeguards would benefit similar developments built within the UK's privatised public transport system.

5.2 Study Two: Hackbridge, London

This study aimed to compare attitudes and behaviour to travel, social interaction and the built environment of a resident sample of a car-reduced street in the BedZed development and those living in regular streets immediately adjacent. The specific objectives were to:

- Compare general travel behaviour between streets;
- Characterise levels of social interaction and community development on each street;
- Gauge attitudes towards urban form of residents of each street;

All of the properties included in the survey sample were located within 200m of each other, giving a more or less equally high level of public transport accessibility and common provision of local shops, schools and services. The four chosen streets contrast markedly in terms of traffic volume and density (Table 2).

	Heavy	Light / Old	Light /New	Car-Reduced
Density	20 DpH	30 DpH	48 DpH	105 DpH
Age	C.1900 – 1950s	C.1900-1970s	1990s	2002
Car Provision	Busy 'A' Road with limited street parking	Residential distributor road with street parking	Residential cul-de-sac with street parking	Limited car access & no street parking. Peripheral parking at 1.5 spaces/home.

Table 2. Characteristics of the four study streets in Hackbridge

Demographic & Background Data

Basic demographic data consisted of household age composition, housing tenure and lead occupation. Although a small data sample means that a degree of caution is required, a number of basic demographic differences are evident between car-reduced and regular streets (Fig.6).

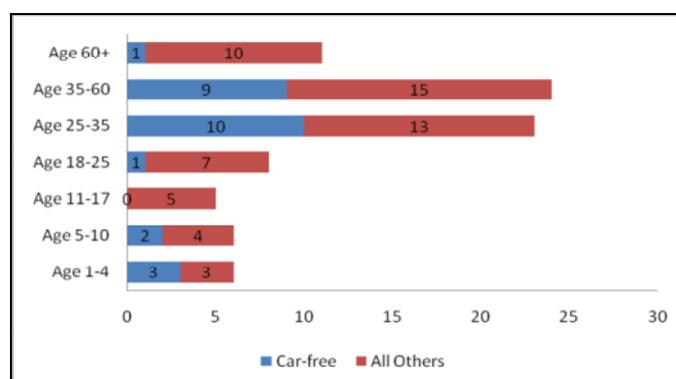


Fig.6 Distribution of Age Groups – Car-Free & Regular

Firstly, just 2 out of 14 BedZed households had children, compared with 4 out of 22 respondents in the regular streets. Secondly, there was a higher proportion of older people living in the regular streets. Generally, there was a greater spread of age groups in the regular housing compared to the car-reduced. Most respondents were owner-occupiers in

both data sets, with just one rental property in the car-free street and four among the regular housing, although 'ownership' included participants in the Peabody Trust's 'shared ownership' scheme for key workers and those on lower incomes. In accordance with its recent completion, time spent at the current address was least in the car-free street (Fig.7). Surprisingly perhaps, in light of the correspondence between traffic levels and occupancy turnover recorded elsewhere (Appleyard *et al*, 1981), respondents in both the older housing along 'heavy' street and those along the 'light' street had all been resident for an average of 15 years.

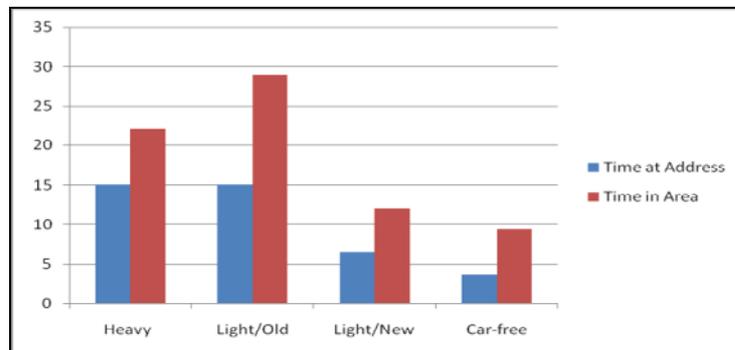


Fig. 7 Time Spent at Address & in Area (in years)

Travel Behaviour

Overall car ownership levels at Bedzed have previously been estimated at between 50% and 59% against 71% overall in Hackbridge generally in previous studies (Francis & Bell, 2008). Within the small sample of 14 households of the car-reduced street, 84% had cars against 100% among the 22 households in the adjacent streets. Clearly, these differences in car ownership rates do not explain the contrasting journey-to work patterns shown in Figure 6 below which show a predominance of train and cycling at BedZed against the automobile based commuting of residents of the regular streets.

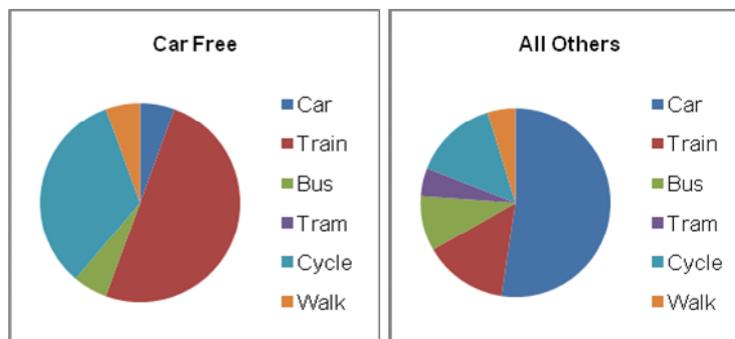


Fig. 8: Journey to work modal share.

Explaining such variance is not straightforward, but a number of factors were considered including the viability of public transport to reach the workplace, combining work and the school run and the effect of the one car per household ratio at BedZed on a household with young children. Using Transport for London's 'journey planner' tool, all commutes were found to be theoretically possible from Hackbridge railway station to the destination district's transport hub to within 5 minutes of the car journey time given by the respondent. Combined work commutes and school runs also do not account for this disparity as only two BedZed households had children, of which one made combined journeys - against 4 of the Hackbridge households, suggesting that other factors affect behaviour.

Environmental issues are evidently of concern to a significant proportion of BedZed residents with nine out of fourteen households selecting environmental concerns as a factor in their decision to locate to the development. Attitudinal differences could be a significant factor, whilst a difference in the age distribution of residents of also needs to be considered. Furthermore, the peripheral nature of car-parking versus the close proximity of cycle lock-ups may explain the popularity of cycling as a travel mode over driving.

Grocery shopping reveals a different pattern, as Fig 9 shows the car and the bus to be equally popular modes within the car-reduced sample in accordance with patterns for BedZed overall (Francis & Bell, 2008). A previous study also found that 22% of residents use the internet for grocery shopping in Bedzed. Internet shopping was included in this study, but although it reduced some grocery shopping trips, it has not yet had a dramatic impact on the residents surveyed generally. In the regular housing sample, the car was used almost exclusively with the exception of a few who did their shopping exclusively at local shops.

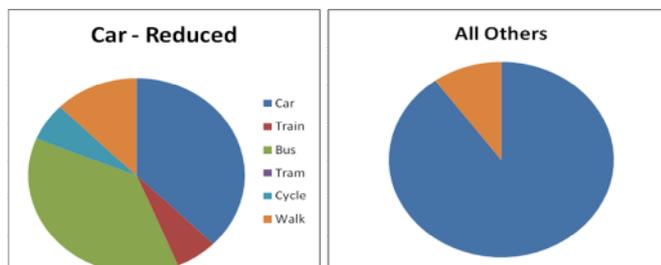


Fig. 9: Shopping & Modal Share

Car use by visitors was at the 80% level across all streets in the study. With limited parking availability at Bedzed, anecdotal evidence from nearby residents suggests that vehicles are parked in adjacent streets which are not governed by parking controls, leading one resident to claim of having had the curb dropped outside his home as a result.

Community Development

The impact of traffic on neighbourly contact and the community strength of each street was assessed by asking residents to diagrammatically show which other residents of the same street they were acquainted with and to evaluate the community strength of their street on a scale of 1-5 from weak to strong (Fig.10).

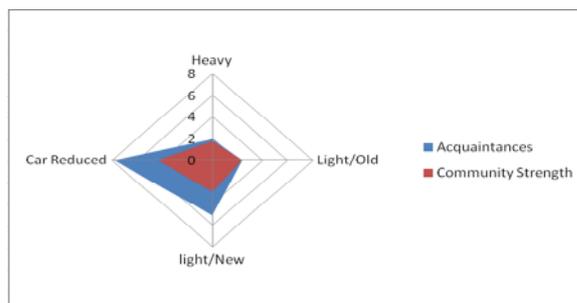


Fig. 10: Community Development & Traffic

The patterns depicted in figure 10 correspond exactly with those uncovered in Appleyard & Lintell's (1971) seminal work in San Francisco, although they do mask a degree of variability. A direct link between length of time at address and development of neighbourly relations might be expected, but almost the reverse is true in the study sample. The residents of the car-free street had been in residence for an average of approximately 4 years but had 8 or so acquaintances, whilst those on heavy street had been there for 15 and knew 5 of their neighbours by name. Length of residency may be factor in the contrast between old and new build streets, but between the new build and car-free. Similarly, tenure seemed to play little role in the development of community relations, although rental rates were highest along 'heavy' street, in keeping with Appleyard & Lintell's findings.

The last section of the survey was dedicated to perceptions of each resident's street graded on a 7 point Likert scale, in which 7 indicated 'very happy', 4 was 'neutral' and 1 meant 'very unhappy' (Fig.11, next page). Unsurprisingly, traffic noise was closely correlated with actual volume with the car-free street suffering slightly from its close proximity to the busy London Road. All streets suffered a slight dip when it came to petty crime. A number of residents of the car-free street complained that the current provision of outdoor and open cycle storage made bikes vulnerable to theft, whereas on Heavy Street concern was mostly about litter and graffiti.

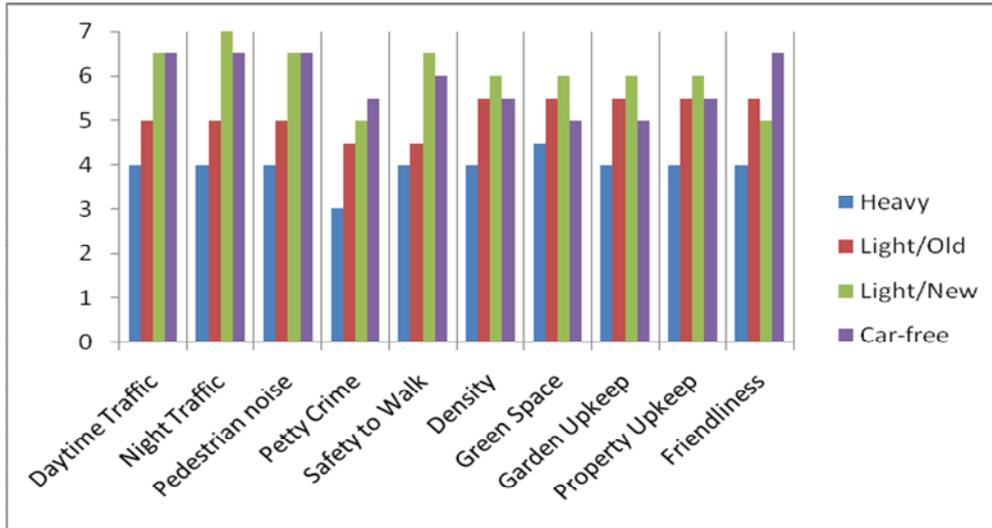


Fig. 11: Residents' Perceptions

The question over density reveals something of a paradox: residents of light/ new-build street were only fractionally more satisfied about density in spite of living in a street one third of the density of the car-free street. Likewise, the density of the light/ old street was about half that of the car-free street. Lastly, perceptions of 'friendliness' of the street confirmed the previous given rankings given for neighbourly relations, which was also confirmed by scores given for 'sense of community'. That is to say, a 3-way check was given on the development of street community which proved consistent with each other and with the volume of traffic.

Community Versus Mobility?

Rather than to draw firm conclusions from a limited data set, the point of this pilot study was to try to identify patterns and lines for further investigation in a subsequent major fieldwork programme. In addressing number of data features are worthy of note: (i) the narrower overall age profile of the car-free street, (ii) the contrast in journey-to-work modal share between car-free and regular streets, and (iii) the patterns of community development and involvement between streets, commensurate with traffic levels.

A graphic representation of the two data sets could look like Fig. 12 below, in which residential design has orientated the car-free street towards community and the regular streets toward mobility.

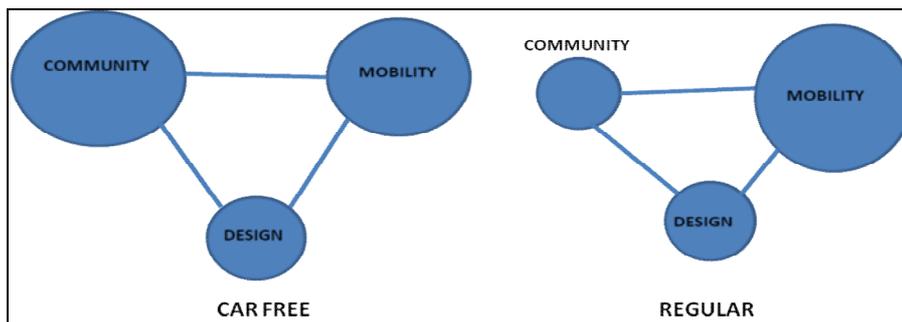


Fig.12 Depictions of car-free and regular streets

Though it is a neat and broadly representative depiction of a limited data set, figure 12 obscures the limited demographic profile in the car-reduced sample in which mobility restrictions do not emerge as perhaps they might for a sample with a greater proportion of households with elderly or young children. However, a significant weakness of this study is that it did not explore in depth the impact on residents' opportunities and choices of available transport options. These important issues will need to form a significant component of future research.

6. Concluding Discussion

This study has set out to examine whether the environmental, social and economic sustainability objectives of car-reduced development, which were detailed at the beginning of this paper, can achieve a reduction in car use by design and set conditions for stronger community relations, whilst also meeting the mobility needs of a fully representative resident population. It was asserted earlier that if such a balance cannot be achieved then it is unlikely that car-reduced housing schemes as new-build concepts or retrofitting strategies will not progress beyond being niche developments for the few. Three different types of housing were examined in the pilot studies: a car-free scheme at Slateford Green, car-reduced development at BedZed, and regular housing in Hackbridge. Rather than draw firm conclusions from limited data, the pilot studies and supporting research presented here aimed to assist in the design of a more extensive programme of field research. However, a number of observations may be drawn from the findings presented above, which address the central issue of *community versus mobility* and which will assist in shaping the next stage of research.

Addressing the subject of community, the Hackbridge study noted the strong correspondence between traffic levels and neighbourly contact first reported in San Francisco by Appleyard & Lintell (1971), but which seemed to have little correlation with duration of residence. The study also noted the limited age profile in the BedZed street compared with adjacent regular housing. Questions over the possibility of self-selectivity in car-reduced development are raised, as are the effects of introducing external controls by housing tenure, which warrants further investigation.

Initial examination of the mobility implications of car-reduced schemes revealed the need for more detailed and comprehensive exploration into individual lifestyle impacts and residents' opinions. However, a number of useful findings were obtained. In Hackbridge, a marked contrast in commuter travel patterns emerged between with residents of BedZed car-reduced development and those in adjacent housing, for which no satisfactory explanation was obtained from the material available, although attitudinal and demographic differences were proposed as possible factors. A recent consultancy study at the Slateford Green car-free development revealed car ownership levels of up to 40%, due to the lack of local parking controls. While this figure is still significantly lower than the 70% average for Edinburgh generally, the report notes a contradiction with the development's founding principles. However, uncertainty generated by a local bus company's recent decision to ban child buggies suggests that tackling car ownership by restricting parking runs a risk of creating further mobility difficulties for young families. It also raises questions over the viability of future heavily car-reduced development against a backdrop of privatised public transportation.

In summary, a conclusive answer to the question of *community versus mobility* is beyond the scope of the limited data produced by the pilot studies and supporting material presented here, but the evidence so far suggests that these desirable outcomes are compatible. Limited evidence from three different types of housing examined have produced different community-mobility outcomes, ranging from community-poor and mobility-rich in the regular housing, more evenly matched mobility and community at BedZed – perhaps at the cost of a broader demographic spectrum, and a communal design at the apparent cost of mobility for some at Slateford Green.

Having begun this work by examining the rationale for car-reduced development in the context of other policy options, the conclusion is a clear need for comprehensive and detailed research in order to identify how community and mobility can best be balanced by design and planning policy. In the context of the three dimensions of sustainability, this would assist in clarifying whether car-reduced residential design has the potential to graduate from being niche developments for the few into mainstream practice.

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