View metadata, citation and similar papers at core.ac.uk

brought to you by CORE

provided by UWE Bristol Research Repository

Driven To Excess: Impacts of Motor Vehicles on the Quality of Life of Residents of Three Streets in Bristol UK

Joshua Hart and Prof. Graham Parkhurst

Abstract

Quality of life in cities and towns is of increasing concern to the public, and to policymakers. A major threat to quality of life is the high volume of motor vehicle traffic, associated with a wide range of mental and physical health detriments arising from immediate, local impacts such as air and noise pollution, road deaths and injuries, as well as global, longer term effects, such as the destabilisation of Earth's climate. The article reports on an investigation into the impacts of traffic on quality of life in a residential area of Bristol (UK), a city which in the British context is particularly car dependent. In essence the study replicated Appleyard's (1969) research on traffic and neighbourhood social interaction. Primary data were collected through observations and a series of interviews with 60 households on three streets selected for their contrasting levels of traffic.

The results confirmed that Appleyard's findings are applicable to the UK in the 21st century; specifically that the number of friends and acquaintances reported by residents was significantly lower on streets with higher volumes of motor traffic. The extent of people's 'home territories' also diminished as motor traffic increased. Other notable outcomes from the research include the finding that individuals' perceptions of road safety in their neighbourhood may be disproportionately influenced by the traffic conditions on their street of residence, especially affecting the degree of independence granted to children. The findings are considered against the context of existing policy solutions to reduce traffic impacts, leading to the conclusion that the tools exist to reclaim urban residential neighbourhoods from traffic, but this will require considerable political will.

"The Automobile, satisfier of private needs, demands, and whims — has created an insatiable demand for access, and a whole profession of planners and engineers both serving and further stimulating that demand."

- Donald Appleyard, "Streets Can Kill Cities: Third World Beware!" (Appleyard, 1980)

1. Introduction

The use of motor vehicles in most urban areas of the world has reached such ubiquity and intensity that few citizens are fully aware of the extent of detriment they cause to quality of life. Nonetheless, a study conducted in spring 2008 in Bristol, UK, attempted to understand residents' perceptions of the impacts of motor traffic on their homes and streets, and on individual and community health. On streets with moderate to heavy motor traffic, our research found significant erosion of social capital, and widespread discontent from residents about the health and safety impacts of car traffic on their street. The results provide renewed focus on a debate about urban traffic and quality of life that has intensified as motor vehicle numbers - and their impacts - have increased.

The study methodology replicates the work of Donald Appleyard (1969), who demonstrated that people living on a street with relatively heavy traffic had only one-third as many social connections as people living on a relatively light-traffic street. Subsequent studies investigated street design, traffic, and neighbourhood quality of life; work that culminated with the publication of the seminal work *Livable Streets* (Appleyard, 1981). *Livable Streets* revealed the social impacts of motor traffic in fine detail through interviews and street observations, demonstrating that casual conversations, children's play, and other street-based social life tend to be suppressed, particularly as vehicle volumes and speeds increase. Appleyard's findings provided a quantitative case for policymakers to consider the social impacts of current transport policies. Figure 1 reproduces the iconic diagram of the original study, which visually represents the erosion of social interaction as traffic volumes increase. (Appleyard, 1969)

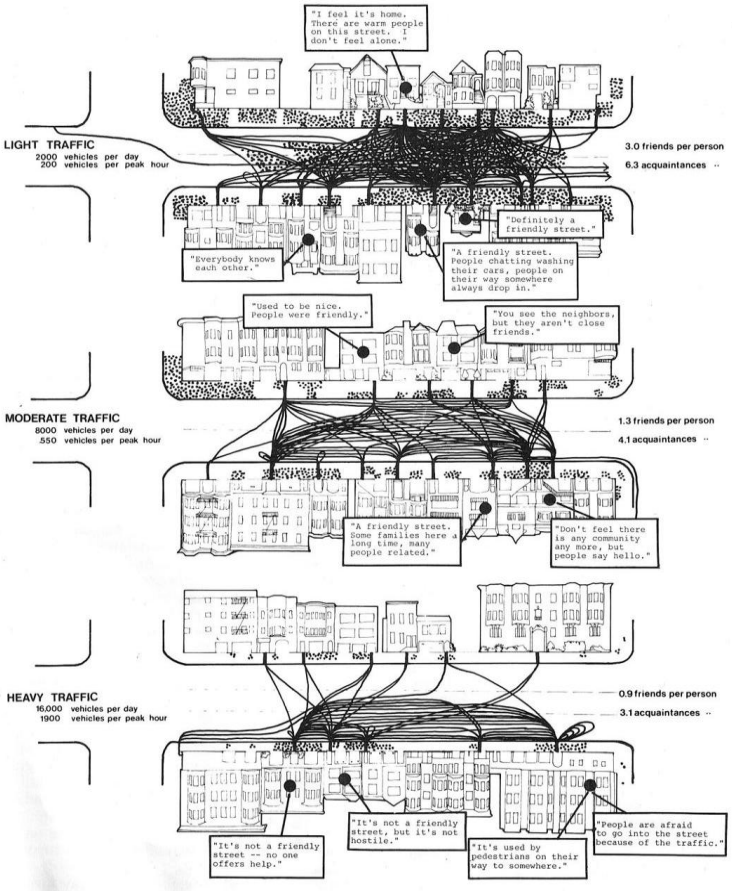


Figure 1: Appleyard's (1969) diagram of intra-street social connections. Lines represent specific social connections whilst dots identify where people were reported to gather.

The present article begins by making the case that there was a timely need for a 21st Century replication of Appleyard's original work, due to the changing sociocultural and transport conditions over the intervening decades. There was also a need for contemporary research into the impacts of motor vehicle traffic on neighbourhoods outside of the United States. Section 2 examines the evidence of social and environmental damage and deterioration of public health associated with motor vehicle dependence. Section 3 briefly introduces the methodology and the data collection procedures. Section 4 initiates presentation of the findings, considering qualitative data about life in the streets and including perceptions about 'home territories'. These are followed by quantitative analysis of the relative numbers of friends and acquaintances reported by the participants. A final discussion section reviews the extent to which the tools necessary to address the problems identified already exist.

2. Appleyard's Thesis Revisited

Since Appleyard's contributions, both vehicle ownership and traffic have continued to rise: for example doubling in the UK since 1980 (Figure 2). However, vehicle-specific emissions performance has improved considerably since the 1960s, whilst building design and adaptation have become more defensive with respect to vehicle impacts, through the orientation of residential buildings away from the carriageway and double or even triple glazing fitted as standard. With many more car owners and users, it might be argued that the costs and benefits of

motorisation are more evenly distributed, and so perhaps more readily accepted. Additionally, with the delocalisation of community, including due to the rise of online communities, there may be less local connectivity and street interaction to be affected by traffic in the first place.

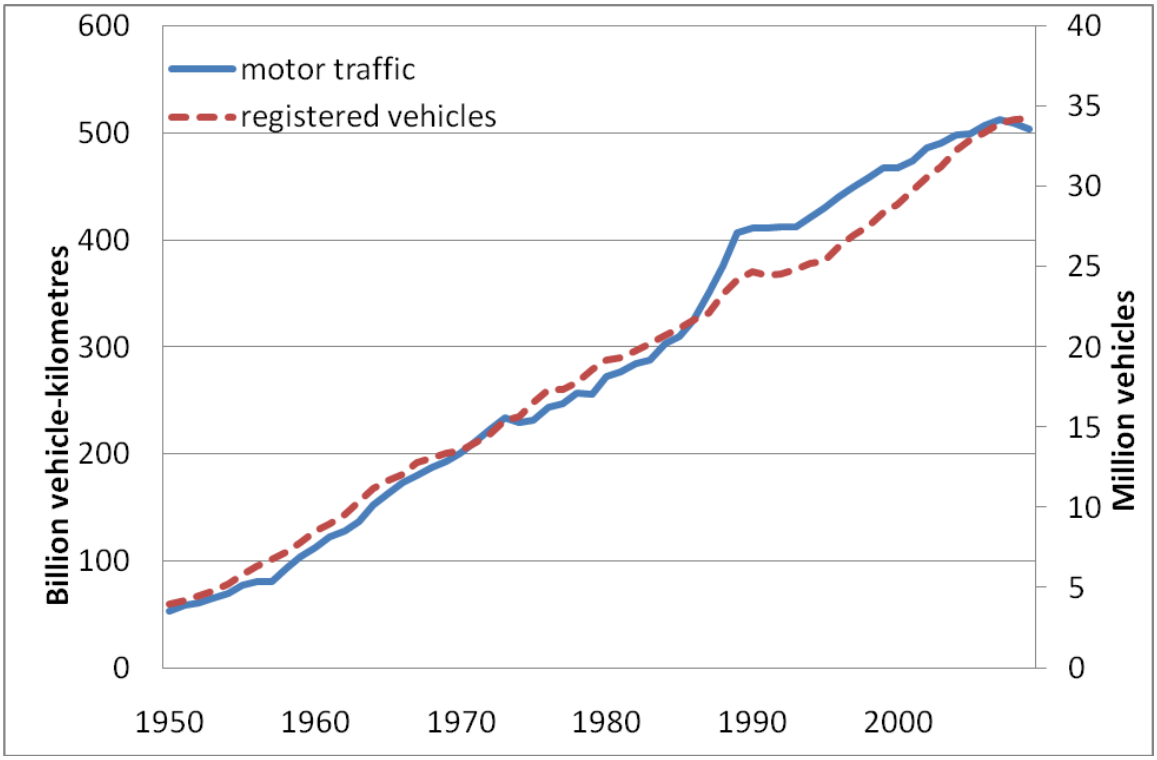


Figure 2: Increase in car ownership and distance travelled, UK 1950-2009
Data source: UK Department for Transport (2011)

The surge in motor traffic has been accompanied by ongoing documentation and analysis by academics and environmental and health agencies concerning the widespread impacts of the consequences of motorisation. In part these initiatives indicate that long-established problems continue to be significant, and at the same time novel areas of concern have emerged. Research into these impacts falls into seven inter-related categories: accessibility, noise, toxic pollution, climate change, traffic danger, physical inactivity, and social degradation, which are briefly summarised here.

The scientific basis of climatic variation was well established by the 1970s. However, that there is a real threat of catastrophic interference in the global climate system in the next years and decades if humans continue to emit CO_2 and other climate change gases at current rates has only gained (near) consensus in more recent years (e.g. Hansen et al., 2008). Future impacts are likely to include melting ice caps and glaciers, rising sea levels, spread of drought, malnutrition, disease, and extreme weather events, many which may appear in a manner that is abrupt or irreversible (IPCC, 2007). For many, future climate change impacts are somewhat disconnected from the immediate and local decision to drive. Nevertheless, cars continue to be a significant source of greenhouse gases. For instance, California's motor vehicles alone emit well over 100 million metric tons of CO_2 annually (California Air Resources Board, 2004).

In contrast, poor urban air quality is fundamentally local in character, and motor traffic is the primary cause; polluting in areas close to where people live and breathe (Duhme et al., 1996). Scientific and medical knowledge has developed significantly since the emergence of traffic-related smogs, with global estimates suggesting that air pollution affects more than 1.5 billion people (Satterthwaite, 1999) and causes over 2.4 million premature deaths annually (WHO, 2002). Motor traffic is also considered to be one of the most significant causes of non-point source water pollution, which has eroded water quality in rivers, lakes, and streams particularly in urbanised areas (Litman, 2010).

Similarly, awareness of the range and extent of health and quality of life effects of exposure to excessive and/or prolonged noise has developed. However, noise pollution generally receives much less attention than air pollution and crashes when the environmental effects of transport schemes are assessed. Traffic noise has been identified as causing annoyance, cognitive performance degradation, hearing loss, and sleep deprivation, and is implicated in heart disease, depression and hypertension (Simpson, 2007). Traffic-related sleep disturbances are also linked with increased child pedestrian casualties (WHO, 2005).

Greater car ownership has in general improved accessibility for those able and willing to travel by car; expanding road networks and the associated infrastructure have allowed for unprecedented personal mobility. However, expanding *mobility* for car owners has led to a diminishing level of *accessibility* for those using other means of travel than a car (Litman, 2003). Even for car travellers, what was once an accessibility benefit tends to become a mobility necessity as facilities are centralised as part of an ongoing shift of transport costs from producer to consumer. Globally, road crashes kill or seriously injure at least 50 million people every year (WHO, 2004). The fear of being killed or injured by a motor vehicle is also one of the primary factors preventing greater use of active travel, particularly among children. Vehicle speed is strongly associated with pedestrian fatality rates in a collision, with a large increase in injuries and fatalities occurring where the vehicle speed prior to collision was above 20mph. And whilst comparatively few individuals may be directly affected by serious collisions, public health in general has seen a significant decline along with the growth of sedentary lifestyles, fuelled by an aversion to walking or cycling through car-oriented areas. The obesity/inactivity pandemic is associated with increased rates of stroke, heart attack, certain cancers, diabetes, and depression (Sallis et al., 2004). In the US, 70% of the population fails to meet minimum recommended physical activity rates (USDHHS, 2000); a deficiency that leads to over $77 billion per year in avoidable hospital costs (Pratt et al., 2000).

Lastly, but with great importance for the current study, healthy social networks are not only crucial to happiness and quality of life, they also defend against multiple forms of mortality: "over the last 20 years more than a dozen large studies have shown that people who are socially disconnected are between 2 and 5 times more likely to die from all causes, compared with matched individuals who have close ties with family, friends, and the community" (Putnam, 2000 cited in Leyden, 2003).

Given the salience of the topic at hand, and the growing importance of Appleyard's original research in light of the ongoing environmental crisis, a number of follow-up studies have been undertaken in the intervening decades. Three were identified during a literature review as representing close replications of the original methodology. An unpublished paper produced for a research methods class of the University of California at Berkeley (Patterson et al., 1988) reports a study that involved a group of graduate students returning to the same San Francisco streets studies by Appleyard. They found similar results: the busier streets had less developed social

networks and abbreviated areas of personal territory compared to streets with fewer motor vehicles.

A decade later, in a study titled 'Livable Streets Revisited', Bosselmann and MacDonald (1997) sought to determine the social and environmental impacts of normal heavily trafficked roads compared with boulevards (with local residential streets paralleling the main carriageway on either side). The results confirmed Appleyard's findings that "heavy traffic is associated with a withdrawal from the physical environment". Despite having very heavy levels of traffic (about 45,000 vehicles/day), residents living along a boulevard designed with side streets recorded lower levels of irritation with the negative effects of traffic, showing that boulevard designs may at least partially mitigate the worst effects of heavy traffic.

Most recently, a study was undertaken in New York City by the pedestrian, bicycle, and public transit advocacy organisation Transportation Alternatives (2006). The researchers used a corps of volunteers to conduct 600 door-to-door interviews in four neighbourhoods over the course of a year. Compared with the initial Appleyard study, they selected streets with significantly lower traffic volumes; with low, medium, and high traffic streets having less than 1,000, 2-3,000, and 5,000 motor vehicles per day respectively. Nonetheless, the findings echoed Appleyard, with those on the highest- traffic streets found to hold more negative views of their block, reporting more interruptions of sleep, meals, and conversations, and spending significantly less time walking, shopping, and playing with their children.

However, it was notable that all three of these studies were carried out in the US, which has both a specific built environment context and a particular culture of car dependence. The authors were interested to examine whether similar findings would be produced through a replication of the study in a typical British city, nearly four decades after the original.

3. Data Collection

The urban location for the study was Bristol, a city of 520,000 inhabitants located in Southwest England, UK. In the UK context, Bristol is fairly typical of the large urban areas outside London, although with the lowest traffic speeds of this group (and so by implication the greatest congestion) and a public transport modal share of less than 15%, it is arguably the most car dependent of the major urban areas. However, for the purposes of the replication, what was more important than the choice of city was the selection of the specific residential streets for study. Three residential streets in the north of the city were identified as being very similar apart from the volumes of motor traffic passing through them (Table 1). Two were through-routes providing for local and cross-city movements, whilst the third had originally been constructed with a similar carriageway width fit for the same function but the street was never adopted for this purpose, remaining a cul-de-sac at the south end. As a result it has a much lower traffic volume. All three streets are lined on both sides principally with late 19th and early 20th Century family dwelling houses of two or three stories in height, mostly in terraces but with some semi-detached (adjoined pairs). Most of the properties are set back about 5m from the carriageway, with small private front gardens and larger gardens to the rear. They were generally constructed without off-street parking, and most car parking therefore occurs on the street, although some off-street parking has been retrofitted, generally through the conversion of front gardens to paved driveways. The streets are hence very typical of the pre-war housing that makes up a significant part of the UK residential stock.

Twenty households on each street were interviewed face-to-face about their street, social ties, and views about traffic. Like the original Appleyard study, residents were told that this was a general study about neighbourhood life and how it could be improved.

Table 1 Three Bristol UK streets selected for study

Street	Category	Traffic Volume
Dovercourt Road	Light	140 motor vehicles/day
Filton Avenue	Medium	8,420 motor vehicles/day
Muller Road	Heavy	21,130 motor vehicles/day

4. Residents' Views about their Streets

Photo. 1: Light Street (140 vehicles/ day)

From physical appearance alone, the light street (Photo. 1) was very similar to the medium and heavy streets. From the 20 interviews with residents, it emerged as a closely-knit community. A majority (13 out of 20) described the street in positive social terms. "(Light street) is a friendly street - most people know other people," said a 49-year-old woman, and "good communication between houses, togetherness" was proffered by a 15-year-old boy. Especially the elderly residents felt supported and cared for: a 70-year-old woman who lived alone remarked that, "people on the street have always helped each other in times of illness and difficulty." Another older lady living alone felt lucky to live on such a street where "everyone's kind, thoughtful, helpful, and really lovely to me. When my next door neighbour hasn't seen me for a few days, he knocks just to see if I'm okay….there are more families here - people who stay for a while and put down roots. We share plants and look after each other. There is really a sense of community."

Of course, the street, just like any other, has its problems. Many of the older generation lamented the deterioration of the street's social life, in spite of the fact that most of them still had quite a few friends and acquaintances nearby. A man who had lived on the street for 42 years said that "people don't talk in the street as much as they used to. Everyone here used to know each other. We used to sit on the wall and chat - there would be 4 or 5 of us - those in their 60s would chat with those in their 30s. I haven't seen that since the 1980s." This kind of intergenerational socialising that is essential to healthy communities (Benson, 2002) was often centred around the minding of children who would play in the street, an activity that still occurred, but far less frequently than before. One resident intimated why: "when our kids were small, they were always in the street - there were fewer cars then."

One older lady seemed to recognise the addictive properties of the car: “I’m glad that I didn’t get a car because I’d be dependent on it now. *Some of my friends would rather go without food than give up their car*. I value my independence too much.”

Even on one of the quietest streets in Bristol, with only about 140 vehicles per day, the occasional speeding car was enough to create the perception of a potentially dangerous environment and prevent children from playing in the street. In a knock-on effect, this also prevented adults (who would not then be minding their children while they were playing) from socialising in the street. The occasional fast traffic was also the most frequently cited cause of stress. A single mother of a young child said that “a few cars come very quickly and threaten people in the street. I am constantly worried that my two-year-old will dart out at the wrong time.”

In summary, light street emerged as a community where people were relatively content with the local environment and their neighbours: a street with a healthy social life and a lower incidence of reported stress than the other two streets, apparently with a support network that could be relied upon during ‘rough times’.

Plate 2: Medium Street (8420 vehicles/day)

Filton Avenue (Medium Street, Photo. 2) is a moderately-busy residential distributor road providing access to major employment and retail centres in the city centre to the south and major peripheral commercial zones to the north of the city. Many seemed to realise that the traffic was undermining the social life of the street. An elderly couple, who had lived in their house for 48 years, said that medium street is “not very neighbourly or friendly because you’re on a main road.”

The oldest inhabitant interviewed on medium street was a 91-year-old man who had been living in the same house for 81 years. When asked to describe his street he said “traffic is really the main thing - life has changed tremendously because of the car. Neighbours don’t see each other like they used to, because people get out of their front door, get in the car, and vice versa when they get home.” A single woman in her twenties described medium street as being “busy in terms of the traffic, quite impersonal - part of the busyness means that it doesn’t feel much like a community place.” One older woman even went as far as to say that “if you were to die here, nobody would know.”

One mother on medium street said that she actively discouraged her children from forming friendships across the street, in order to avoid crossing the busy road on a regular basis - evidence that traffic flows can hinder the development of social networks. Whilst this may be an extreme

example of such a mechanism, it may be indicative of the more general underlying attitudes and beliefs about traffic dominance.

Yet despite the bleak reality of a neighbourhood impacted by the noise and fumes of traffic, many of the residents expressed an appreciation of their neighbours and a desire to see a more fully-fledged community develop. A single woman in her thirties said that "we need to be a bit more friendly on this street - it's important to know your neighbours."

Photo. 3: Heavy Street (21,130 vehicles/ day)

Heavy street (Muller Road, Photo. 3) links at its southeastern end directly to a junction of Bristol's urban motorway spur from the national motorway network. At its northwest terminus it joins an arterial road linking the city centre with more peripheral northern suburbs. The dominant picture that emerged of heavy street from the interviews was that of a street where residents largely 'keep to themselves', and have arranged their lives in such a way as to minimise the primary source of stress on their street, which they identified, more than any other cause, as the heavy vehicular traffic (14 out of 20 households).

Although several residents mentioned their "friendly neighbours" and two residents said that they "swap Christmas presents, and often have meals together," more often than not these friends and/or acquaintances were located in close proximity to the interviewee's home, and only rarely across the street. More residents expressed negative observations about the street than positive.

A middle-aged man living alone described heavy street traffic as a "mountain range, cutting you off from the other side of the road." He described the street environment almost like a war zone: "The street is hellishly busy….it's a bloody nightmare. The buses and lorries shake the house when they come by. The air pollution can be quite bad out the front, sometimes during rush hour you feel the air getting thicker and thicker." He went on to say that "people have moved out because of the traffic." Over half of those interviewed reported spending more time in the back of the house due to traffic noise.

Poor air quality turned out to be a major irritant and source of frustration. A married couple in their late thirties who have been living on the street for six years, and have a four-year old daughter, seemed desperate: "This street is unfriendly, suspicious, dirty, and not very family

friendly. We don't like it, mostly because of the traffic." The father reported that air pollution was a constant irritant. He worries about his little girl: "We're very concerned about her health- she has a constant cough- and we limit the amount of time she spends outside." he said. Remarking that he had cleaned the television the day before, he took a clean white paper towel and wiped it across the screen in order to demonstrate how it was again dirty. "We're constantly breathing this in," he said with an exasperated tone.

A divorced, middle-aged man who grew up on heavy street, and moved back into the house when his parents died, has noticed a huge increase in traffic. "The air pollution is really very bad - it's annoying when the dirt builds up in the kitchen. There's just always so much dirt, grit, and grime around. I've considered moving out because of this."

Residents on heavy street variously adapted to the impacts of traffic pollution by choosing black curtains and painting their front door black to hide the build up of soot, frequently washing the car, the front of the house, and indoor surfaces, and keeping the front windows shut.

The prevalence of vehicle collisions, and lack of safety was another major area of concern for residents on heavy street. According to several residents, traffic collisions on the street are a frequent occurrence. A middle-aged man who has lived there for 27 years reported that "a cyclist who lives on this block got hit crossing the road, and his leg was broken. A pedestrian was killed crossing at the lights. There have been many deaths and casualties on the road."

Residents attempted to limit the exposure of those deemed to be the most unpredictable and vulnerable groups - young children and pets - to the danger posed by passing traffic. On heavy street some interviewees reported no longer keeping pets, in order to avoid re-living the emotional pain they had felt when their animals had been killed on the busy street. Children were frequently forbidden from playing in front gardens, on pavements, or in the street.

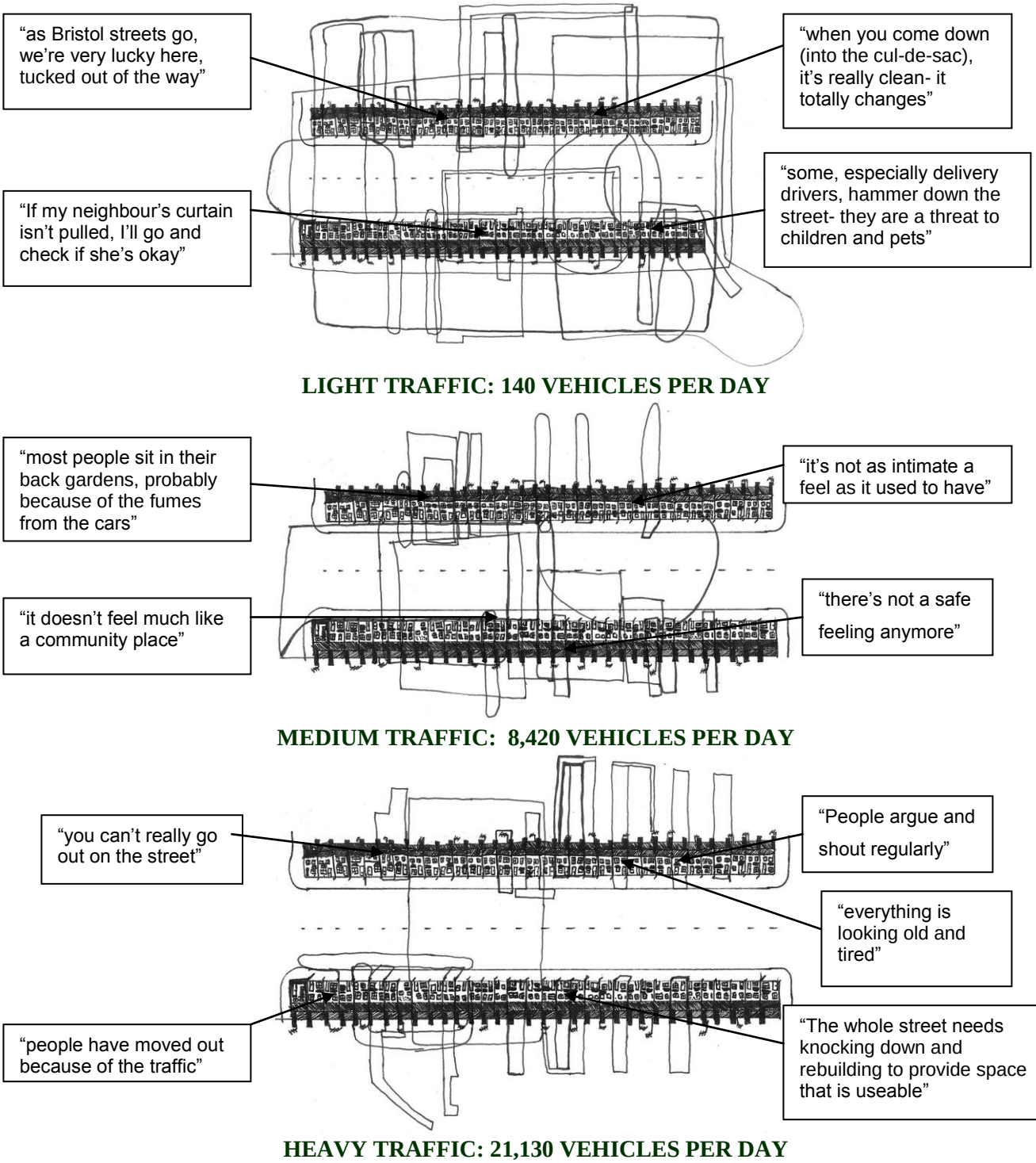
Hence one consequence of the danger posed by cars is that children tend to become 'invisible'. Residents from all three streets made similar observations to that of a female interviewee who said that "there are only about three children on the street". Yet in going door-to-door to conduct the research it turned out that there were at least 13 children just in the twenty households interviewed in each of the three streets (so there were likely many more in households not interviewed). A mother of two young children who had lived on the medium traffic street for two years expressed the view that "there will never be a time when kids can play unsupervised."

Although decisions to accompany children to school reflect a number of factors including concerns about traffic, such as personal security and practical motivations, it is notable that while every interviewed parent who lived along the medium and heavy streets reported accompanying their children to school (mostly by car), only eight out of twenty of those on light street did so. Parents in the UK can exercise some choice over where their children attend school, although many children attend the nearest school. A junior school (for ages 7-10) is located near to medium street; otherwise schools are not located close to the study streets. Detailed analyses of routes to the schools attended by members of participant households were not conducted, but based on the authors' knowledge of the neighbourhood, it is likely that the children from all three streets would face similar traffic hazards on their journeys to school. However, it has been argued that threats immediately outside the front door are of particular salience (Timperio et al., 2004) and this may explain the finding that the parents on light street were less restrictive.

During the interviews, residents were asked to draw their 'home territories.' Home territory was defined as the "area over which you feel you have a sense of personal responsibility or

stewardship" (Appleyard, 1981). The results confirmed Appleyard's findings about the relationship between traffic level and the range of home territories, as is evident from the extent of the ranges in Figure 3.

Figure 3. **Composite Home Territory Diagrams for Interviewees from each Street**



5. Social Connections

Residents were asked to identify the locations of friends, acquaintances, and family members living on their street and to indicate their 'home territory' using an aerial photograph provided. Figures 3 and 4 demonstrate the outcome of this exercise, in the format of Appleyard's original social diagrams, with the clear indication being that motor traffic through a neighbourhood has an inverse relationship with the number of social relationships in that neighbourhood. The mechanisms for this finding can be assumed to draw on the evidence presented in the previous section. In addition, activities that lend themselves to social interaction, such as gardening and sitting outside, are especially vulnerable to traffic-related environmental impacts, particularly noise and air pollution. Second, as traffic increases, so does the barrier effect between opposite sides of the street. Residents on heavy street reported often having to wait as long as five minutes for a gap in traffic just to cross to the other side. Finally, the threat of being hit and injured or killed by a car in the street environment not only discourages people from spending time there, but those who do may be more likely to be on the defensive, and less inclined to engage in a spontaneous chat with a stranger.

Table 2 Comparison of Bristol findings with Appleyard's 1969 San Francisco study

	Light Street		**Medium Street**		**Heavy Street**	
Study Location	SF	Bristol	SF	Bristol	SF	Bristol
Traffic volume	2,000	140	8,000	8,420	16,000	21,130
Avg. no friends	3	5.35	1.3	2.45	0.9	1.15
Avg. no acquaintances	6.3	6.1	4.1	3.65	3.1	2.8

Table 2 summarises the mean number of acquaintances and friends identified in Appleyard's original San Francisco study, and in Bristol. The average number of friends reported on light street (5.35) was greater in the Bristol study than in the original San Francisco study (3.0). This difference may result from the much lower traffic volume of the light street selected for the current research compared with Appleyard's study (140 vs 2,000 vehicles/day), or may be due to other differences between the streets, such as ethnicity or cultural differences.

Table 3 reports the results of chi-square tests conducted for all three streets and for pairings of streets with respect to numbers of friends, acquaintances, and all social contacts reported. Significant departures ($p<.001$) were found from the null hypothesis (that residents of all three streets would have similar numbers of friends plus acquaintances). This was the case considering all three streets together, for the comparison of light street with medium street and for light street contrasted with heavy street. The comparison of medium and heavy was also significant, but at a lower confidence level ($p<.01$).
Similar findings occurred considering friends only. However, considering acquaintances only, there was no significant difference between the medium and heavy streets.

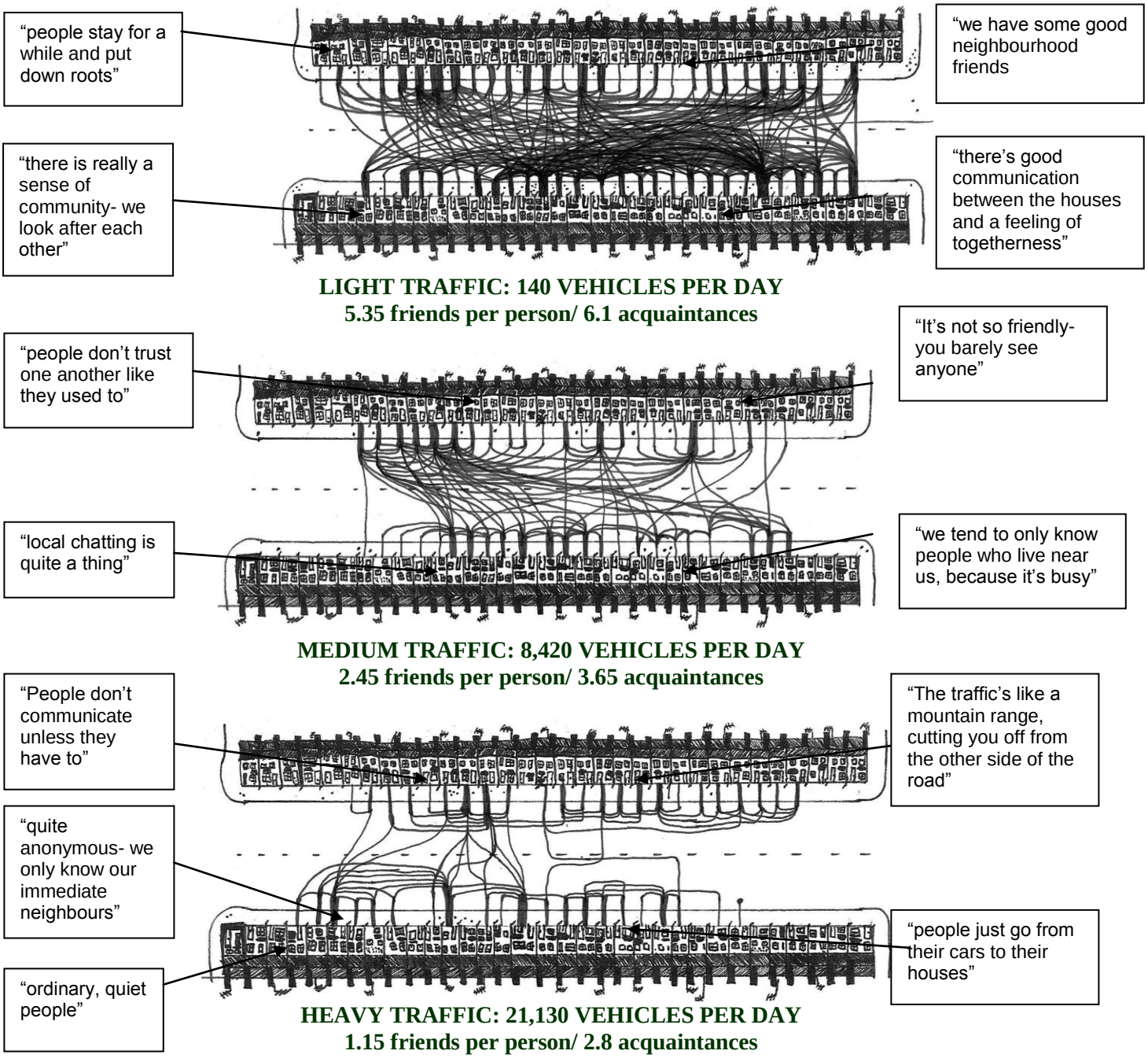
Table 3: Results of Chi-squared tests of difference in reported social connections

			Social relationships	
Traffic levels (degrees of freedom)		**Friends**	**Acquaintances**	**Combined**
All (2)	x^2	61.99	28.07	83.25
	p<	.001	.001	.001
light vs medium (1)	x^2	21.57	12.32	32.62

	p<	.001	.001	.001
medium vs heavy (1)	x^2	9.40	2.25	9.20
	p<	.01	not significant	.01
light vs heavy (1)	x^2	54.28	24.48	73.06
	p<	.001	.001	.001

These findings suggest that the high level of traffic is more implicated in limiting the development of friendships than it is in preventing the formation of less socially-involved acquaintances. This can be explained by high traffic levels not deterring visual recognition, non-verbal communication and brief discussion as much as they would prevent the kind of in-depth discussions that could enable the development or sustenance of a friendship.

Figure 4 Community interaction on three Bristol streets



6. Discussion: Reversing the Tide of Motorisation in Residential Neighbourhoods

This study has replicated the primary findings of Appleyard's original research for a UK neighbourhood in 2008: higher levels of motor vehicle traffic were found to have a considerable negative impact on the social and physical environment, whilst residents identified numerous impacts on psychological and practical quality of life. Specifically, fewer friends and acquaintances from the same street were found in the medium and heavy traffic streets, and for the extent of friendships, even the difference in incidence between the medium and higher level traffic streets was significant. Given that the three study streets had been selected primarily for being unremarkable as examples of UK traditional urban residential environments, the severity of the impacts documented presents a bleak picture of the quality of life in densely populated areas of cities and towns, particularly along major roads. There is no reason to suppose that similar findings would not be found in many other streets in Bristol, elsewhere in the UK, and arguably beyond.

Given the strength and depth of evidence that emerged from the interviewees, perhaps the most surprising finding from the study was that popular concern has not been expressed more loudly and clearly in national and local transport debates. This may arise from the dilemma that those that suffer from the effects of motor traffic are often the same people who create motor traffic in others' neighbourhoods. The ubiquity of motoring may suggest to some that there is no alternative to the status quo; leading to the conclusion that the current urban environment is the best (and only) possible one. Some residents no doubt move on from the most trafficked localities (and were therefore no longer in situ to be interviewed for this study), but not all have this option, due to economic means, family ties, or stage of life.

The limitations to adapting streets like those studied to insulate residents from traffic are overwhelming. Demolition and redevelopment is theoretically possible but would be unaffordable, practically complex, and urban redevelopment schemes are very rarely welcomed by - or carried out in the interests of – incumbent residents (e.g. Gans, 1962). Hence, the crisis can only be addressed by seeking major reductions in traffic in such localities. Here it is worth remembering that the automobile was introduced at the turn of the 20th Century and has only dominated cities and achieved public acceptance for a few decades (Southworth & Ben-Joseph, 1997). Therefore the dominance of motor vehicles over public space may not be as immovable or inevitable as one might first assume.

Overall policy to reduce the effects of motor traffic in residential neighbourhoods must first reduce the volume of that traffic. Subsequently, regulatory measures must be applied to manage remaining traffic and parking more effectively, including that resulting from residents themselves. Specific policies must be enacted that ensure a shift from car use to walking, cycling, and public transport use, applying economic incentives and shifting priority to non-motorised modes and public transport and away from private motor traffic. Greater coordination in planning to provide high-quality, accessible networks and flexible interchanges between active travel modes and public transport is identified as an essential part of this strategy (Parkhurst et al., 2011).

Improved information provision about the social and environmental costs of car use may have a role to play (Steg and Gifford, 2005), although it is debatable who should be the identified communicator of this information given that trust in the public authorities has been identified as a key lacuna in contemporary politics (Pew Research Center for the People and the Press, 2010). While smoking-reduction campaigns may provide a model, cognitive dissonance phenomena may be stronger with respect to car dependence, as smoking, although addictive, is ultimately a

discretionary consumption choice, whereas many people currently do not have viable options besides the car, due to spatial location and other fundamental lifestyle constraints. For others though (and for the currently car dependent in the longer-run), travel choices are open to influence by social norms and emotions, with needs and constraints being overstated in many individuals' travel choice discourses (Steg, 2005). Indeed, analysis of large travel behaviour datasets shows that in any given period, a portion of citizens make choices towards car ownership and use and a portion make changes in the other direction. In recent decades the net direction of this 'asymmetric churn' has resulted in heavier motor traffic, but the presence of the counter-movements suggests there are mechanisms which policy can seek to exploit to reverse this balance (Goodwin, cited in Chatterjee, 2001).

Copenhagen provides one successful example of how to push 'churn' in a positive direction: a city centre strategy to limit parking supply gradually was implemented from 1962, with 2-3% of parking capacity removed each year, and combined with investment in the quality of public spaces, growth in cycling, and public transport provision. CABE (2002) identified this policy as having effectively improved urban liveability and widened travel choices, whilst avoiding political backlash, as the reduction in parking policy was incremental, and hardly noticed, whilst the cumulative change was balanced by capacity increases for the other modes. Here policy balance (rather than emphasising provision of the more politically acceptable policy measures) is a key issue, as enacting policies that affect the price and availability of vehicle storage can be more effective than public transport provision at managing levels of traffic in an urbanised area (DfT, 2001).

Residential neighbourhoods do not exist in isolation and many journeys made by residents will be to travel out from them to destinations rather than within them, so it is important not to over-focus on the very local. Nonetheless, the site of impact and the location where the trips that become 'traffic' begin is the residential street. 'Filtered permeability' (Melia, 2007) has been identified as a key means by which bicyclists and pedestrians can be afforded or retain fine-grain access to a street network while cars are restricted by design, physical barriers and regulations. The concept can effectively design a non-motorised advantage into the built environment, and has been particularly successful in cities like Groningen in the Netherlands. A transformation of residential neighbourhoods themselves - from polluted, dangerous thoroughfares to quality environments directly outside one's front door can - in and of itself - encourage walking and cycling, and discourage driving (Killingsworth et al., 2003).

A number of theorists have placed the blame for our hostile streets on a planning code that fails to distinguish between the necessarily highly-predictable world of the high-speed highway, and the urban places where people live, work, and play (CABE, 2002). The philosophy of 'shared space' provides an alternative, following a logic which was initially heretical for traffic engineers steeped in the doctrine of segregation of different flows and clarity of carriageway priority for greater safety. Yet the available research would seem to indicate that in some circumstances, as a result of reducing priorities the degree of perceived safety reduces but actual safety increases, as a greater degree of care is taken by road users (Hamilton-Baillie, 2004). Shared space in residential streets has been embodied in the development of woonerven or home zones, although they are potentially complex and expensive to deliver as retrofit schemes, and can have negative as well as positive community cohesion outcomes if a full consensus around the specific remodelling is not achieved. (Sherwin, Parkhurst, and Chatterjee, 2006).

Legal and regulatory measures also have an important part to play, given the political limits to introducing economic restraints and the relatively weak effect of voluntary measures. Since 2006,

local authorities in the UK have had the ability to declare a 20mph (approximately 32 km/h) speed limit on built up roads (DfT, 2006) and a former (impractical) requirement that physical measures be used to reduce vehicle speeds to the legal limit has been dropped. Lower speed limits as well as strict liability laws for drivers have been successfully adopted in Netherlands and Scandinavian countries (Whitelegg, 2007). Such measures are seen as essential for the promotion of cycling and walking as at lower speeds the risks of fatality in the event of a collision are dramatically reduced (Table 4).

Table 4: Risk of pedestrian fatality in a vehicle collision by vehicle speed (IIHS 2000)

Vehicle Speed	Risk of Pedestrian Fatality
20 mph	5%
30 mph	45%
40mph	85%

Whilst for most of our residential neighbourhoods retrofitting is the only option, at least where new development is planned then there are opportunities to ensure that the location is well served by public transport, cycling and walking routes so that a car is not a routine daily necessity (Barton, 2003). Employment centres should be located within the existing urban fabric and in close proximity to public transport stops or stations. These types of compact land uses are associated with lower levels of car use, and improved air quality (Frank et al., 2000).

Finally, we note that whilst this article has focused on problems and solutions in the highly industrialised countries, motorisation is developing rapidly in industrialising states. While it is in some senses 'too late' at least for preventative solutions in the industrialised world, considerable opportunities remain to avoid similar mistakes for those states yet to adopt mass car ownership. In all jurisdictions interventions will need to be multifaceted, bespoke for the context, but vigorously pursued, with consensus-building matched with clear leadership. By any account this is a considerable challenge, but perhaps sufficient (if rather too rare) examples exist to confirm it is possible to halt and even reverse the "mutual detriment and significant loss" of car dependence. (Whitelegg, 1997).

Afterword

The authors gratefully acknowledge the pioneering and visionary work of Donald Appleyard, who was, with tragic irony, killed in 1982 by a speeding motorist in Athens, Greece. A much anticipated 2nd edition of *Livable Streets* is expected to be published by Routledge Press in 2011. We also thank the 60 households of north Bristol for their generosity with their time and insights.

References

APPLEYARD, D., 1969. The Environmental Quality of City Streets: The Residents' Viewpoint. *Journal of the American Planning Association*, **35**, 84-101.

APPLEYARD, D., 1980. Streets Can Kill Cities: Third World Beware!." Working Paper 336. Berkeley, CA: Institute of Urban and Regional Development, University of California.

APPLEYARD, D., 1981. *Liveable Streets*. Berkeley: University of California Press.

BARTON H. et al, 2003. *Shaping Neighbourhoods*. London: Spon Press.

BENSON, P., 2002. Adolescent development in social and community context: A program of research. *New Directions for Youth Development*. 2002: 95, 123-148.

BOSSELMANN, P. and MACDONALD, E., 1999. Livable streets revisited. *Journal of the American Planning Association*. 65, No. 2 1999.

CABE, 2002. *Paving the Way: How we achieve clean, safe and attractive streets*. London: CABE.

CALIFORNIA AIR RESOURCES BOARD, 2004. Greenhouse Gases Inventory 2004. Available from: http://www.climatechange.ca.gov/inventory/index.html [accessed 21 December 2010].

CHATTERJEE, K., 2001. *Asymmetric churn - academic jargon or a serious issue for transport planning?* Transport Planning Society. Available from: [http://tps.org.uk].

DfT, 2001. *Planning Policy Guidance 13: Transport*. Available from: http://www.communities.gov.uk/index.asp?id=1144016#P13_304 [accessed 7 January 2007].

DfT, 2006. *DfT Circular 01/2006: Setting Local Speed Limits*. Available from: http://www.dft.gov.uk/pgr/roadsafety/speedmanagement/dftcircular106/ [Accessed 10 April 2008].

DUHME, H., WEILAND, S.K., KEIL, U., KRAEMER, B., SCHMID, M., STENDER, M., CHAMBLES,S. L., 1996. The association between self-reported symptoms of asthma and allergic rhinitis and self-reported traffic density on street of residence in adolescents. *Epidemiology*. 7:578 – 582.

FRANK, L., STONE, B., BACHMAN, W., 2000. Linking land use with household vehicle emissions in the central Puget Sound: methodological framework and findings. *Transportation Research Part D* 5: 173-196.

GANS, H.J., 1962. The Urban Villagers: Group and Class in the Life of Italian-Americans. Free Press of Glencoe, New York.

HAMILTON-BAILLIE, B., 2004. Urban Design: Why Don't We Do It In The Road? Modifying traffic behaviour through legible urban design. *Journal of Urban Technology*, **11** (1), 43-62.

HANSEN, J., SATO, M., KHARECHA, P., BEERLING, D., MASSON-DELMOTTE, V., PAGANI, M., RAYMO, M., ROYER, D., ZACHOS., J. 2008. *Target Atmospheric CO_2: Where Should Humanity Aim?* Available from: http://www.columbia.edu/~jeh1/2008/TargetCO2_20080407.pdf [Accessed 8 April, 2008].

IIHS, 2000. *Insurance Institute for Highway Safety, Status Report 35* (5), May 13, 2000.

IPCC, 2007. *Fourth Assessment Report*. Available from: http://www.ipcc-wg2.org [Accessed 7 August 2007].

KILLINGSWORTH, R., NAZELLE, A., BELL, R., 2003. *A New Role for Public Health in Transportation Creating and Supporting Community Models for Active Transportation*. Chapel

Hill Active Living by Design National Program Office. Chapel Hill: University of North Carolina School of Public Health.

LEYDEN, K., 2003. Social capital and the built environment: The Importance of Walkable Neighbourhoods. *American Journal of Public Health*. September 2003, 93, No. 9.

LITMAN, T., 2003. Regional Transport Issues in North America. In: Whitelegg, J. and Haq, G. (eds.) *World Transport Policy and Practice*. London: Earthscan Publications.

LITMAN, T., 2010. Transportation Cost and Benefit Analysis II – Water Pollution Available from: http://www.vtpi.org/tca/tca0515.pdf [Accessed 19 November 2010].

MELIA, S., 2007. Urban mobility: The 'New Urbanists' may be taking us down the wrong road, Should we seek to build on the Best of European transport and mobility practice. *Town and Country Planning*. Vol. 76, no. 11, 398-400.

PARKHURST, G., KEMP, R., DIJK, M., SHERWIN, H., (2011). Intermodal personal mobility: a niche caught between two regimes. Chapter 15 in Geels, F., Kemp, R., Dudley, G., Lyons, G., (Eds). *Automobility in Transition?* Routledge, Abingdon.

PATTERSON, L., GUTER, D. & MCGOVERN, P., 1988. *Liveable Streets*. Unpublished paper, research methods class (IDS 241) Berkeley: University of California.

PEW RESEARCH CENTER FOR THE PEOPLE AND THE PRESS, 2010. *Distrust, discontent, anger and partisan rancor: The people and their Government. Survey report* [online]. Available from: http://people-press.org/report/606/trust-in-government [Accessed 20 Apr 2010].

PRATT, M., MACERA, C.A., WANG, G., 2000. Higher direct medical costs associated with physical inactivity. *The Physician and Sports Medicine*. 28 (10), 63–70.

SALLIS, J. F., FRANK, L.D., SAELENS, B.E., KRAFT, M.K., 2004. Active transportation and physical activity: opportunities for collaboration on transportation and public health research. *Transportation Research Part A* 38, 249-268.

SATTERTHWAITE, D.,1999. *The Earthscan Reader in Sustainable Cities*. London: Earthscan Publications.

SHERWIN, H., PARKHURST, G., CHATTERJEE, K., (2006). Southville Home Zone: An Independent Evaluation. University of the West of England, Bristol. http://www.transport.uwe.ac.uk/research/projects/southville.asp [accessed 15 December 2010].

SIMPSON, S., 2007. Personal Communication to Traffic Management and the Environment course module, University of the West of England. 3 May 2007.

SOUTHWORTH, M. and BEN-JOSEPH, E., 1997. *Streets and the Shaping of Towns and Cities*. New York: McGraw-Hill.

STEG, L., 2005. Car use: Lust and must: Instrumental, symbolic and affective motives for car use. *Transportation Research Part A*, 39, 147-162.

STEG, L. and GIFFORD, R., 2005. Sustainable transportation and quality of life. *Journal of Transport Geography*, 13, 59-69.

TIMPERIO, A., CRAWFORD, D., TELFORD, A., and SALMON, J., 2004. Perceptions about the local neighbourhood and walking and cycling among children. *Preventive Medicine* 38 (2004) 39-47.

TRANSPORTATION ALTERNATIVES, 2006. *Traffic's Human Toll: A Study of the Impacts of Vehicular Traffic on New York City Residents.* New York: Transportation Alternatives. Available from: http:// www.transalt.org/campaigns/reclaiming/trafficshumantoll.pdf [Accessed 24 January 2008].

UK DEPARTMENT FOR TRANSPORT (2011). Transport Statistics Great Britain 2010 data archive. http://www.dft.gov.uk/pgr/statistics/datatablespublications/tsgb/ [accessed 20 January 2011]

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES, 2000. *Healthy People 2010*. Washington, DC: USDHHS.

WHITELEGG, J., 1997. *Critical Mass: Transport Environment and Society in the 21st Century*. London: Pluto Press.

WHITELEGG, J., 2007. *Integrating sustainability into transport*. Conference presentation at the National Transport Conference, London on 17th October 2007. Available from: http://www.national-transport-conference.org.uk/ [Accessed 10 April 2008].

WHO, 2002. *Estimated deaths & DALYs attributable to selected environmental risk factors*. WHO Member State, 2002.

WHO, 2004. *Global strategy on diet, physical activity and health*. Geneva: World Health Organization.

WHO, 2005. *Experts Consultation on methods of quantifying burden of disease related to environmental noise.* Available from: http://www.euro.who.int/Document/NOH/EDB_mtgrep.pdf [Accessed 10 April 2008].

About the Authors

Joshua Hart is a freelance activist and journalist working on issues related to appropriate technology: sustainable energy and transportation, and health-based wireless policies. He resides in the San Francisco Bay Area Contact email: joshuanoahhart@gmail.com

Graham Parkhurst BA (Hons), MSc, DPhil is Professor of Sustainable Mobility and Director of the Centre for Transport and Society, University of the West of England (UWE). Contact email: graham.parkhurst@uwe.ac.uk

The article is based on work undertaken for a Masters dissertation by Joshua Hart MSc while studying at UWE's Centre for Transport and Society. The full dissertation can be downloaded by following the link from Hart, J., Parkhurst, G., (2011) on the following webpage: http://www.transport.uwe.ac.uk/publications/publications.asp