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This issue marks the start of our third decade of publication and it is appropriate to use this occasion to thank the hundreds of people who have written articles for the journal over the last 20 years and carried out the onerous task of external reviewer and kept us on our toes with comments, criticism and suggestions. I am especially grateful to the support and encouragement I have been given by Eric Britton in France, Helmut Holzapfel in Germany and Paul Tranter in Australia. When I think of this team of wonderful people I know that sustainable transport will very soon migrate from the world of rhetoric to the world of delivery.

I also want to thank Jeff Kenworthy (Curtin University in Australia but now working in Frankfurt) who in addition to sending us a steady flow of truly excellent articles has kept up a running commentary on world events and was instrumental in successfully connecting this journal with a funder and a partner (announced below).

A huge vote of thanks is also due to Rob Clow who converts the material we accept for publication into a high quality final form for loading on our web site.

This issue also marks a very significant change in the way the journal is funded. We are very pleased indeed to announce that we have received a small grant from the Helen and William Mazer Foundation in New Jersey in the USA and have established a link with the "Transportation Choices for Sustainable Communities Research and Policy Institute" (TCSC) in California.

We would like to use this first editorial of 2015 to put on record our thanks to the Helen & William Mazer Foundation. We are very grateful indeed for their financial support.

The journal is very proud of its editorial independence and that continues to be the case but we felt the need for external funding to develop our web site and invest in other technical improvements and that is now in place. Equally we felt the need

to have a link with the US based policy-oriented TCSC to bring a strong North American dimension to our well-established links with European, Indian and Australian organisations. The TCSC mission statement strongly resonates with our own objectives:

*Our aim is to advance understanding and support for sustainable transportation as an essential component of livable communities and cities. The Institute studies and evaluates the ways and means of creating more life-affirming transportation systems and disseminates this information to both the public and decision makers.*

<http://transportchoice.org/>

In this issue we have three articles that all make substantial and fundamental contributions to a better understanding of sustainable transport and evidence-based decision-taking.

Uneb Gazdar and his colleagues in Karachi (Pakistan) reveal a great deal about the state of play in transport choices and transport challenges in a very large, fast growing city in that country. It is very important indeed that the very special geographical, cultural and decision-making contexts of cities like Karachi are explored and linked to transport problems and solutions in the same way that this paper has achieved. Karachi is large, fast-growing, unplanned and subject to very serious traffic safety problems. All these problems are solvable but require a step change in the quality and quantity of pedestrian, cycling and public transport facilities and like many other mega cities Karachi has still not managed to make this step change.

Karel Martens and his colleagues in the Netherlands take a new approach to car sharing and in addition to reviewing the many benefits of shifting personally owned vehicle use to shared use show that increasing the supply of car share vehicles can increase the use made of them even in areas where the car share idea is already well-established. This is important because yet again it shows that the poten-

tial for behavioural change towards sustainable modes is much bigger than many decision-takers assume. We can only hope that one day the concept of large scale behavioural change will take root in the priorities of decision-takers so we can look forward to an urban area functioning very well indeed on a 90-10 pattern (90% of all trips every day by bike, on foot, public transport and car share and 10% by the personally owned vehicle).

Chris Gilham and Chris Rissel in Australia report on a detailed statistical study of cycling rates, fatalities and injuries amongst young cyclists in the USA. The analysis goes to the heart of the global debate about compulsory helmet wearing and the degree to which it contributes to public health outcomes/does not assist in achieving public health gains. The decline in cycling participation rates for children aged 7-17 in the period 1995-2012 is very worrying indeed when there is a global recognition that increased cycling rates have so much to offer to the health of cyclists, reductions in pollutants and greenhouse gases as transport choices switch away from the car to the bike and reduced congestion. The authors conclude that compulsory helmet wearing may have contributed to decreased cycling rates "without improvements in cycling safety at a population level". This is a very important public policy contribution given the desire of many jurisdictions to "solve" cycling safety problems by focussing on quick fixes rather than by addressing the fundamental problems of reducing traffic volume, reducing traffic speed, high quality infrastructure and enforcement to eliminate anti-social driving behaviour.

The flow of high quality material supporting and promoting a shift in political and funding priorities towards sustainable transport continues unabated as does the flow of truly crass decisions about national transport priorities and funding that lack intelligence, vision and concern for future generations. Recent events in the UK continue to mark out the steady decline in the quality of public decision-taking and an increase in the importance of ideology and the ability to ignore evidence. The decision to spend £15 billion on increases in road capacity<sup>1</sup> flies in the face of many

years of careful research and evidence-building that shows the futility of such policies when compared to policies that shift the system in the direction of the 90-10 future.

John Whitelegg  
Editor

<sup>1</sup> <http://www.bettertransport.org.uk/campaigners-respond-autumn-statement>

**Transport Issues in Karachi: Recommendations for Public Transport System**

*Uneb Gazdar, Mir Shabbar Alia, Raza Ali Khanb*

**Abstract:** Karachi has experienced major surges in population due to the migration of people and urbanization. This growth in population has not been complemented with appropriate planning, which has been evident in the transportation sector as well. This paper discussed in detail the current situation of public transport in the city. The outcome of this research consists of identification of major problem areas and recommendations to be adapted for integrated improvement of the transportation system in light of various surveys and studies.

**Key Words:** Public transport, Karachi, Policy

**Broadening the market for carshare? Results of a pilot project in the Netherlands**

*Karel Martens, William Sierzchula, Sander Pasma*

**Abstract:** This paper describes a pilot project consisting of a substantial increase in the number of carshare vehicles in a neighborhood in the city of Nijmegen, the Netherlands. The goal was to explore, first, the impact on the demand for carshare services and, second, the impact on the socio-economic composition of the new carshare members. The results show a substantial increase in the number of carshare members, but little proof for the diversification hypothesis. While households interested in carshare membership had a different socio-economic profile than existing carshare members, the households that eventually became carshare members more closely resembled the existing members.

**Key Words:** carshare, supply-side approach, diversification, experiment, the Netherlands

**Children’s cycling participation, injuries, fatalities and helmet legislation in the United States**

*Gillham C, Rissel C*

**Abstract:** Studies of child and teenage cyclist injury rates in the United States (US) consistently report a downturn since mandatory bicycle helmet laws were introduced in various states and municipalities during the 1990s and progressively since. However, the decrease in children’s injury rates may be related to decreases in children’s cycling participation. This study examines US children’s cycling participation since 1995, children’s injuries and concussion injuries and, as a proxy for injuries, children’s cycling fatalities by states with bicycle helmet laws and those without. Data examined are publicly available and include the US Census Bureau report on Participation in Selected Sports Activities, the US Consumer Product Safety Commission National Electronic Injury Surveillance System, and the National Highway Traffic Safety Administration’s Fatality Analysis Reporting System.

Cycling participation by children aged 7-17 years declined significantly from 1995 to 2012, which was matched by a decline in all-body injuries. Concussion injuries did not decline despite some form of helmet legislation being gradually introduced for children in 45% of jurisdictions across the US. There was no reduction in cycling fatalities among children in those states with helmet laws compared with those without such laws. Helmet legislation may have contributed to the decline in children’s cycling participation over time, but without improvements in cycling safety at a population level.

**Keywords:** Cycling, bicycle helmet, legislation, children, injury

## Transport Issues in Karachi: Recommendations for Public Transport System

Uneb Gazdar, Mir Shabbar Alia, Raza Ali Khanb

### 1. Introduction

Karachi was the first capital of Pakistan and consequently the centre of government employment. After independence and during Afghan war, a major surge of migrants have come from India and Afghanistan respectively. During the decade of 1980, one million people from neighbouring countries including Bangladesh, Afghanistan and Burma, have migrated to Karachi. There has been no regularization or restriction for migrants and refugees in the city.

Karachi is the industrial, commercial and economic hub of Pakistan. Karachi hosts 9% of national population, contributes 20% to national GDP, 53% federal revenues and controls 30% of Pakistan's manufacturing. Due to the escalating commercial and industrial activities in the city, it has also attracted people from rural areas to come and search for their livelihood. Almost half of the population growth of the city is due to migration of people from other parts of the country [Qureshi et. al., 2008].

Due to the above mentioned factors, Karachi is characterized by an accelerating rate of suburban growth as shown in Table 1. The population growth rate in Karachi has been phenomenal and estimated to be around 5–6% annually. The city has seen a 35-fold increase in its population and expanded by almost 16 times spatially since the independence of Pakistan. This expansion

rate is much faster than any other city in the neighbouring region. Moreover, it is forecasted that by the year 2015 that the city may reach a population of 19.2 million estimated with an annual growth rate of over 5%.

Rapid population growth and spatial expansion have led to a sharp increase in demand for urban transport facilities and services. Unfortunately, this growth has not been complemented with appropriate planning strategies. Since 1949 five development plans have been prepared for Karachi, but none of them were fully implemented. For example, during 1960s a Greater Karachi Resettlement Plan (GKRP) was proposed with the aim to construct the refugee colonies away from the city centre with the job creation in the new industrial estate. But neither the industrialization took place nor were the houses and jobs provided as planned, so refugees and migrants started settling into the squatters settlements inside and outside the city.

As a consequence the city suffers from a chronic shortage of basic facilities including public transport. The available public transport system is focused to serve central areas of the city. Whereas citizens living in peripheral slums are captive riders of limited and low level public transport service and have limited accessibility [Qureshi et. al., 2007, 2008]. This situation also creates social imbalance in the society due to lack of opportunities for the all the citizens on equal basis [Ahmed et al., 2008].

Dependence on cars and motorcycles due to poor public transport system tends to increase traffic volume resulting in higher

Year	Population (Millions)	Area (Km <sup>2</sup> )
1947	0.4	233
1981	5.3	1994
1998	9.8	3527
2004	14.0	3566

**Table 1: Expansion in Area and Population of Karachi**

environmental degradation and accident rates. The noise and pollution levels in the city are more than the national and international standards [Qureshi et. al., 2007]. A significant portion of the road accidents are fatal and involve children of age 15 or less [Razzak et al., 2004; Raza et al., 2013].

This paper discusses the factors leading to the current dismal situation of general road transport, with special emphasis on public transport. The strategies planned to rectify the situation are also presented alongwith their progress. In the end, potential steps and strategy to improve the present system of public transport are recommended. The rest of the paper is organized as follows. Section 2 discusses in detail the current issues related to transportation in the city. Section 3 presents the results of a road users' survey to include their perspective of the current situation in to analysis. Section 4 presents conclusions and recommendation based upon the review of present situation and past strategies and travellers' surveys.

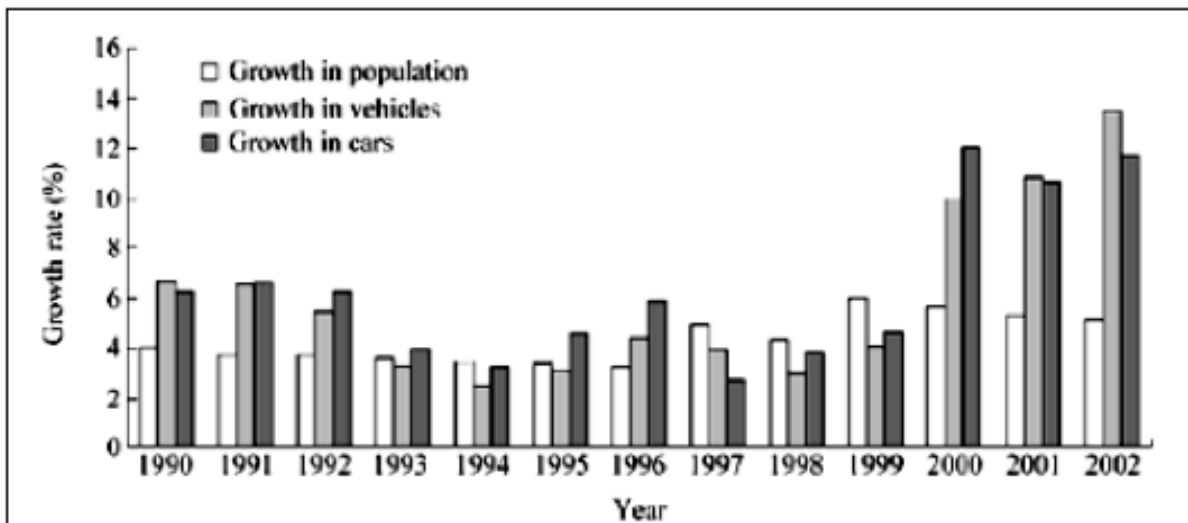
## 2. Situation of Transportation System in Karachi

The increased urbanization and economic growth in Karachi has put a tremendous pressure on travel demands. About 33% of all motorized vehicles in the country operate in this city, which has resulted in capacity conditions on its roadways. At the time of independence of Pakistan, only rich people had their own cars. The general

public used non-motorized vehicle (Horse-Driven carriages) and Trams for their conveyance. With the increase in public and private vehicles on the road, role of non-motorized vehicles for travel have become almost negligible except for recreational purposes. The Tram system was abolished in 1970s when Karachi Circular Railway became fully functional [Imran, 2009].

Since 1999, after the seizure of Karachi Circular Railway service, urban transport system in the city is mainly dependent upon road-based vehicles. Recently, KCR has been partially revitalized but no recent statistics have been released about its percentage of rides. Karachi owns 7400 km of road network with a density of 207 km road length per 100 km<sup>2</sup> of area. This limited road space combined with poor maintenance, bad quality construction, and absence of essential support functions create problems in satisfying the travellers' demands. The road capacity is also constrained due to encroachments by on-street parking. For the development of signal free corridors, a number of access points to city centre have been closed which has aggravated the jam conditions on the existing collector roads.

Figure 1 shows that from 1990 to 2002 the total registered vehicles and cars were growing at twice the growth rate of population. This rapid rise in personal vehicle ownership without any restrictions, such as charged parking and road pricing, has led to enormous congestion especially in the central part of the city. Consequently,



**Fig.1: Growth rate of Population, vehicles and cars in Karachi**

the average commute travel time to the city centre is increased by a significant amount [Qureshi et. al., 2007]. The proceeding subsections present the current situation of Karachi transport with the strategies intended to affect it.

**2.1 Societal Effects**

It is evident from the examples of developed cities of the world; high levels of automobile use bring large social and environmental costs which mainly originate due to increased congestion on the roads. The same situation can be observed in Karachi as well and these problems are aggravated further for the suburban population which keeps on increasing with expansion of city [Newman, 1996; Kutzbach, 2009]. Road accidents and environmental degradation are commonly observed phenomena in this situation.

From 1993 to 1996, 80% of the injuries to children of 15 years or less were caused due to motor-vehicle crashes [Razzak et al., 2004]. The severity of the road accidents has also been an issue of concern. It has been observed that during 2010-11, above 37% of the road accidents were fatal [Raza et al., 2013]. Major reasons behind the road accidents are poor management of traffic and pedestrian movement, road encroachments and presence of different types of vehicles on the road (Uddin 2008). This situation will improve if better public transport facilities are pro-

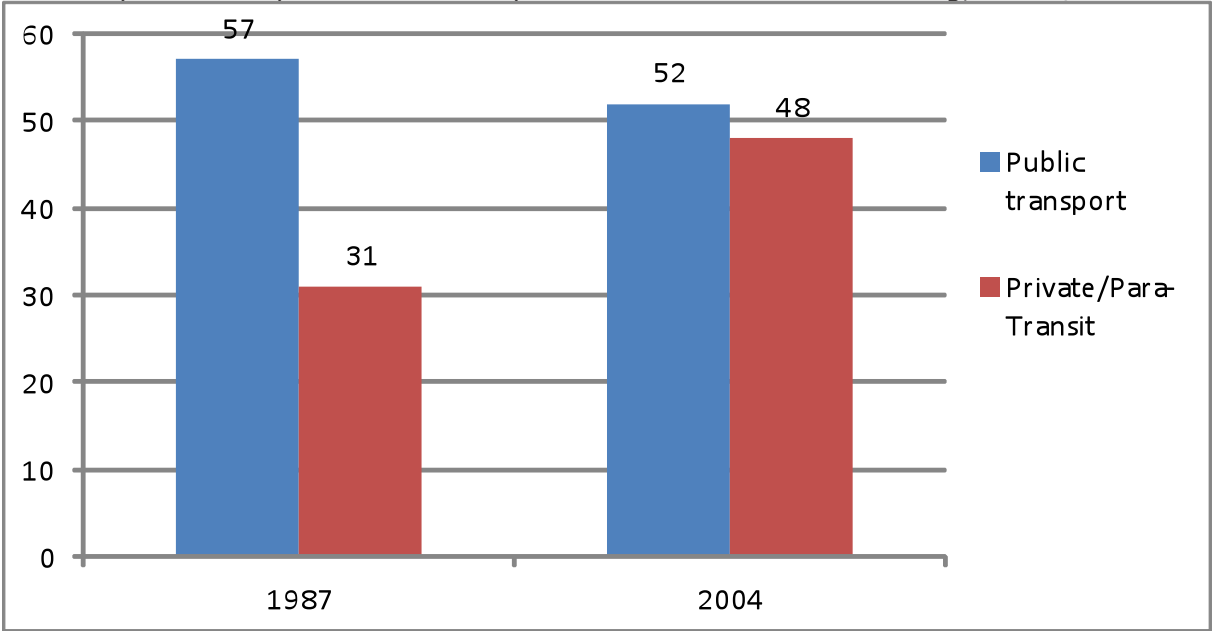
vided. It will reduce the number vehicles on the roads and in turn reduce chances of accidents.

High levels of vehicular traffic and road congestion also affect the environmental conditions in the form of pollution as well as elevated noise levels. The noise recorded for Karachi in the year 2003-04 was 99 decibels which is much higher than the National Environmental Quality Standards (NEQS) of 85 decibels. Moreover, pollution indices such as; total suspended particulate matters and particulate matters also exceed the international standards of US Environmental Protection Agency (USEPA) [Qureshi et. al., 2007; Uddin 2008].

**2.2 Modal Split**

The transport needs of a city largely depend on the travel behaviour of the citizens.

Figure 2 shows the modal shares extracted from two surveys carried out in 1987 and 2004 by the Traffic Engineering Bureau of Karachi. It should be noted that 1987 data also contained the walking/cycling data which was not available for year 2004. Thereby the modal share comparison is only presented for motorized transport [Qureshi and Huapu, 2007]. Although the trips made by private and para-transit vehicles are increasing, buses/minibuses



**Fig. 2: Trend of Modal Split**



still continue to provide over 50% of the travel demand. Therefore, the buses/mini-buses constitute an important mode of public transport for a large population of Karachi. This share is expected to increase due to the recent inflation in prices and shortfall of energy including petrol and Compressed Natural Gas (CNG). Hence, better transport management strategies, and fare policies can help in improving the service to a major portion of the city travellers [Imran, 2009].

**2.3 Public Transport**

The road-based public transport system in Karachi is mostly in the hands of the private sector with very little public sector influence. In fact, they have very strong coordination among themselves and influence the government’s decisions regarding fares and routes [Sohail and Maunder, 2007]. The existing public transport system capacity is insufficient for the increasing travel demand. This is evident from the fact that public transport system constitutes only 2% of the total vehicle fleet. Unlike other countries like Singapore and England, public transport receives no preferential treatment in terms of dedicated lanes and/or traffic management. As shown in table 2, all the routes specified for public transport are not functional, which shows lack of coordination between planning and implementation. Majority of Karachi’s public transport (81%) is comprised of low capacity (27/32 passenger’s carrying capacity) minibuses/ coaches. The ratio of available seat capacity on public transport to the population in Karachi is 1:40 as compared to 1:12 in Mumbai and 1:8 in Hong Kong. This deficiency compels

the commuters to travel in overcrowded vehicles, exposing themselves to serious hazards by travelling on footboards, roof-tops, and rear guards of the vehicles.

Karachi is the only mega city in the world without a rail based mass transit system. The KCR, which acted as a suburban railway system, started its operation in 1964. It served as a cheap and reliable alternative mode of public transport for the low-income and middle-income groups of the city. Until 1978, approximately 300,000 commuters travelled on KCR every day. The deterioration of the KCR services reportedly began in 1979. The negligence of successive governments in maintaining infrastructure and operations of the KCR system was the main reason for declining numbers of riders. The Pakistan Railway record shows that the daily trip frequency taken by KCR dropped from 104 in 1970s to only 1 in 1999, which caused the operation to cease as the operation of the system was deemed infeasible. At that time, total losses exceeded Rupees 6 million (US\$ 0.104 million) per-annum [Haque et. al., 2011, Qureshi et. al., 2007]. Although, plans have been made to revitalize this system but no progress has shown until now.

**2.4 Recent Development Projects**

As stated earlier, the initial development of Karachi was haphazard with very little reactive planning. Recently, more emphasis has been made to complement the growth of the city with comprehensive planning. This trend has mainly initiated due to the involvement of international funding agencies like International Monetary Fund (IMF) and Asian Development Bank (ADB)

Modes	Number of On-Road Vehicles	Routes	
		Classified	Operational
Buses	2300	110	48
Minibuses	6284	197	104
Coaches	3562	96	67
Total	12146	403	403

**Table 2: Public Transport Vehicles and Routes**

in the public development projects. There have been a number of projects proposed for improving the transportation system of Karachi city. These projects include expansion of existing road networks as well as the public transport capacity as part of the "Karachi Strategic Plan 2020" [Imran, 2009]. The progress of the projects under this plan is discussed in the following subsections.

### 2.4.1 Urban Bus Transport Scheme

The urban bus transport scheme proposed a strategy to revamp the road-based public transport system in the city by replacing the mini buses with large buses operating on CNG. Initially, more than 300 large capacity buses were deployed on the roads in 2007-08 and 8000 buses were to be added to the system later on. The project is aimed to mitigate the issues of severe overcrowding, congestion, deteriorating service, and environmental pollution associated with the existing system.

### 2.4.2 Lyari Expressway and Northern Bypass

Presently, major portion of goods is transported by trucks due to lack of reliable service by Pakistan railway. This puts extra pressure of heavy traffic on urban arterials of Karachi. In order to avoid heavy traffic from upcountry or port area to come on the local arterials, two elevated express-

ways were proposed. The construction of the 32.1 km long 4 lane Lyari expressway and the 57 km long 6 lane Northern bypass is planned to divert heavy upcountry traffic outside the city [Haque et. al., 2011]. These projects are hoped to ease traffic pressure in the city and will give a much cleaner and pleasant environment to the inhabitants of the city.

### 2.4.3 Mass Rapid Transit (MRT)

A rail-based mass transit master plan has been proposed identifying three corridors with the revival of the KCR as an integral part of the system. Figure 3 shows the proposed corridors, Corridor 1 that runs northeast and southwest will be constructed in two stages. Stage one is a 15.2-km route which will have some elevated and some underground portions, stage two is to extend the system for further 8 km. Corridor 2 will have a 13.4-km line along the north and south axis of the city. The KCR line is planned to be revitalized for 50 km of length to serve for this system.

### 2.4.4 Progress

So far, partial progress has been made for the road based options i.e. CNG bus system, signal free corridors and expressways. In spite of allocating Rs.5 billion (US\$ 83.3 million) for CNG bus scheme, it is still not fully functional. Presently these buses are operating on only 6 classified

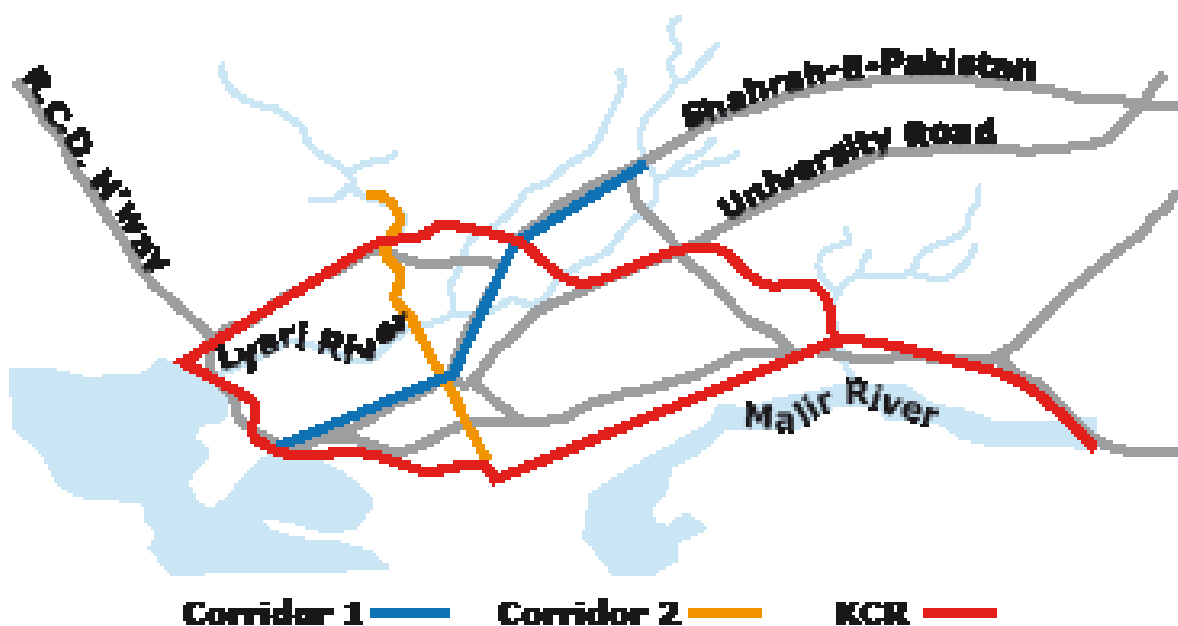


Fig. 3: Proposed Corridors for MRT

routes [Karachi Metropolitan Corporation, 2014]. The problems for operations of these buses have compounded due to the current shortfall of CNG in Pakistan. In this situation the feasibility of this scheme looks further doubtful (Zulfiqar, 2014). More than 50 % length of Lyari expressway has been completed and the rest is expected to be completed by December 2014 [Uddin 2013], while Northern bypass is almost complete [Urban Resource Centre 2014].

Lyari expressway has been opened for traffic in selected segments for one or two-way traffic. But, MRT option which could prove to be the cheapest and fastest mode for low to middle income groups of the society is still to be initiated physically [Qureshi et. al., 2007]. However, this project has regained life in December 2013 after the involvement of ADB. The actual construction is hoped to start soon with the first review planned in July 2015 [Asian Development Bank, 2014].

The current modernization of the transport infrastructure will provide no more than temporary relief. The experience of other mega cities like Beijing suggests that expansion of road network induces more traffic on the roads in the long run. This approach by city administrations, to focus on road network expansion, also creates scarcity of resources for public transport projects. A more sustainable solution is the improvement of public transport system, which would reduce congestion on the roads and provide cheap and efficient mode of travel [Imran, 2009; Salman and Qureshi, 2009].

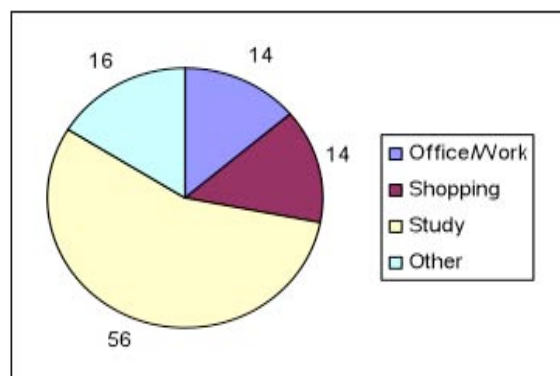
Public-private partnership (PPP) is an efficient way to carry out public transport projects in conjunction with road expansion projects in spite of the limited resources of public sector. This approach will assure a comprehensive improvement for the transport system of the city. PPPs have been implemented in other developing countries of the region like India and China; where they have resulted in effective and innovative improvements. A successful model with public-private partnership in Pakistan is implemented by Faisalabad Urban Transport Society (FUTS) [Sohail et. al., 2004; Willoughby, 2013].

### 3. Users' Perspective (Survey Analyses)

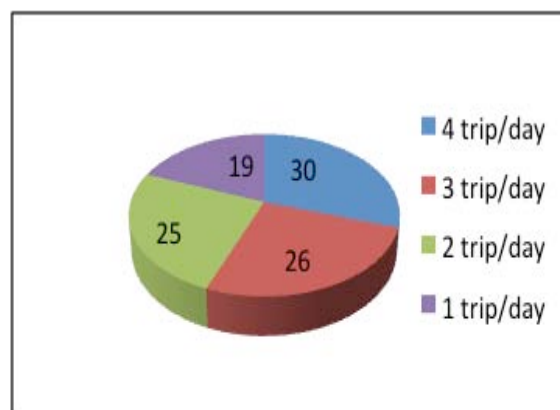
To include travellers' perspective in to our analysis, a survey was conducted as part of study by Khan et al., (2010). Respondents were asked regarding their usage and expenditure of public transport. Roadside interviews were conducted by the students using a questionnaire. The accuracy and relevance of the questionnaire was assured by conducting a pilot survey. The results of the survey are discussed in the following sub-sections.

#### 3.1 Purpose of Trip

As shown in figure 4, most of the respondents were using the transport service for their routine activities including study and work. Moreover, majority of travellers were taking more than 1 trip per day (as shown in figure 5). It points to the fact that the users are highly dependent upon the use of public transport in their daily life and good quality of public transport is important for their efficiency.



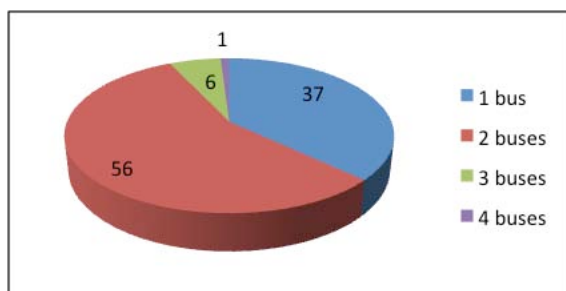
**Fig. 4: Purpose of Trip on Public Transport**



**Fig. 5: No. of Trips Taken per Day**

### 3.2 No. of Buses to Reach Destination

Figure 6 shows that more than 60% of the people have to use more than 1 bus to reach their destination. It shows that appropriate routes are not available for the people to directly reach their destinations. This point was also evident from the fact that all the classified routes are not operational as mentioned in section 2.2.



**Fig. 6: No. of Buses to Reach Destination**

### 3.3 Average Time to Reach to Destination

Table 3 shows the average time from all towns of Karachi to NED University and the average speed comes out to be approx. 18.67Km/hr. This speed value is less than speeds expected on arterials and collectors, which is evident of the congestion problems on the roads of city.

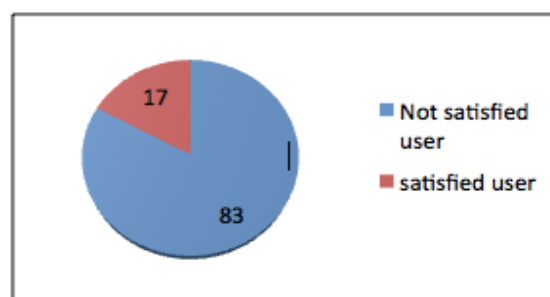
NAME	Road Distance (KM)	AVG TIME	NAME	Road Distance	AVG TIME
Sadar Town	14	47	Bin Qasim Town	35	82
Malir Town	15	46	Shah Faisal Town	9	50
New Karachi Town	11	49	Gadap Town	20	50
Nazimabad Town	9	40	Malir Cantonment	NA	NA
Baldia Town	23	71	Cantt Bazar	4	20
Landhi Town	20	NA	Korangi Town	25	63
Gulberg Town	7	33	Clifton Cantonment	24	46
Gulshan-e-Iqbal	5	17	Kemari Town	19	0
Jamshed Town	12	44	Orangi Town	17	78
Layari Town	17	67	SITE Town	15	90
Liaquatabad Town	11	43			

**Table 3: Average Actual Time to Reach Destination**

prox. 18.67Km/hr. This speed value is less than speeds expected on arterials and collectors, which is evident of the congestion problems on the roads of city.

### 3.4 Level of Satisfaction

The respondents were asked whether they were satisfied with the current public transport system or not. Figure 7 shows a clear discontent of people towards the quality of bus service and fare. The reasons for which are evident from above statistics as well, they are also discussed in detail in the next section.



**Fig. 7: Satisfaction Level of Users**

### 3.5 Reasons of Dissatisfaction: Stakeholders' Survey

Any recommendation or proposal cannot be deemed viable without the input from stakeholders. Stakeholders of transportation sector comprise of government transportation and planning agencies, traffic police, hospitals, industrial and commercial centres, educational institution and everyday commuters [Sohail et. al., 2006; Sohail and Maunder, 2007]. In this section, results of a stakeholders' survey are presented which was conducted as part of a research effort by Ali et al. (2010). Stakeholders were surveyed through a questionnaire to identify, understand and prioritize current traffic flow problems. These results point out the main reasons of dissatisfaction of users from overall transportation system of Karachi.

In this survey stakeholder were asked to rank different traffic related problems on a scale of 1 to 3 (1 = least important, 3 =

most important). These problem areas and their sub-categories were identified and categorized through literature review and pilot surveys. Among other problem area, the issues related to the public transport are listed in table 4 alongwith their average importance indices.

The main factors of concern for the stakeholders are in-effective enforcement of traffic and vehicle inspection laws, encroachment of road space by parking vehicles, inefficient management of resources and ill-maintained roads. In addition to that, high fare level, long delays and insufficient capacity have also been mentioned in other studies as the reasons of dissatisfaction for Karachi travellers [Haque et. al., 2011; Imran, 2009].

### 4. Conclusions and Recommendations

The unplanned nature of development in Karachi has also been evident in the transportation sector. The increase in car

S. No.	Traffic Related Problem Areas	Importance Index
1	Over speeding; not following traffic rules and/or traffic control devices	2.95
2	Illegal parking practices, inadequate traffic parking sites, need of multistoried parking structures	2.90
4	Effective use of resources and setting priorities	2.86
8	Pot holes, bumps, poor drainage, cuts	2.83
9	Traffic congestion and gridlock sites identification	2.76
14	Deploying bus rapid transit(BRT) using CNG buses on dedicated bus lanes and routes with good Light Rail Transit (LRT) transfer connectivity	2.74
16	Adapting light rail transit on circular railway route and additional radiating branches with good bus transfer facilities	2.71
18	Upgrading and enforcing vehicle inspection and emission testing regulations	2.71
19	Over-crowding in vehicles, lack of safety restraints	2.69
20	Poor communications within agencies, among agencies, and with the public	2.69
21	Establishing vehicle regulations to phase out all defective and polluting vehicles older than 15 years	2.67

**Table 4: Importance Indices for Traffic Flow Problems**

ownership has increased at twice the rate as growth in population which puts more pressure on the road of Karachi. This situation results in environmental and safety concerns for travellers and inhabitants in general. Unfortunately, Karachi is facing problems in both these areas with high noise and pollution levels and significant proportion of fatal accidents. The reasons for most of the crashes are mismanagement of traffic, encroachment of road space and presence of different types of vehicles on the road. However, these factors can be controlled by providing better quality of public transport of sufficient capacity. It will reduce the number of different types of vehicles on the road which will be easier to manage. Moreover, public transport travellers will not require parking spaces that will reduce encroachment of road space.

In order to achieve this, public transport buses should be inspected regularly and ill-maintained buses should be removed from the roads. Another step in this direction would be to expand the network of larger buses which are presently operating on limited routes. In this regard, presently operating bus transport companies should be subsidized to replace their mini-buses with these buses. But Compressed Natural Gas (CNG) may not be feasible for successful operation of these buses due to its shortfall. This partnership of government and private sector would work more effectively and efficiently instead of establishing a new transport system solely operated by the government.

Due to the exponential spatial growth of the city, the current bus system does not provide access to all the travellers adequately. Hence, the current bus routes have to be regularized and expanded to reach all parts of the city including the suburban areas.

Other actions that will mitigate transport related issues of Karachi are full operation of Lyari expressway and Northern bypass and Mass Rapid Transit (MRT) system. But these projects have faced large delays since their inception. These delays could be attributed to the time-consuming nature and limited resources of public sector. Therefore, it is recommended to use

the framework of Public-Private Partnership (PPP) which has been successfully employed in other projects nationally and internationally. It is expected that after these projects have become operational, the traffic will reduce on the roads. Consequently the overall transport situation of the city will improve addressing many concerns indicated by the travellers in surveys. MRT system can be initiated soon by revitalization of Karachi Circular Railway (KCR) which will provide short-term relief to the citizens. Moreover, it will also help in analyzing the attractiveness of the new mode for the city travellers.

The law and order situation in Karachi has worsened in the recent years, which hampers the progress of any project in the city. Hence it is important to take care of this issue for overall development and growth of the city.

Provision of recent traveller and traffic data is also important for effective development and implementation of any transportation plan. The surveys, presented in this study, were helpful in investigating the reasons for current transportation situation of the city and recommending solutions for it. However, more recent and updated surveys on these issues would have been more effective to accurately comprehend the situation. Hence it is recommended to conduct such surveys on periodic basis to ensure community involvement in development of the city. This practice has been adopted internationally including in USA and European countries.

Another challenge is the inherent nature of the public sector which is time-consuming and does not encourage innovative thinking. This system has caused delays to important projects such as MRT. Hence restructuring the existing transport administrative system should be prioritized.

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## **Broadening the market for carshare? Results of a pilot project in the Netherlands**

*Karel Martens, William Sierzchula, Sander Pasma*

### **1. Introduction**

Carshare is a relatively new transport service in which different individuals become members of a club or a commercial service provider and make use of a shared pool of vehicles. Over the past decade, the number of cities with carshare services has grown substantially (Huyer, 2004). Much of the growth has been incremental in nature: carshare companies have expanded the number of vehicles in response to an increase in demand, usually on a one-by-one basis. In other cases, organizations have more aggressively entered the market, placing a number of vehicles in neighborhoods previously not served, in hope of generating demand for the service (Lane, 2005).

In this paper, we report on a pilot project in which a different approach has been applied. The pilot project consisted of a substantial increase in the number of vehicles in a neighborhood with existing carshare services. The goal of this project, carried out in Nijmegen, a medium-sized city in the Netherlands, had several different aspects. First, the project aimed to show that increased supply could generate additional demand. It assumed a significant level of unrealized demand for carshare services in a target area and tried to develop that potential. The pilot intentionally increased the supply above the demonstrated demand and expected to see a proportional membership uptake. This approach is in contrast to an incremental style of adding one vehicle when warranted by a proven increase in demand. Second, the pilot explored whether it is possible to attract users with a different profile than those of the existing car share users. While carshare businesses often try to bring in early adopters or members who fit an established profile, expanding membership in an already-serviced area entails diversifying the target market and successfully engaging individuals who were not previously interested in the service. Carshare experts expect growth in nontraditional carshare markets such as among groups with lower

socio-economic demographics (Shaheen & Cohen 2007). We will use the data generated in this project to examine the prevalence of low-income households as both potential and actual carshare members. Finally, this study seeks to help understand the decision process of potential carshare members as they determine whether or not to become a subscriber. Such an analysis is useful for carshare operators as they seek to develop the most effective programs for attracting new members.

From a scientific perspective, the pilot project also adds to the – still limited – body of literature on carshare. There are two common approaches to carshare research. One uses (stated-preference) surveys of carshare members (e.g, Momo, 2010; Zhou, & Kockelman, 2011; Zheng et al., 2009; Millard-Ball et al., 2005; Burkhardt & Millard-Ball, 2006). These efforts provide a picture of the demographics of existing carshare users or a profile of potential users in an area without carshare services. A second line of research follows pilot projects as they bring carshare service to a community (Shaheen & Rodier, 2005; Shaheen & Novick, 2005; Cervero, 2003; Lane, 2005). Those studies focus on the impact of the new service: the number of users, their demographic profiles, travel behavior, and attitudes toward transportation. This paper adds to the carshare body of literature by comparing the profile of potential members – those respondents that indicated an interest in carshare services – to the profile of new members. To this purpose, a survey was carried out among area residents at the beginning and end of the project in order to identify characteristics of both potential subscribers and the households that actually became carshare members (see below). This analysis provides additional information regarding the possible diversification of carshare users in the future.

Note that the crucial assumption of the approach in the pilot project is that carshare services can realize latent demand through increased supply and a marketing campaign. If this assumption is incorrect or if the supposed demand does not exist, this approach will be wasteful of both time and money. On the other hand, if the project proves successful, it

may provide a new way for carshare companies to expand their market share in already served neighborhoods and possibly also to attract a new type of user. The project findings are therefore of relevance for carshare companies and local authorities interested in expanding the number of carshare users in cities.

The paper is organized as follows. The following section is a background on carshare, including a brief overview of the environmental and societal benefits (Section 2). Section 3 provides a detailed description of the pilot project including a description of the accompanying marketing campaign and of the scientific surveys carried out as part of the project. Section 4 presents the results from both the surveys and the pilot project as a whole. The paper wraps up the findings in a brief concluding section (Section 5).

## **2. Background of carshare**

Carshare offers members access to a fleet of vehicles on a paid basis according to a period of use. The number of carshare members has expanded globally over the last ten years, but it still represents a peripheral mode of transportation. According to research, carshare is mostly unknown to the public as a transportation option (Loose, Mohr & Nobis, 2006, Nobis, 2006). In 2006, carshare included approximately 348,000 members and 11,700 vehicles around the world with most of those located in Europe (Shaheen & Cohen, 2007).

The societal benefits of carshare are numerous and well documented. It lowers emissions, decreases vehicle miles traveled, and reduces congestion and traffic (Cervero, Golub & Nee, 2007; Lane, 2005; Shaheen, Cohen & Chung, 2009; Steininger, Vogl, & Zettl, 1996; Loose, Mohr & Nobis, 2006). In contrasting research, Cervero (2003) and Katzev (2003) found carshare to induce car usage among some new members who did not own a vehicle. Additional studies found that decreased auto usage of other members more than outweighs this impact (Cervero & Tsai, 2004). Researchers have found that every carshare vehicle replaces between 4.5 and 20 vehicles (Shaheen, Cohen & Chung, 2009). This decrease in the number of cars helps alleviate traffic, congestion and parking is-

ues. With fewer total vehicles, the space required for parked cars decreases by up to 44% (Meijkamp, 1998). Area previously used for parking is available for other land uses such as green space, commercial development or residential housing.

Individual carshare benefits include a healthier lifestyle for carshare members and increased accessibility for formerly carless households (Shaheen, Cohen & Chung, 2009). In the US, 12% - 54% of carshare members walk more and 10% bike more since joining a carshare company. Carshare increases accessibility to members by extending benefits of auto transportation to non-owners (Cervero, Golub & Nee, 2007). Benefits include allowing members the ability to get to destinations not easily accessed through other available means of transportation (i.e. walking, biking, train, taxi), such as out-of-town shopping centers, natural areas and rural towns.

## **3. Description of pilot project set-up**

The pilot project carried out in Nijmegen represents the intersection of academic, municipal and business interests. Business and municipal entities promote the expansion of carshare programs for financial gain and/or social benefit. Academically, this pilot allowed researchers a chance to study who is interested in carshare and why. This project analyzes the response of demand for carshare services after increasing vehicle supply and implementing a targeted marketing campaign. The pilot did not include a control, so it is impossible to know how much carshare membership would have expanded in the study area without the influence of the pilot project and its associated marketing strategy.

A common way for organizations to expand the number of vehicles in an area is to do so one at a time as is warranted by demand. Such an approach leads to small and incremental gains in membership rates. By increasing the number of vehicles in an area by a large proportion (from 9 to 17 vehicles or 88%), pilot partners hoped for a relatively large increase in demonstrated demand and memberships. This approach attempts to understand whether a latent demand for carshare exists, and to what extent an organization can use this demand to increase member-



**Figure 1: Location of the pilot town Nijmegen in the Netherlands**

ship rates in areas that already have a customer base. This project is different from other pilot research in that it focuses on expanding instead of beginning carshare service in a community. Having surveys before and after the pilot project provided the opportunity for comparison between potential, new and existing carshare members, as well as households not interested in carshare services. Survey responses enabled researchers to study who was attracted to carshare (due to the marketing campaign or other reasons), and how successful the pilot was at encouraging those individuals to become carshare members.

#### *Project Area*

The pilot project took place in the Nijmegen-East neighborhood from April to December 2009 (figure 2). Pilot partners included the carshare organization Greenwheels, the Radboud University Nijmegen, and the Nijmegen municipality. Greenwheels is a Dutch carshare corporation that started in Rotterdam in 1995. In 2010, there were Greenwheels vehicles in over 60 cities and 1,000 locations, mostly in the Netherlands and Germany (Trouw, 2010). In this pilot project, Greenwheels provided the vehicles and was responsible for the overall marketing strategy and implementation. The university was



**Figure 2: Location of the study area Nijmegen-East vis-à-vis the city center**

responsible for carrying out the surveys and analyzing the resulting data. Nijmegen municipality provided parking spaces and helped with the marketing effort.

When selecting a project area, the initiators of the pilot were looking for a community with an existing carshare base where expansion of membership could be successful. When the project began, Nijmegen-East had 172 Greenwheels members, nine carshare vehicles and several characteristics that correlate strongly with carshare success. These characteristics include dense mixed-use development, a shortage of available parking and good access to public transportation through bus and train service (Millard-Ball et al., 2005; Andrew & Douma, 2006). In 2009, the neighborhood had a population of 15,230 residents with a density of 8,448 people per sq. kilometer. For comparison, in 2009 the city of Ni-

jmegen had a population of approximately 162,000 with a density of 3,005 individuals per square kilometer (CBS, 2010).

#### *Initial Phase*

The marketing effort began in late March 2009 with a teaser campaign of eight vehicles wrapped in bright plastic placed throughout Nijmegen-East. The purpose of these vehicles was to draw attention to the new pilot project and the expanded supply of carshare autos. Additional automobiles enhance carshare service in multiple ways. With more vehicles spread across a neighborhood, the average distance between member and vehicle decreases, meaning the user does not have to walk as far to access an automobile. Furthermore, it reduces the chances that no automobile is available at reasonable (walking) distance when a subscriber wants to use a carshare vehicle. The goal of increasing the number

of vehicles in a neighborhood was to show potential subscribers that carshare is an easily accessible and readily available service. The vehicles became available to Greenwheels members on April 3, 2009.

In early May, the municipality sent a mailing to 5,858 households in the pilot area. This message contained information about the carshare promotional offer and other bicycle-related transportation deals. The carshare offer included a free Greenwheels subscription until August and 250 free km per month, not including fuel. The normal Greenwheels subscription has a monthly fee, a charge for the length of time the vehicle is used, a vehicle charge per km driven and a variable fuel charge per km. These charges depend on the vehicle type reserved and time of day of use (Greenwheels, 2010).

The first mailing directed households to an online survey developed by Radboud University, based on existing literature and lessons from earlier carshare surveys<sup>1</sup>. The purpose of this first survey was to provide an understanding of the characteristics of the residents in the project area. It included questions concerning demographic status, transportation habits, and attitudes toward carshare. The response rate was 22% or 1,296 households. Individuals who expressed interest in carshare on the initial survey received direct marketing through telephone or mail. Analysis of this first survey divided responding households into existing carshare members and nonmembers. This research further identified potential carshare members as those nonmembers who did not need a vehicle for work, did not drive many kilometers in a year, and found carshare either somewhat or very attractive. Survey analysis identified 154 potential carshare households from the respondents (3% of all households, 12% of respondents). These households will be referred to as potential carshare members throughout the rest of the article; their characteristics are presented in figures 2 and 3. Of these potential carshare members, 66 indicated they were willing to be approached by the carshare organization to discuss carshare more in-depth (1% of all households, 5% of respondents). Their responses are used in tables 2 and 3. Note

that, throughout the paper, the number of respondents (n) is indicated that have actually answered a particular question.

In the initial survey, 782 households indicated they would cooperate with a follow-up research effort. Those households received a second survey in September. That survey attempted to determine the reason(s) why households did or did not become carshare members. The second survey had a 59% response rate (469; 9% of total number of households in the neighborhood). In September a third survey was sent around to all 209 Greenwheels members in the research area to identify their transportation tendencies and demographic information. There were 46 responses to the third survey, a response of 22%. Based off the survey format, there is some concern of self-selection bias and the unreliability of a small sample set.

#### *Second Phase*

The increase in carshare subscribers did not happen to the extent pilot initiators had initially expected. In an attempt to reach the desired membership numbers, the pilot project was extended through November and included an additional marketing campaign. This extra marketing activity focused on making people aware of the carshare system by giving demonstrations at a large supermarket in the research area. During the demonstration 870 people were actively informed about carshare and the practicalities of using a carshare vehicle, and about 3,500 flyers were handed out to passers-by. In November, it was determined that the project was not financially beneficial in its current form. The increase in carshare members was not sufficient to justify the number of extra vehicles in the pilot project. Greenwheels reduced the number of additional carshare vehicles in Nijmegen-East from eight to four in November 2009, bringing the total number of carshare vehicles in the project area to 13 from 17. This research cannot discuss the full financial details of the project because it reveals proprietary Greenwheels business information.

<sup>1</sup> Respondents that could not or did not want to fill out the online survey could request a paper version of the survey by phone. Only a handful of respondents made use of this service.

#### 4. Results

This pilot saw a net increase of 46 carshare members in the project area from April 3 to December 9. That growth represents a 27% increase on 172 members from when the pilot made the vehicles available to the public. Table 1 shows a description of carshare growth in the project area compared to Nijmegen as a whole during the same period. The initial marketing campaign from April 3 to September 16 saw a net increase of approximately 6.5 members per month. During the second marketing campaign, from September 16 to December 9, a net increase of approximately 6 carshare members per month occurred. Greenwheels memberships in Nijmegen had a net increase of 48 during the pilot timeline, 46 of which occurred in the project area. During the pilot project, Nijmegen-East accounted for approximately 50% of Nijmegen's carshare members, but 96% of its subscription growth. Increasing the carshare supply in the project area by eight vehicles was not able to generate sufficient demand to maintain that

tion that carshare was well-known and well received throughout the project area. Ninety-two percent of current members (21) and 44% of nonmembers (522) found carshare either somewhat or very attractive. The project area accounted for 9% of the population in Nijmegen, but 50% of the city's carshare members. Of the 18 respondents in the second survey who became carshare members during the period of the pilot (referred to in this paper as 'new carshare members'), 100% indicated they had heard of the concept before the project began and 50% indicated they knew how it worked. This is in comparison with the general response from the first survey, where 78% of respondents identified they were familiar with carshare, and 42% of respondents identified they understood how it worked (n = 1,296). These findings are in accordance with the literature, which shows that households tend to be familiar with the concept before deciding to become carshare members (Shaheen, Cohen, & Roberts, 2006).

	Number of carshare members	
	Nijmegen-East	Nijmegen
April 3rd	172	346
September 16th	205	378
December 9th	218	394
# Growth	46	48
% Growth	27%	14%

**Table 1: Effect of Supply-Side Approach to Carshare Membership**

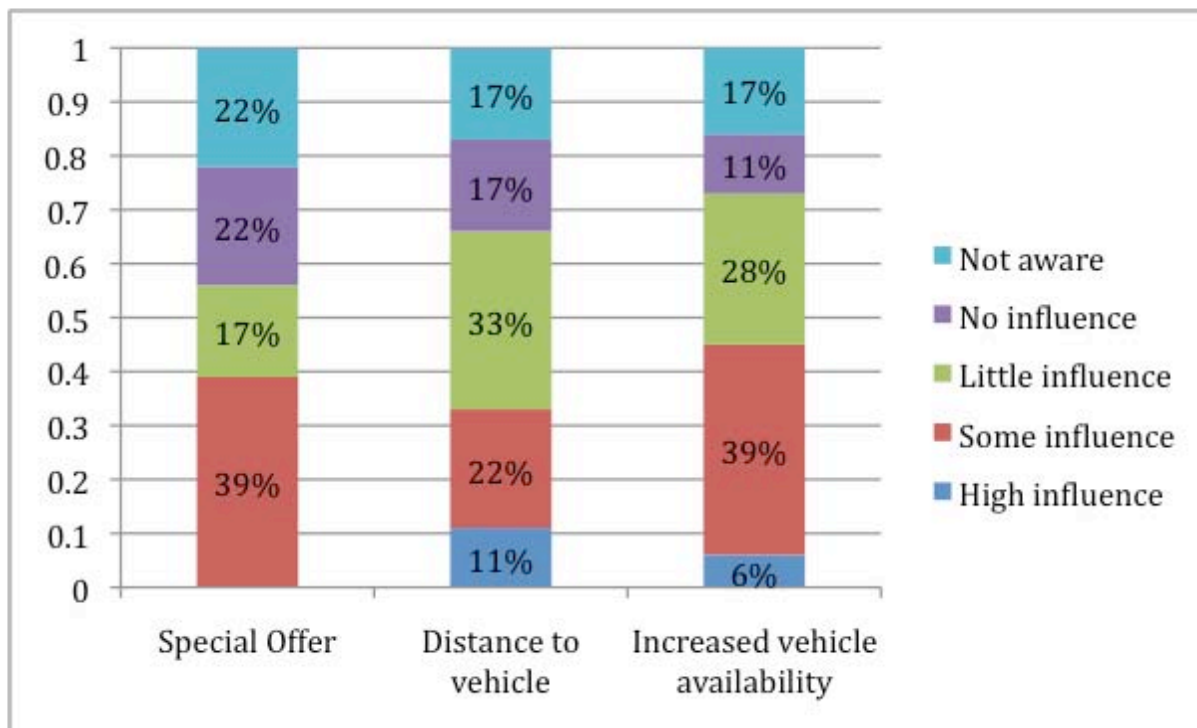
number of automobiles. However, by the end of the project, greater demand in the project area justified more than an incremental increase of vehicles. At end of the project, Greenwheels had added four additional vehicles (a 44% increase) to the carshare supply in Nijmegen-East.

##### *Profile of neighborhood*

Based off the initial survey, the average respondent was older (46) than the average resident in the research area (34.5) (Gemeente Nijmegen, 2010). Most respondents had a high level of education (80% attended at least college) and a mid-level income. According to the Dutch Central Bureau of Statistics, the income numbers of Nijmegen-East were representative of the city of Nijmegen as a whole (CBS, 2006). Survey responses support the no-

##### *Decision process of potential and new carshare members*

Figure 3 shows that each of the pilot project elements (special offer, distance to vehicle and increased vehicle availability) had an effect on whether a potential member signed up for carshare service. Increased availability influenced the decision-making of the greatest number of new members. Marketing campaigns are often a part of membership drives for carshare companies (Momo, 2010; Shaheen & Novick, 2005; Millard-Ball et al., 2005). This research expands on those studies by showing the extent to which the different project elements influenced the decision-making of households that actually became carshare members.



**Figure 3: Influence of elements of the pilot project on new carshare members (n = 18)**

	Positive	Negative	Total
Web search	41% (27)	17% (11)	58% (38)
Calculation of carshare costs	12% (8)	41% (27)	53% (35)
Spoke with current carshare member	24% (16)	5% (3)	29% (19)
Spoke with carshare company	15% (10)	8% (5)	23% (15)
Researched accessibility of public transportation	6% (4)	12% (8)	18% (12)
Other	8% (5)	8% (5)	16% (10)
Identified options for current vehicle disposal	3% (2)	8% (5)	11% (7)
Calculation of other transportation costs	2% (1)	8% (5)	10% (6)

**Table 2: Potential member action (and its influence) before deciding on carshare (n = 66)**

	Positive	Negative	Total
Web search	61% (11)	0% (0)	61% (11)
Calculation of carshare costs	33% (6)	6% (1)	39% (7)
Spoke with current carshare member	6% (1)	0% (0)	6% (1)
Spoke with carshare company	33% (6)	6% (1)	39% (7)
Researched accessibility of public transportation	6% (1)	6% (1)	11% (2)
Other	11% (2)	6% (1)	17% (3)
Identified options for current vehicle disposal	17% (3)	0% (0)	17% (3)
Calculation of other transportation costs	11% (2)	6% (1)	17% (3)

**Table 3: New member action (and its influence) before deciding on carshare (n = 18)**

Tables 2 and 3 show the actions that new members and potential members took before making a decision of whether or not

to join Greenwheels and whether those actions led to a positive or negative image of carshare. The group of potential members in table 2 came from households which in-

licated on survey 1 that they viewed carshare positively and were also receptive to having additional conversations with Greenwheels about their carshare service. Information for tables 2 and 3 was collected after the pilot project had finished. This data shows that both groups were likely to search for information on the internet and also calculate the costs before making a decision. Web searches and speaking with a current member were the actions most likely to provide a positive image of carshare to potential members. New members received a positive image from web searches, cost calculation and speaking with representatives of Greenwheels. Negative opinions of carshare came primarily through cost calculation for potential members, while none of the actions led to a negative image for new members.

The actions of both potential and new members before making a decision were fairly similar. Both groups had significant proportions that searched for information

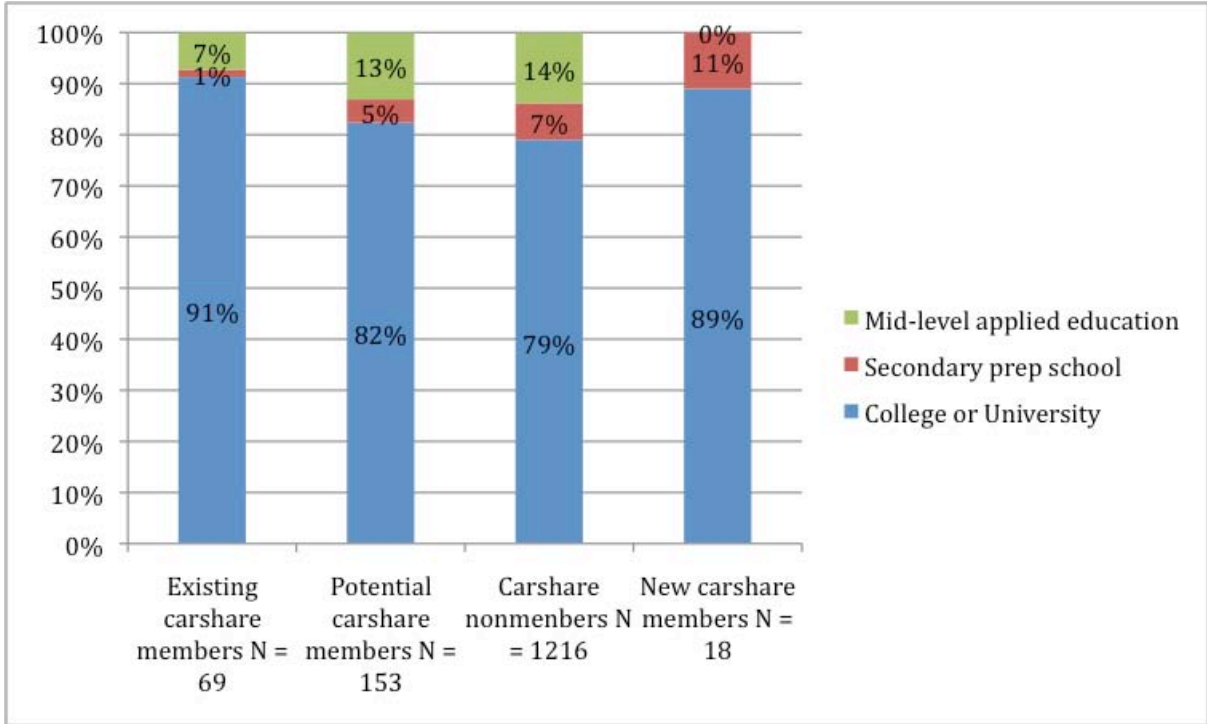
on the internet and calculated the cost of carshare. The households in this study went through the same steps before deciding whether or not to become a carshare member. Almost a third of new members (5 or 39%) spoke with Greenwheels before making a decision. Approximately a

quarter of potential members spoke with a current member (29%) or Greenwheels (23%) before deciding about carshare.

*Diversification of carshare market?*

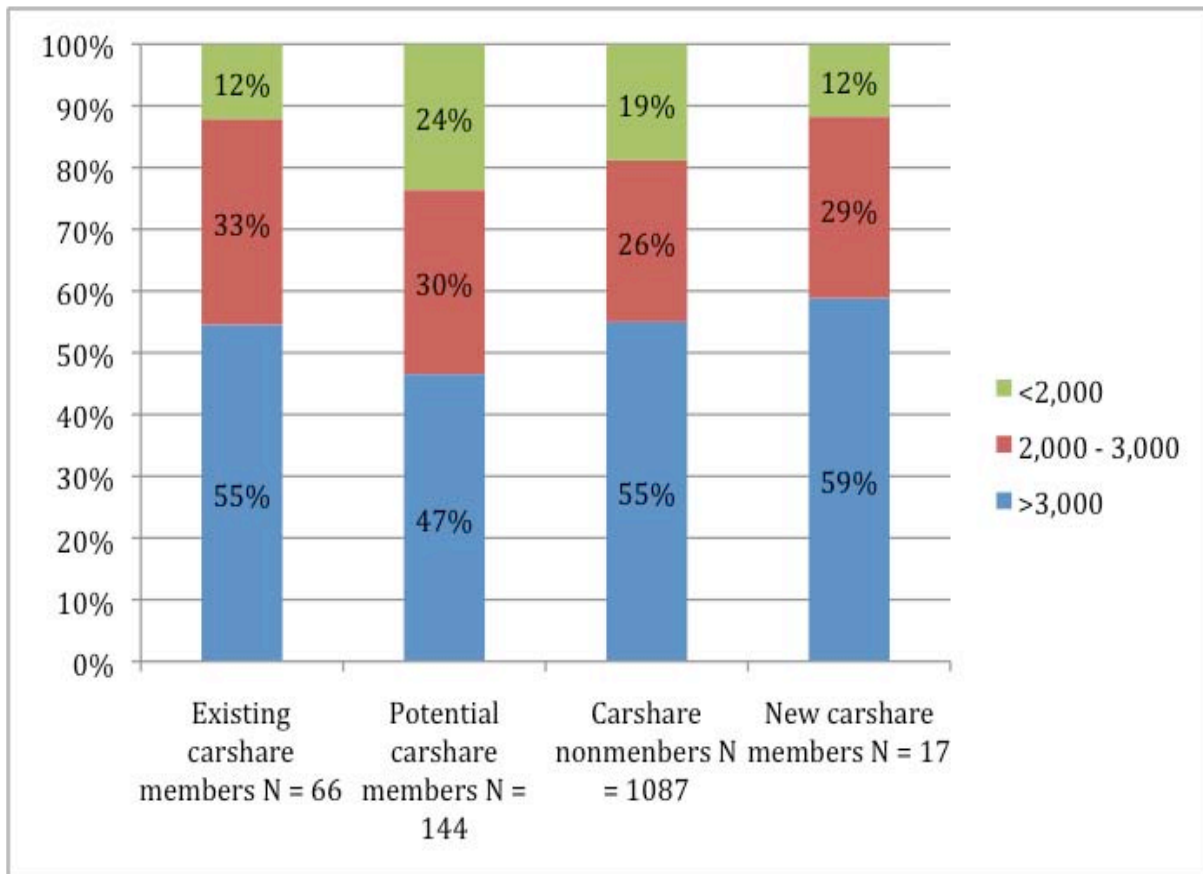
Figure 4 summarizes the highest education level attained by surveyed households. This shows that a large majority of the surveyed households had a college or university education. Existing members had the highest education levels while nonmembers as a group had the lowest education levels. The education level of potential members was lower than existing members, but higher than nonmembers. New members (signed up for carshare service after the first survey had been sent) exhibited high levels of education attainment. This means that primarily the highly educated of the potential members went on to sign up for carshare service.

Figure 5 compares income levels from existing members, potential members, nonmembers and new members. It shows that carshare members were more likely to be in higher income brackets than nonmembers. Potential members were more likely to be in lower income brackets than the population of nonmembers from which they came. However, from this group of potential members, primarily high-income households went on to



**Figure 4: Respondent highest household education level (Chi-square = 7.14)**





**Figure 5: Respondent gross monthly household income level (Chi-square = 5.58)**

become members. Actually, the income level of the new members closely resembled the profile of the existing members.

Comparing figures 4 and 5 indicates a difference of who is attracted to carshare, and who ends up becoming a member. Potential members had the lowest income and education levels. Experts from Shaheen and Cohen's 2007 study anticipated carshare markets around the world would continue to diversify in the coming years, leading to such developments as the expanding low-income market in Sweden. A recent report on the state of carshare in Europe concluded that carshare has grown most among high and middle socio-economic groups, but has experienced less success with lower income demographics (Momo 2010). The results from our research suggest that a lower-income and less-educated demographic is indeed attracted to carshare. However low-income and less-educated households did not make the transition from being potential members to signing up for the service. Only those households with relatively high income and education levels from the potential member group went on to actually

become members. Even though carshare attracted a demographically more diverse group of potential members, only those households with traditional carshare demographics (high income and education level) went on to actually become members.

Table 4 shows the conditions under which potential members would become carshare members. Lowering costs (both fixed and variable) would convince the largest number of potential members to sign up with Greenwheels. Certainty of vehicle accessibility was the second most cited factor that could convince potential households to join a carshare service. Momo (2010) identified preconceived ideas about availability of automobiles as one of the main barriers to carshare growth. Vehicle accessibility concerns represent an opportunity for carshare companies. With the proper tools, a carshare company could address this issue by showing levels of vehicle accessibility over the past year for the potential member's area. Depending on rate of accessibility, this information could persuade potential members to sign up for carshare service.

Lowering of the fixed costs	35% (50)
Certainty of vehicle accessibility	35% (49)
Lowering of the variable costs	26% (37)
Other	17% (24)
Improvement of public transportation	15% (22)
Greater variety of vehicle types	8% (12)
Lowering distance to the vehicle	3% (4)

**Table 4 Conditions that would persuade potential members to become members (N = 142; more than one answer was possible)**

## 5. Conclusions

The number of carshare users has been growing around the world over the past decade. In this paper, we have described a pilot project that aimed to increase the number of new carshare members through the provision of carshare vehicles above the demonstrated demand.

The most important conclusion to be drawn from this pilot project is that there was a successful increase of membership rates. Carshare members increased with 27% in the pilot neighborhood, substantially above the growth number in the remainder of the city. This result is impressive in and of itself, especially considering it was during a time of economic uncertainty and shrinking budgets. While the additional supply of eight vehicles was reduced to four towards the end of the pilot project, the project still resulted in an increase of approximately 40% in carshare vehicles in the neighborhood, thus improving vehicle proximity and availability to existing and new users. The growth in membership numbers underlines that the approach might also be viable in a financial sense. Depending on business models, carshare companies may eventually be able to recoup initial investments related to the over-supply of vehicles during a short period of time through increased subscribers and subscription revenue. Taken together, these results suggest that a supply-side approach may generate additional demand in already served neighborhoods beyond that which an incremental approach to membership growth might provide. This suggests that businesses and municipalities could use the prescribed approach to increase carshare in a city as a whole or in specific parts of the city, although based on the project we cannot

determine whether such an approach is also cost-effective due to the proprietary nature of the cost structure in the participating carshare company (Greenwheels).

The analysis of the characteristics of potential carshare members and new carshare members seems to provide only limited evidence for the diversification hypothesis, as posed by Shaheen and Cohen (2007) and others. While potential members had a different profile from existing carshare members, in terms of both educational and income levels (both lower), the profile of new members more closely resembled that of existing members. Thus, while many households with low income and education levels were interested in carshare, they did not actually become carshare subscribers. Further research should try to determine why these households refrained from becoming carshare members and how organizations could translate this possible unrealized demand into increased carshare membership.

If carshare is to grow out of its niche market status and become a more common mode of transportation, then it needs to find ways to reach new potential members. Although the statistical basis of the results is somewhat limited for drawing hard conclusions, this project represents a successful attempt to expand membership in an area with existing carshare service. The challenge now becomes finding the circumstances whereby more potential carshare members with low income and education levels actually become subscribers.

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## **Children's cycling participation, injuries, fatalities and helmet legislation in the United States**

*Gillham C, Rissel C*

### **Introduction**

There is general consensus that cycling participation is associated with good individual health, as well as contributing positively to societal and environmental benefits such as improved air quality, reduced traffic congestion and reduced motor vehicle injuries (Garrard et al., 2012, Oja et al., 2011). Cycling may also be an important tool to combat the obesity epidemic, with ecological studies noting lower rates of obesity in regions with high rates of cycling (Bassett et al., 2008). In recognition of these benefits, many countries (and especially those with low bicycle mode share) have national plans and have set targets to increase cycling levels (UK Department for Transport, 2010, United States Department of Transportation - Federal Highway Administration, 2010, Australian Bicycle Council, 2010).

Strategies to increase levels of cycling are well understood, including provision of cycling specific infrastructure, driver education and cycling skills central elements, along with mixed land use planning and medium density planning policies (Bauman et al., 2008, Pucher and Buehler, 2008). Addressing safety concerns is critical as the perception that cycling is 'dangerous' is a major deterrent to cycling participation, and repeatedly identified in community consultations (Daley et al., 2007, City of Sydney, 2010).

The role of mandatory bicycle helmet legislation in increasing cycling safety is controversial (Robinson, 2007). The compulsion to wear a helmet may reinforce the perception that cycling is inherently dangerous (Horton, 2007). While helmets may have a small protective effect at the individual level, there is no clear evidence of the effectiveness of such legislation in reducing cycling head injury rates at the population level (Robinson, 2006, Walter et al., 2011, Rissel, 2012). The evidence supporting decreases in injury rates is far from definitive and there may be a net negative effect with mandatory helmet legislation leading to lower levels of

cycling participation in the Australian (De Jong, 2010, Gillham, 2010) and New Zealand contexts (Land Transport New Zealand, 2006).

Mandatory bicycle helmets are commonly reported as a barrier to more people cycling (Rissel and Wen, 2011). Users of bicycle share programs (Fishman et al., 2012), youth (Crawford et al., 2012) and a substantial sub-group of transport cyclists (Cycling Promotion Fund, 2011) have reported that the requirement to wear a helmet deterred them from cycling. Mandatory helmet legislation is unlikely to impact upon the small percentage of 'hard core' daily riders who would ride under any circumstances, but is a powerful disincentive to non-regular riders and those people who do not see themselves as a 'cyclist' (Daley and Rissel, 2010; Rissel and Wen, 2011).

Gillham and Rissel have argued that there has been a net decline in cycling rates in Australia since 1985, allowing for population growth, which may in part be attributed to mandatory helmet legislation (Gillham and Rissel, 2012). This decline in cycling participation in Australia may be continuing, with a recent national survey showing a statistically significant decrease in the level of cycling participation in Australia between 2011 and 2013 (Australian Bicycle Council, 2013). This national decline in cycling participation is in spite of local cycling increases in inner city areas (Bureau of Transport Statistics, 2013, Zander et al., 2012).

Declining participation in cycling is surprising, particularly given the policy directions of many countries. In Australia there is also some suggestion that there is a decline in children's cycling participation (Titze et al., 2013), with sales of children's bicycles decreasing (Acott, 2013). A possible decline in children's cycling is particularly concerning as this may lead to generational declines in cycling.

Previous studies of child cyclist injury rates in the United States have identified a significant decline since the 1990s and have generally attributed this to the introduction of mandatory bicycle helmet laws (Meehan et al., 2013). Published surveys

suggest helmet wearing among 5-15 year old cyclists in the United States increased from 25% in 1994 to 48% in 2001/2002 (Dellinger and Kresnow, 2010, Pucher et al., 2011), increasing to 72.3% in helmet law states and 49.6% in states without a helmet law (Rodgers, 2002). However, published injury studies mostly overlook the confounding effect of lower child cycling participation which could mask underlying rates of injury per cyclist.

This paper examines publicly available data from the United States of America (USA) to explore cycling participation rates among children over time. As some states in the USA have introduced mandatory helmet legislation for children, we also examine trends in injury rates and compare fatality rates (as a proxy indicator of injury) between those states with helmet legislation for children and those that do not.

## Methods

The data for this paper are from published US government reports or websites. Data on cycling participation for children aged 7-17 years for 1995-2009 are from the US Census Bureau report on Participation in Selected Sports Activities (US Department of Commerce, 2103), for 2010 and 2011 data on cycling participation are from the Outdoor Industry Association (The Outdoor Foundation, 2013), and for 2012 are from the National Sporting Goods Association (National Sporting Goods Association, 2013). Participation is defined as having participated in the activity at least once in the past 12 months. Data on injuries (all body and concussion injuries) from 1995-2012 for children aged 7 to 17 years are from the US Consumer Product Safety Commission's National Electronic Injury Surveillance System (US Consumer Product Safety Commission, 2013). Fatality data are from the online-query web pages of the National Highway Traffic Safety Administration Fatality Analysis Reporting System (<http://www.fars.nhtsa.dot.gov/QueryTool/QuerySection/SelectYear.aspx>).

The introduction of legislation requiring children to wear helmets when cycling is detailed at [http://www.cycle-helmets.com/us\\_helmets.html#childfatal](http://www.cycle-helmets.com/us_helmets.html#childfatal) in tabulated format for each US state, year of

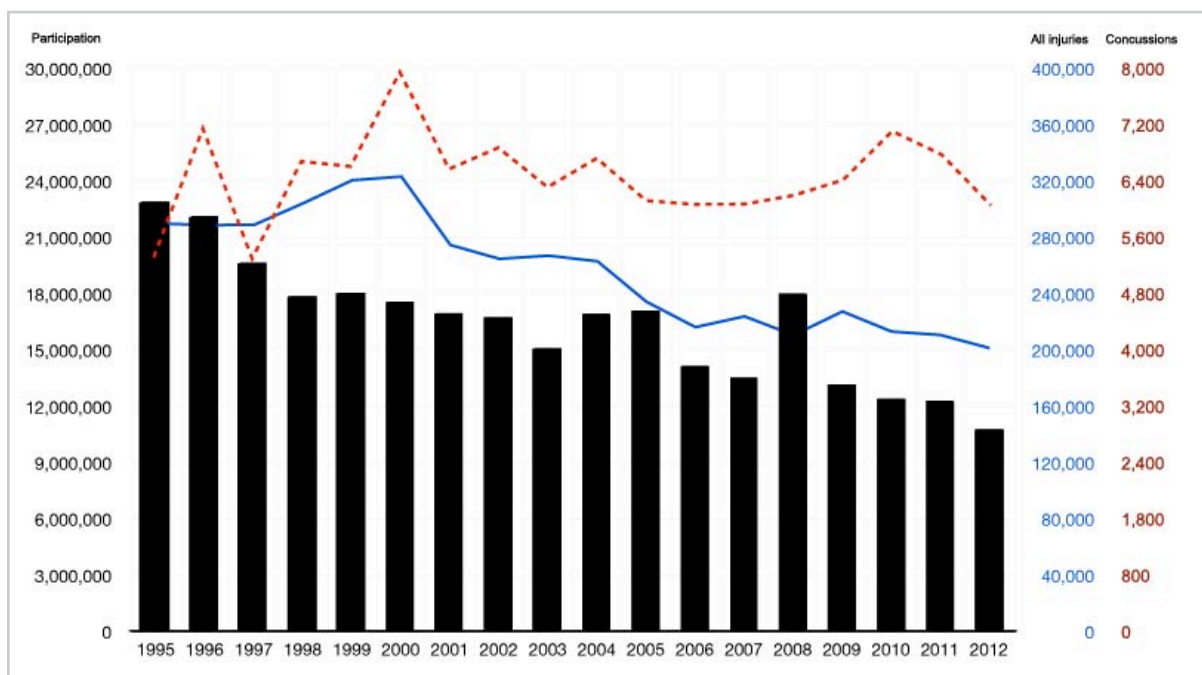
introduction (or Not Applicable), ages affected, total population of the state, and population (number and percent) affected by the law. Out of 51 jurisdictions in the National Highway Traffic Safety Administration Fatality Analysis dataset for 2011, 23 jurisdictions (45.1%) had some form of helmet law for child cyclists, some for children up to 17 years. The first was introduced in California in 1987, with the majority introduced in the mid to late 1990s.

The association between children's cycling participation and all body injuries, and with concussion injuries, was examined using regression analyses. Similarly, the association between all-age cyclist and pedestrian fatalities in those states with child helmet laws and those states without such laws was examined using regression analyses. Further, cyclist fatalities for all-age and 0-16 year children in those states with child helmet laws and those states without such laws were also examined using regression analyses.

## Results

In 1995, 22,948,000 children aged between 7 and 17 years had ridden a bicycle in the past 12 months. By 2012 this had more than halved, with 10,800,000 children having ridden a bicycle. Over this time the population aged 5-17 years increased by 9.6%. Cycling participation among 7-17 year old children in the United States declined 23.1% from a 1995-2003 average of 18,593,000 persons to a 2004-2012 average of 14,296,889 persons (see Figure 1). Regression analyses indicated that this decline over time was statistically significant ( $p < 0.001$ ) with 557,371 (95% confidence interval 413,662-701,080) fewer children cycling each year. Over the same time period, 7-17 year old cyclist all-body injuries in the US declined from a 1995-2003 average of 291,970 to a 2004-2012 average of 222,869, a 23.7% decline (see Figure 1).

Regression analyses indicated that this decline over time was statistically significant ( $p < 0.001$ ) with 6,796 fewer injuries each year (95% confidence interval 5,025-8,566). Over the same time period, concussion injuries among 7-17 year old cyclists declined from a 1995-2003 average of 6,555 to a 2004-2012 average of 6,420, a decline of 2.1%. However, there was no

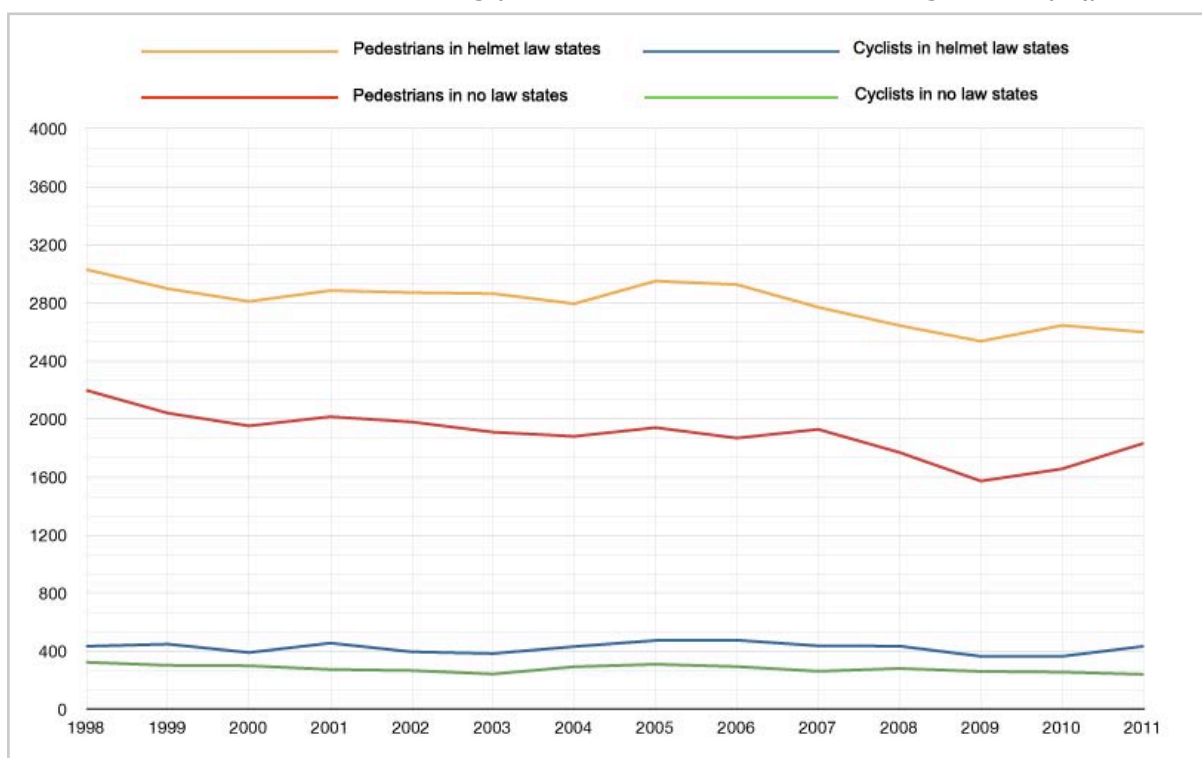


**Figure 1. Cycling participation, all injuries and concussion injuries among 7-17 year olds, 1995-2012**

statistical association between the number of concussion injuries and time ( $P=0.826$ ). There was a statistical association between all body injuries and cycling participation ( $p=0.001$ ) but not between concussion injuries and cycling participation ( $p=0.613$ ). Pedestrian fatalities (all ages) in helmet law states ( $p=0.001$ ) and non-helmet law states ( $p<0.001$ ) declined significantly from 1998 to 2011 and were strongly cor-

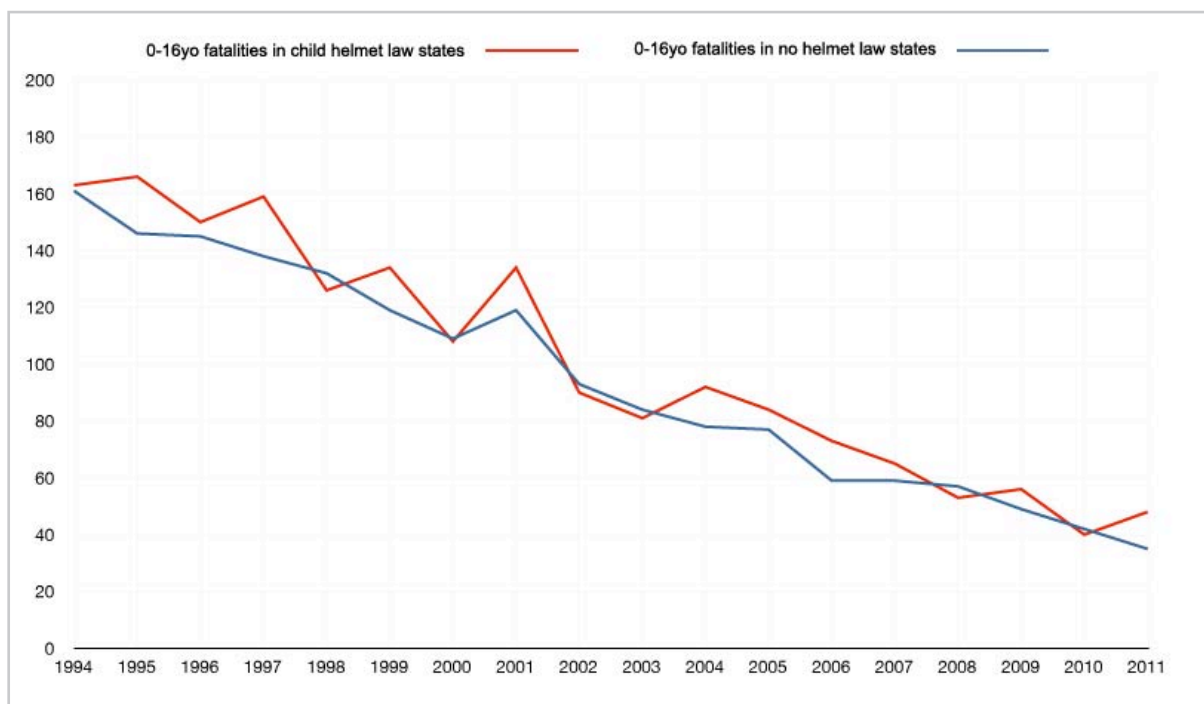
related ( $r = 0.865$ ) (see Figure 2). Cycling fatalities (all ages) declined significantly in non-helmet law states ( $p=0.016$ ) but not in helmet law states ( $p=0.506$ ), with a non-significant ( $p=0.063$ ) moderate correlation ( $r = 0.509$ ) between the helmet and non-helmet law states.

Among children aged less than 17 years, fatalities declined significantly ( $p<0.001$ )



**Figure 2. All-ages cyclist and pedestrian fatalities by child helmet law and non-law states, 1998-2011**





**Figure 3. Fatalities among child cyclists aged 0-16 years by states with and without children helmet laws, 1994 -2011**

in both helmet and non-helmet law states, with a very high and statistically significant correlation ( $r=0.977$ ), indicating no differences in fatalities between the helmet and non-helmet law states (see Figure 3).

### Discussion

There has been a clear decline in child and teenage cycling participation in the United States, which is consistent in several data sets. This reduction of more than 17,000,000 young people from 1995 to 2012 who did not cycle represents a substantial decline in recreational physical activity among American youth, especially considering that the population aged less than 18 years grew 7.5% over the same period.

There has been a decline in the annual total number of all-body injuries to younger US cyclists which was associated with a decline in cycling participation. With fewer children cycling, there are simply fewer injuries overall. However, there was no change in the number of concussion injuries over the same time period, despite fewer riders, and this was not associated with cycling participation. If concussion injuries are indicative of impact to the head and potential head injury, these data suggest that the significant increase in child and teenage mandatory/voluntary helmet wearing since 1995 has not made a meaningful contribution to young cyclist head

injuries. This is consistent with recent Canadian data which showed no impact on head injuries resulting from helmet legislation (Goldacre and Spiegelhalter, 2013).

Although youth cycling participation rates in each state were not available, there are consistent reports from Australia (where mandatory helmet legislation exists for all ages) that young people, particularly teenagers, do not like wearing helmets and when helmet legislation was introduced in Australia over 40% of teenagers stopped cycling (Crawford et al., 2012, Smith and Milthorpe, 1993). There is likely to be a similar negative effect on cycling by teenagers in the US with the introduction of helmet legislation, and this is a likely contribution to the decline in cycling participation. Other factors are also likely to have contributed to the decline in cycling participation, such as increased parental safety fears (Malone, 2007).

The negative impact of helmet legislation on cycling participation would not be a problem if participation returned to previous levels over time. However, this is not the pattern in Australia, where the average number of cycling trips per day had declined in 2011 from 1985/6 levels despite increases in population size (Gillham and Rissel, 2012). A 2013 government update on cycling participation con-

firmed a statistically significant reduction in Australian cycling over the previous two years (Australian Bicycle Council, 2013).

Using fatalities as a proxy for injuries, the decline in all-age pedestrian fatalities (both in states with or without helmet legislation) suggests improvements to the road safety environment over time. This general improvement in road safety that benefits all road users has been noted in the Australian context (Rissel, 2012). However, all age cyclist fatalities declined in non-helmet law states but surprisingly did not decline in those states with helmet laws. When only child fatalities are considered, there is no difference between helmet and non-helmet law states, indicating that helmet legislation made no impact on reducing child cycling fatalities. Consistent with this view, the US government recently removed from its official site the claim that helmets reduced injuries by 89% as being unsubstantiated by the evidence (National Highway Traffic Safety Administration, 2013).

### **Strengths and limitations**

These analyses are limited by using only publicly available data without access to the individual level unit record files. No analysis of head injuries by helmet law states compared with no-law states was possible. Further, fatality rates may not be a good proxy for injury.

A strength of this study is that the data are all publicly available and the trends in cycling participation, injury and fatalities are all clearly observable. It draws attention to the decline in children's cycling participation as the most probable explanation for the decline in the number of cycling injuries.

### **Conclusions**

Declining child cycling participation rates in US states warrant further study to determine if the reduction is directly related to helmet laws. The decline in children's all-body injuries but lack of decline in concussion injuries suggests that helmet legislation has had minimal impact on improving children's cycling safety. Similarly, improvements in pedestrian fatalities were not matched by improvements in cyclist fatalities. Without any evidence of clear public health benefits, children's helmet legislation may be a policy failure in the

United States, particularly if the decline in cycling participation by children proves to be caused by bicycle helmet legislation.

**Note:** Neither author has any financial or other interest in the sale or use of bicycles in Australia. Chris Gillham is owner and author of the website Mandatory Bicycle Helmet Law in Western Australia (<http://www.cycle-helmets.com>). There was no sponsorship or financial support of the research and preparation of this paper.

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Reviewed by John Whitelegg

This is a much needed book on a subject that represents an alarming collision between a subject of great importance and a public health response lacking in vigour and determination. When future generations look at the 20th and early 21st century response to 3,400 deaths per day they will be as amazed as we are when we look at early 19th century cities bursting at the seams with no clean drinking water and mains sewage. There are very few major public health problems on this scale that attract so little serious attention aimed at reducing it to zero. This is the "complacency" that is examined in this book.

The world of road safety is a very strange world. It is still dominated by strong, often unstated assumptions. These include the central belief that death and injury are inevitable (after all this is what the word "accident" means). They are inclined towards individual behavioural explanations e.g. the pedestrian hit by a car did not take care, was not highly visible, ran out between two parked vehicles etc. On a societal scale there is an assumption that we can't reduce speeds to 30kph/20mph because this will slow traffic down, create delays, damage the economy or deprive motorists of fundamental freedoms. This is the same as putting a higher value on 1 minute of time saved for several thousand drivers than a few lives of elderly pedestrians who failed the road crossing test and were killed.

The authors of this book present us with a great deal of useful information that is well-suited to the question of a total reconceptualization of road safety thinking and intervention. They talk about research that shows that about half of fatal crashes and two thirds of non-fatal injuries driver error was not related to breaking the rules "in short error is common and typically legal" (page 74). They show that the total system (roads, vehicles, people)

is inherently unsafe because it has not been designed to deliver system safety. They show (page 77) that "safe system thinking" is the way forward and already in place in Sweden and the Netherlands.

The "safe system approach" (pp81-85) is a fundamental shift from traditional road safety thinking: "its aim is to support development of a transport system better able to accommodate inevitable human error. The recognition that humans do make, and will continue to make, errors of judgement as road users is one of the core shifts in thinking". The safe system "cornerstones" are:

- Safer vehicles
- Safer roads
- Safer speeds
- Safer road users

The book makes an especially useful contribution on the benefits of speed reduction (page 121). The scientific evidence identifying the road safety gains of speed reduction is routinely ignored by professionals, decision-takers and politicians who in the UK still find tortuous reasons to avoid implementing 20mph/30kph speed limits on all residential roads. Even though Lancashire County Council has adopted a total, system-wide 20mph general speed limit on all residential roads and deserves credit for doing so politicians in Shropshire and Wiltshire cling to old fashioned and discredited arguments against this safe systems approach. It is particularly insulting when decision-takers insist that those worried about road traffic danger prove that the road is dangerous before a 20mph limit can be introduced. Sadly proof often comes in the form of a dead body.

The benefits of speed reduction are clearly summarised (page 120): "an increase of 10kph in average travel speed resulted in a doubling of the risk of a serious casualty crash, an increase of 15kph increased the risk 4-fold and a 25kph increase in average speed increased crash risk 10-fold..". The critical finding is that relatively small increases in speed from the average doubled the risk". Further "there is an exponential relationship between speed above average and crash risk" (page 121).

The authors review US experience when speed limits were reduced and then increased, a so-called "natural experiment". In 1973 the speed limit was reduced from 65mph to 55mph (105kph-90kph) on all interstate highways and in response to the oil crisis. The result was \$2 billion in fuel savings and 2000-4000 lives saved and an increase of 1 billion hours of total driving. In summary: fuel saved, lives saved, time lost. In 1987 the speed limit returned to 65mph and by 1995, 95% of the network was back at 65mph and fatalities increased. In summary: fuel lost, lives lost, time saved.

The overwhelming evidence in support of the lifesaving gains from speed reduction is very clear indeed and yet is rarely factored into serious road safety policy interventions. The prevailing ideology of traffic, transport and road safety still prioritises the convenience of the motorist (or even worse "the economy") over the clear policy alternative of reducing deaths, injuries and road traffic danger. As a society we opt for more risk and not less risk and accept the differential impact of that risk so that, for example, older pedestrians are at greater risk because they can't run very fast.

The book does occasionally lose its way when it strays into bigger societal issues e.g. economic growth and a rather strange discussion of fluoridation and human health. On page 37 the authors make a remarkable assertion when they say "economic growth is essential for the health of a modern society". This is most certainly not the case and over 100 years of pursuit of economic growth have not solved the really big problems of access to clean drinking water, sanitation, health care and the elimination of poverty. Economic growth certainly makes rich people richer and increases the size of the gap between rich and poor but that is not much of an indicator of the "health of a modern society".

On page 105 the authors stray into the highly contentious areas of immunisation, the MMR vaccine and fluoridation. They need not have done this. There is not enough space in a review of a road safety book to even begin discussing the many flaws in this dismissive approach to some highly complex medical subjects

and what Illich would call "iatrogenesis" (medically induced illness) but the compulsory fluoridation of large populations in an attempt to improve dental health has been subjected to a great deal of robust scientific dissection and the nicest thing we can say about compulsory medication/fluoridation (apart from the fact that it is illegal without consent) is that there is very strong evidence that it causes damage and it does not address the root causes of dental disease in children.

The discussion of seat belts (page 68 and 100-102) studiously avoids reference to the work of John Adams and "risk compensation" and the criticism of seat belt legalisation for its overall impact on redistributing risk and adding to total risk e.g.

*"the clear reduction in death and injury to car occupants is appreciably offset by extra deaths among pedestrians and cyclists."*

Source: <http://www.john-adams.co.uk/2013/03/24/the-biggest-lie/>

This reviewer also has a quibble about the statement on page 166 "Three countries with the best safety records, Sweden the Netherlands and the UK". As far as the UK is concerned the statement is incorrect. In the 12 months up to June 2014, 1760 people were killed on our roads, a 3% increase on the previous year. In the same 12 month period 24,580 were killed or seriously injured, a 4% increase compared with the previous year. There were 193,290 reported road casualties of all severities, 4% higher than the previous year. This does not have any sense of "safe" Even when there has been a drop in fatalities this is not same thing as "safe" which is why the UK has a strong movement in support of "road traffic danger reduction". Reducing numbers may result from a number of different sources. If older people are very frightened of traffic they will not go out so from a population point of view the number at risk falls and the number of deaths declines, but imprisoning our older people is not a good swap for these reduced numbers. In some villages where a primary school is less than 500m away from the main populations centre the children are driven to school and do

not walk or cycle because the road is too dangerous. This also reduces the size of the population at risk. Reduced numbers of deaths in the UK cannot be attributed to some wonderful road safety policy intervention but scaring people off the streets helps. We need a new measure of road traffic danger and social interaction and we need totally safe streets and roads operating in a way that sees more people walking and on bikes. That is the real societal goal we should all be trying to achieve.

**Reference:**

Illich, I (2001) *Limits to Medicine: Medical Nemesis - The Expropriation of Health* Marion Boyars Publishers Ltd; New edition (10 Dec 2001)

**Transportation Choices for Sustainable Communities  
Research & Policy Institute (Transportation Choices)**  
<http://transportchoice.org/>

**Overview:**

The purpose of this non-profit corporation is to advance understanding and support for sustainable transportation as an essential component of livable communities. Transportation Choices studies and evaluates the ways and means of creating more life-affirming transportation systems and disseminates this information to both the public and decision makers.

The overall aim of our endeavors is to illuminate the central role that sustainable transportation plays in the vibrancy of communities. In pursuing these aims, the corporation researches and informs on a variety of policies and programs, including non-motorized transport, public transportation, traffic calming, street design, transit-oriented development, travel safety, public health, environmental quality, urban design, placemaking, and smart growth.

Transportation Choices conducts applied research on sustainable transportation topics for public agencies and private foundations and disseminates research results to practicing professionals, public officials, and advocates for sustainable transportation policy.

**Illustrative Projects and Potential Research:**

- *Determining Success Factors in North American Pedestrian-Oriented Streets*
- *Defining Best Practices in North American Public Transportation Integration Transforming downtowns, central cities, and suburbs into sustainable communities*
- *Retrofitting Suburban Office Parks to Become Mixed-Use Communities*
- *Defining the transportation Factors in Successful Placemaking*
- *Creating viable, sustainable transportation choices for individuals and communities*
- *Offering sustainable land use choices for individuals and communities*
- *Designing blueprints for the transformation of transportation and land use in communities*
- *Fostering creation of "complete streets" which accommodate all modes of transport safely and effectively*
- *Improving access and circulation for bicyclists and pedestrians*
- *Illuminating the purposes and benefits of various forms of public transportation*
- *Advancing understanding of the important role of traffic calming in improving travel safety*
- *Educating stakeholders on the importance of sustainable communities in improving public health*
- *Enlightening communities and the general public on the link between transportation choices and air quality and greenhouse gas emissions*
- *Informing communities about the advantages of high quality urban design, including the design of streetscapes*
- *Highlighting the benefits from transportation demand management (TDM) efforts at work sites and within communities.*

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