INVESTIGATING THE IMPACTS OF POLICY ON SCHOOL TRAVEL

By

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ABSTRACT

Millions of children travel to and from school each day as part of their daily routine. A large percentage of children make this journey by car, and the numbers are steadily rising and this is leading to many environmental and health implications for children.

The current economic climate has persuaded the British Government to look again at policies relating to all school travel funding to highlight areas where savings and cuts can be made. This is interesting because the home-to-school transport provision policy has been in place since the Education Act 1944 and this policy costs local authorities in England over £1 billion a year. Therefore, the focus of this thesis is threefold.

Firstly, it seeks to determine the main issues within school travel and reports on the views of current professionals in the school travel industry. Structured in-depth interviews were carried out with 16 UK and US school travel experts. The questions focused on the current stakeholders of school travel, issues regarding school travel, bus use in school travel, and the challenges faced by transport planners to ensure school pupils have a safe and pleasant journey to school.

Secondly this thesis quantifies the traffic and environmental impacts of the school choice policy in England. It achieves this by analysing School Census data from 2009 from the Department for Education. Multinomial logit modelling and mixed multinomial logit modelling are used to illustrate the current travel behaviour of English children in their journey to school and examine how there can be a significant reduction in vehicle miles travelled, CO_2 emissions and fuel consumption if the 'school choice' policy is removed. The results suggest that if all children attended their nearest school, this would result in reductions in their personal mobility, vehicle miles travelled and CO_2 emissions.

Finally, this thesis examines the policies relating to the funding criteria of home-to-school public school transport provision. Specifically, the paper employs a multilevel modelling technique to develop a series of relationships between bus usage by school and the level of spending by local education authorities on home-to-school bus travel provision while controlling for other factors such as school quality, land-use patterns and various proxies for household incomes. The results suggest that there is a significant effect of funding on the total school-level bus passenger mileage for primary (aged less than 11), secondary (aged 11 to 16) and Post 16 schools.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABBREVATIONS

ARTA	Auckland Regional Transport Authority
BBC	British Broadcasting Corporation
CAPT	Child Accident Prevention Trust
CCTV	Closed circuit television
DE	Department of Education (Northern Ireland)
DECC	Department of Energy and Climate Change
DEFRA	Department for Environment, Food and Rural Affairs
DFE	Department for Education (England)
DFT	Department for Transport
DSB	Dedicated School Bus
FSM	Free School Meals
GCSE	General Certificate of Secondary Education
IDACI	Income Deprivation Affecting Children Index
IIA	Independence of Irrelevant Alternatives
INCA	International Review of Curriculum and Assessment
JCQ	Joint Council for Qualifications
LA	Local Authority(ies)
ML	Multilevel Model
MNL	Multinomial Logit Model
MMNL	Mixed Multinomial Logit Model
NAEI	National Atmospheric Emissions Inventory
NI	Northern Ireland
NMT	Non-motorised Transport
NTHS	National Travel Household Survey
NTS	National Travel Survey
ONS	Office for National Statistics
OPT	Other Public Transport
PSB	Public Service Bus
RUM	Random Utility Models
SEN	Special Educational Needs
STP	School Travel Plan
TFL	Transport for London
UCAS	Universities and Colleges Admissions Service
US	United States
UK	United Kingdom
VMT	Vehicle Miles Travelled
YBC	Yellow Bus Commission

CHAPTER 1 INTRODUCTION

1.1 Introduction

In the past, children have been travelling to school traditionally by walking and cycling but in the last decade travel behaviour has gradually changed and this is having a greater impact on the rest of society. In the United Kingdom (UK) school travel accounts for 11% of daily trips, and over a quarter of these trips are made by private car (DFT, 2011).

In the last decade, the numbers of pupils travelling to school by private car has risen to over 30% whilst the numbers of pupils walking and cycling to school is steadily falling. Only 22% of pupils travelled to school alone in 2009 (DFT, 2011) and these trends appear set to continue in the future potentially resulting in significant transport and environmental related problems over time.

However, although there are clear signs that school travel behaviour is changing and becoming more reliant on car travel; little seems to be in place to counteract this from a policy perspective.

1.2 Increase in car use in society

Transport and travel is essential to our daily lives. Each day people rely on transport to get to and from a whole range of activities. Without transport, people would be very restricted as to how far they could travel from their homes. Transport creates more employment opportunities, more leisure opportunities and increases choice of schools, shops and residence.

Increasingly, these transport trips have been made by the private car, such that last year (2010) the number of cars globally passed the 1 billion mark for the first time. In terms of how these are distributed, the United States (U.S.) has the highest car-to-person ratio in the world at 1:1.3 among a population of almost 310 million. Italy has the second highest ratio at 1:1.5, followed by France, Japan, and the United Kingdom (U.K.) at 1:1.7 (Sousanis, 2011). In fact, in 2009 less than 10% of households in the US did not own a car (NHTS, 2009) while the corresponding figure in the UK was 23% (ONS, 2009).

This increase in car use has been due to a variety of reasons such as rising income, convenience, independence and various psychological reasons such as self-image and self-presentation (Van Acker and Witlox, 2010; Whelan, 2007; Gardner and Abraham, 2008; Davison and Knowles, 2006). Steg (2005) declares that the personal car is seen to be a status symbol and a representation of money and success. Moreover, the car is seen to deliver significant benefits (in particular to the individual).

Beirão and Cabral (2007, p. 482) list some of the benefits of travelling by private car as:

- Freedom/ independence
- No restriction to journey destination or purpose
- Convenience
- Rapidity
- Comfort
- Flexibility
- Predictable journey experience
- Safety
- Having my private space

in comparison to travelling by public transport which can be crowded, unreliable, expensive and lead to the need of transfers, long waiting times and long walking times to and from destinations (Beirão and Cabral, 2007).

Unfortunately though, it is also the case that 'excess' car use poses major economic, environmental and social problems to communities more widely. Such issues include:

- Traffic congestion
- CO2 emissions
- Energy
- Accidents
- Severance

Moreover a cycle exists in which as the number of cars rises, levels of traffic congestion, noise pollution, air pollution, health impacts and the increased use of natural resources such as fossil fuels also rise (Tertoolen et al, 1998; Boyes and Stanisstreet, 1998; Greene, 1997).

Acknowledging these issues, there has been a large number of studies in recent years conducted in the area of reducing car use since the 1960s (e.g. see the Buchanan Report, 1963 and Fishman and Wabe, 1969).

1.3 Increase in car use in school travel

One stream of this topic area has been to consider different trip purposes, one of which is the journey between home and school. The journey to school is made by millions of children in many developed countries. Many of these pupils choose to walk or cycle to school, and others rely on motorised transport when travelling to schools greater distances from their homes.

As with travel patterns generally, in the past decade fewer children have been walking and cycling to school and the trend of children travelling to school by car has grown throughout the world (Buliung et al 2009; McMillan, 2007).

Evidence that more children are travelling to school by car can be seen in many developed countries. In the US, in 2001 50% of young pupils aged 6-12 and 76.9% of older pupils aged 16-18 travelled to school by car (NHTS, 2009). In the UK, 42% of young pupils aged 5-10 and 22% of older pupils aged 11-16 travelled to school by car (DfT, 2011). In Toronto, Canada travel to school by car has risen from 11.9% to 25.7% between 1986 and 2006 (Buliung et al, 2009). As a result, in Sydney, Australia 50% of children travelled to school by car in 2008/09 (TDC, 2010), and in Auckland, New Zealand 54% of children travelled to school by car in 2005 (ARTA, 2007).

Unfortunately, as school children develop a reliance on car travel they also begin to develop other problems such as social skills and health issues. Children need to learn some social skills and independence in order to be able to look after themselves as they get older (Valsecchi et al 2007, Hillman, 1993). Children are becoming increasingly unhealthy due to lack of active travel and the encouragement of alternate journeys to school could help. Parents are also becoming more involved in their children's travel and their concerns regarding safety, 'stranger danger' and traffic levels is becoming a barrier to children travelling to school by non-motorised travel (Headicar, 2009). Findings in the National Travel Survey (NTS) show that the percentage of children (aged between 7-10 years) travelling to school accompanied by an adult rose to 80% in 2009 (DfT, 2011). In addition, it has long been a concern in the UK that the 'school run' causes problems on the roads (Moreton, 2006).

In the UK the 'school run' is the term to describe the traffic generated by parents driving their children to school each morning and collecting them from school in the afternoon. It has been claimed that the school run traffic causes congestion in residential areas, increases carbon emissions and makes school unsafe for children as a result of increased cars parked on side roads, cars driving fast, and dependency on car use leading to health problems (Pike, 2003). Finally, the cost of transporting children to and from school (i.e. through infrastructure, education, marketing and public transport subsidy) during a time of economic recession (and resulting in cuts to public expenditure) is proving to be an additional pressure which could potentially lead to more children travelling to school by private car (LTT, 2010; LTT, 2011).

Overall, existing research demonstrates that car dependence in the daily journey to school is a global issue and is likely to continue to increase just as car ownership is increasing. It is likely that as children are brought up to rely on the car, they will also do so when they are able to drive themselves, thus creating a cycle of reliance of travelling by car only.

1.4 Policy and school travel

Current academic literature concerning school travel (i.e. Ridgewell, 2009; Ahlport, 2008) has previously focused on travel behaviour from a user point of view. Previous studies (i.e. Hillman, 1993) have investigated the reasons behind why children travel they way they do and looked at how parents are the main decision makers in how their children travel. However, although parents appear to be the key stakeholders in travel to school, current policy makers and practitioners have stressed that current school transport related policies are also responsible for the current changes in school travel.

School transport policies are seldom discussed as most of the time they are 'out of sight and out of mind' unless blamed for overspending or the cause of an accident (Thornthwaite, 2009). However, in the last few years in a time when spending and budgets are closely examined and analysed, school policies have become more of a focus for the national and local Government.

The current school transport provision policy has been in place in England since the 1944 Education Act and very little has changed since its implementation. Some of the criteria for this policy are beginning to become very dated the natural and built environment in England has greatly changed since the 1940s, but local authorities continue to abide by the strict policy guidelines (Thornthwaite, 2009).

More recent school policies, such as the school choice policy (introduced in the 1980s in the UK) are also beginning to come under investigation as researchers are highlighting how travel behaviour is influenced by these policies (Headicar, 2009). The school choice policy in particular has been shown to encourage more travel to school by private in other developed countries including the United States (US) and Germany due to children travelling further distances to school when not restricted to a catchment area (Müller et al, 2008; Marshall et al, 2010). This is a trend that is likely to occur in the UK also.

1.5 Research Rationale

In research terms, there are many studies relating to the negative impact of increased car use in school travel, although few exist into the additional reasons for this car reliance and travel behaviour. Yet, if policy makers and practitioners understand the underlying factors which influence child travel behaviour more policies and schemes could be developed to encourage school travel by modes of transport other than the personal car.

One particular research gap appears to be a lack of information as to the transport related and broader impacts of certain public policy decisions. Specifically, the effects of two topical and high profile policies – school choice and statutory home to school transport provision – have apparently been relatively under researched.

1.6 Research aim and objectives

In light of the research problems described above, this thesis seeks to explore the relationship between policy and school travel (and both traffic and environmental related impacts). There is a significant body of research pertaining to child travel behaviour and parental concerns and influences, but less so on the school travel policies themselves which are in place.

Accordingly, this thesis aims to investigate some of the current school transport related policies which could be partially responsible for the gradual change from sustainable school travel behaviour via walking, cycling and school bus travel to private car reliance. This has been achieved by conducting a series of in-depth interviews with transport planners, consultants and academics with an interest in the school travel sector, combined with the application of econometric modelling techniques to examine the degree to which policy has an impact on school travel.

Therefore, the aim of this thesis is to **investigate the transport related impacts of policy on school travel**. This is formulated in the following objectives:

- To identify the current issues and factors affecting school travel.
- To determine the opinions of academics, consultants and travel planners in the transport sector, regarding school travel.
- To quantify the transport related impacts of the school choice policy across England.
- To evaluate the impacts of the statutory home-to-school transport provision policy and determine the effectiveness of this policy in school travel.
- To provide recommendations for policy makers and practitioners relating to school travel in England.

1.7 Structure of the Thesis

This thesis is organised into 10 chapters. This section provides an overview of each of the following chapters;

Chapter 2 provides a literature review of the various factors which influence school travel around the world. The main factors include individual factors, school factors, area factors and policy.

Chapter 3 investigates the views and opinions of current experts in the school travel field. The experts selected come from a range of backgrounds and expertise and include academics, transport consultants, school travel planners and bus operations.

Chapter 4 presents the methodology utilised in this thesis. A review of current studies into school travel have also been analysed and compared to the methods used in this thesis. Details of econometric models used to analyse the school choice policy and the statutory school bus provision policy are then presented.

C**hapter 5** investigates current school structure in England and how school travel has changed in recent years. It examines two school policies which experts have highlighted as impacting upon school travel in England and discusses their purpose, origin and place in school policy.

Chapter 6 explores the data selected to be used in this thesis. This incorporates pupil related data from the School Census 2009 including pupil's personal factors (such as age, gender, ethnicity and eligibility for free school meals) how pupils travel to school, and the distance from their home to their current school to the nearest school. This chapter also outlines other data used, including the DfE 2009 Budget data outlining the annual spending of all local authorities on school transport. Finally, details of all the school travel related policies provided by local authorities in England.

Chapter 7 and **Chapter 8** present the results from the school choice and statutory bus provision policy models respectively. Three types of econometric models detailed in Chapter 4 are developed and tested using the data described in Chapter 5 and the impacts that occur as a result of these two policies are explored.

Chapter 9 discusses the further impacts of the two main policies which influence school travel in England based on the results and findings from Chapter 7 and Chapter 8. The overall impact of the school choice policy and the statutory school bus provision policy is then discussed. The impacts of these policies based on the findings are also discussed and compared to the previous studies reviewed in Chapter 2.

Chapter 10 concludes this thesis with a list of recommendations made to policy makers and practitioners, acknowledgment of the limitations of the research and direction for further research.

CHAPTER 2 FACTORS AFFECTING SCHOOL TRAVEL AND TRANSPORT

2.1 Introduction

Chapter 1 of this thesis established that there are a number of issues relating to school travel that make it a topic area worthy of investigating.

The purpose of this chapter is to recognise what research has already been conducted in order to identify specific avenues of further study.

The chapter is structured as follows: section 2.2 defines 'school travel' and establishes a framework for considering the factors affecting school travel and transport. Subsequently sections 2.3, 2.4, and 2.5 examine the available literature on individual, area and institutional factors respectively, before section 2.6 concludes by setting out the research gap that emerges.

2.2 Defining School Travel

Attending school is a rite of passage which children make from a young age. Over the years the journey made from home to school has significantly altered. It was just part of a daily routine and little notice was taken. Thornthwaite (2009, p.11) explains that for many years school transport was "*the 'Cinderella' of transport – out of sight and out of mind*". However, this has gradually changed over time and the journey from home to school is becoming of more interest to Government, policy makers and academics. This is because the trends of mode choice and school travel are gradually changing and increasingly impacting upon society. Whilst these changes may seem small when compared to the broader transport system it is part of a growing transportation and health issue (McMillan, 2007).

According to Scheiner (2010) over the last decade there have been 5 key trip characteristics which have influenced all travel:

- Travel frequencies have remained steady
- Travel time expenditure has remained constant
- There has been a shift to personal car from non-motorised and public transport
- There has been a shift from slower transport modes to faster modes
- People are travelling further

In the past, school travel was just a matter of getting from home to school on time, but this has changed to incorporate many other concerns such as safety, health, sustainability, environmental issues and peak hour congestion (Thornthwaite, 2009).

Traditionally, children were given the responsibility of getting themselves safely to school by walking and cycling, yet over the years, this has been gradually changing based on the result of current transport trends.

This change in behaviour is also known as a modal shift or, often also referred to as modal transfer, which implies a change in transport mode for various reasons (Ryley, 2010). Globally, the numbers of children walking and cycling to school has fallen over the recent years with children increasingly being dropped off at school by car (Buliung et al 2009; McMillan 2007) and parents are taking a more prominent role in deciding how children travel to school.

It has been an issue in the United Kingdom (UK) that the school run causes problems on the roads (Moreton, 2006). Increased car use can lead to issues such as noise pollution, a decrease in fuel resources and an increase in road traffic accidents (Ryley, 2008). It has been claimed that as a result of increased car use, school run traffic causes congestion in residential areas, increases in carbon emissions, and makes school unsafe for children as a result of increased cars parked on side roads, cars driving fast, and dependency on car use leading to health problems (Pike, 2003).

School travel is an interesting area of research. One of the key reasons for this is that the main users (the children) are usually not the main decision makers in how they travel (Leslie et al, 2010). According to Koppleman and Lyon (1981), the study of travel behaviour is traditionally based on the relationship between observed travel and travel services characteristics. Children (particularly young children) have very little influence over how they travel. Hillman (1993, p.9) approaches this issue of parents being the main decision makers in school travel and suggests that this is a reflection of "*parental withdrawal of their children from increasing danger*" which, as a result, reduces children's freedom and independence outside their home. However, the underlying theory behind a child's travel behaviour still remains the same, whereby they want to receive maximum utility or the greatest benefit from the mode they choose to travel by.

The following sections will examine each of the factors that influence child travel behaviour (as a result of parental decision making), the modes of transport available to children for the journey to school and investigate the advantages and disadvantages of each. First, Lin and Yu (2011) suggest that school travel decisions are influenced by children, their parents, their household, their neighbourhood, the surrounding built environment and other activities (see Figure 2.1) which influence the travel behaviour of children.

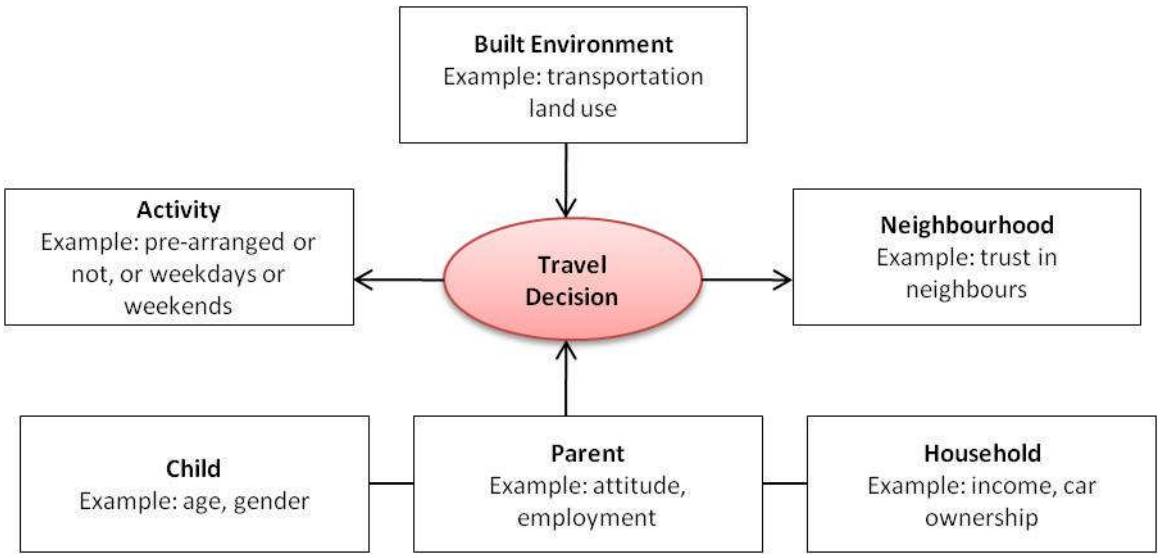


Figure 2.1 Influences on children's travel by Lin and Yu (2011)

Second, Fyhri and Hjorthol (2009) draw on a study of Norwegian school travel, noting the importance of parental attitudes in child travel behaviour. Figure 2.2 elaborates this further, explaining that the main parental concerns include safety, local traffic, stranger danger and the distance children are travelling.

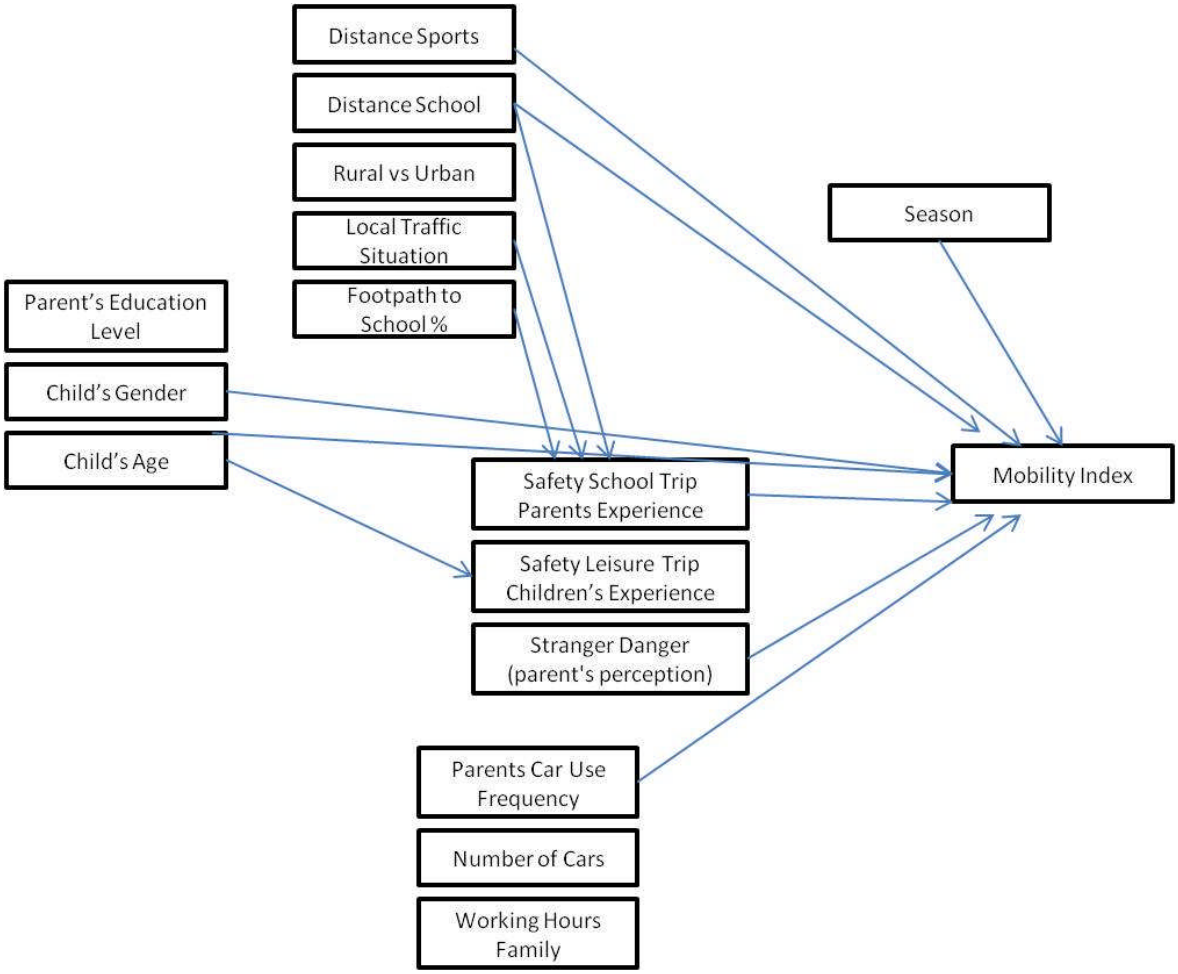


Figure 2.2 Structural Model of Factors Influencing Degree of Independence by Fyhri and Hjorthol

In addition, a number of other influences emerge from the literature, namely:

* Child's ethnicity
* Parent's working hours
* Climate
* Parent's Education
* School size, type and national curriculum
* Policy issues and influences
* Dedicated school buses
* Home-to-school transport provision
* Culture
* Topography
* School travel plans
* School choice policy

From the references, it is possible to represent these influences as shown in Table 2.1. Specifically, three main categories are presented as a means of structuring the literature review: individual factors, area factors and institutional factors.

Table 2.1 Literature Review Organisation

Category		Sub-Category	Characteristics	Section
1	**Individual Factors**	Child	Age	2.3.1
			Gender	2.3.1
			Ethnicity	2.3.1
		Parent	Attitude	2.3.2
			Employment	2.3.2
			Education	2.3.2
		Household	Income	2.3.3
			Car ownership	2.3.3
			Working Hours	2.3.3.
2	**Area Factors**	Neighbourhood	Perception of Safety	2.4.1
			Local Traffic Levels	2.4.1
			Culture	2.4.1
			Land Use	2.4.2
			Distance to School	2.4.2
			Population Density	2.4.2
		Natural Environment	Climate	2.4.3
			Topography	2.4.3
3	**Institutional Factors**	School	Size, Type, and Quality	2.5.1
			Curriculum	2.5.1
		Policy	Issues and Influences	2.5.2
			School Travel Plans	2.5.2
			Dedicated School Buses	2.5.2
			Statutory Home-to-School Transport Provision	2.5.2
			School Choice	2.5.2

2.3 Individual Factors

This section will explore all the individual factors which affect how children travel to school. The first part will explore the child related factors such as age, gender and ethnicity.

This will be followed by the parental related factors such as attitude, employment and education. As already stated, parents play a vital role in how children travel and are usually the main decision makers in their child's travel behaviour.

Finally, the concluding section will explore the household factors which can affect how children travel to school.

2.3.1 Child Factors

Children are the main focus of school travel. One of the key objectives of school travel is to ensure that a child arrives at school safely and on time (Thornthwaite, 2009). However, over time the way children travel has varied greatly when compared to how children's grandparents and even their parent's generation travelled to school.

In a study into the travel of young people in Canada, Marzoughi (2011, p.623) acknowledges that the travel of adults is a "*very saturated area, but researching travel behaviour of younger people is understudied*". When researching young people, Mazoughi notes that needs and demand patterns or freedom of choice differs greatly from that of adults, as do the decision making factors and influences on mode choice.

Age

Age is a key factor in how children travel to school, or to be more specific, in how their parents allow them to travel. Hillman (1993) states that the independence of younger children is the most restricted, particularly aged 7 years or younger in which parents usually do not allow them to travel alone after dark.

Fyhri and Hjorthol (2009) find that in Norway, age and distance are two of the most influential factors in how children travel to school and add that mobility usually increases as the age of the child increases (p.381). Cooper et al (2003) add "*as children get older they become less active, raising the possibility that active commuting may be a more-important contributor to daily physical activity in older children and adolescents*" (p.276)

Table 2.2 from McDonald et al (2011) shows data for US pupils in 2009 from the National Household Travel Survey (NHTS).

Table 2.2 Mode of travel to school in US pupils from McDonald et al (2011)

Mode	Elementary pupils aged 5-11 years	Middle School pupils aged 12-14 years
Car	47.5	40.5
Walk	12.1	10.7
Cycle	1.0	1.1
Bus	37.9	42.8
Other	1.5	4.9

Table 2.2 shows that most US pupils travelled to school via motorised transport. Car use was the predominant mode of transport for journeys to school in 2009 for both age groups accounting for almost half the pupil population, with travel by bus the highest percentage share. The percentage of pupils travelling via active travel modes (walking and cycling) was much lower at only 1%-12%

Mackett et al (2005, p.216) find contradictory results in an English based study in which older children travelled more actively (via walking or cycling) than younger children and notes it "*is possible that the children who are aged 12–13 are at or near the peak of their childhood levels of physical activity*".

From a 2-year study of Australian school children and documenting how they travelled to and from school, Hume et al (2009, p.199) found that age influenced how children travelled to school and concluded as children grew older *"parents' willingness to grant their children independent mobility following a reduction in their concerns about their child's safety".*

Overall, age is a significant factor in how children travel to school and the reason for this (according to previous literature) is that parents associate safety and independence with older children and only allow them to travel independently as they get older.

Gender

Gender appears to play a key part in how children travel to school. Current research from various countries suggests that male pupils travel to school more actively than female pupils (Hillman, 1993; Fyhri and Hjorthol, 2009; Loucaides and Jago, 2008; Leslie et al, 2010).

In a comparison study of monitoring physical activity of Danish and English primary school children, Cooper et al (2005) find that although if both genders actively travelled to school they were more likely to be active during the day. Boys were seen to be much more physically active throughout the school day than girls of the same age. The study also states that boys overall were much more likely to cycle to school than girls. Similar findings are produced by Carver et al (2010) in a research review. Gender was considered a contributing factor to perceived risk by parents for children travelling to school via walking or cycling. In particular parents were more concerned about girls than boys travelling to school via walking and cycling. It is likely this perceived 'risk' of safety leads to the above observations of travel behaviour.

In an examination of US children, McDonald (2011) finds that there was no significant difference in the number male and female pupils walking to school, but boys were 2-3 times more likely to cycle to school than girls. In an on-line survey, Leslie et al (2010) also determines that gender has little influence on school travel in a study of Australian secondary school children. A differing result was gathered by Shi et al (2006) in a Chinese study in which boys and girls had very similar levels of active travel to school, however it was also noted that emphasis on study and education as a result of the Chinese culture is likely to contribute towards this result.

It is expected that boys and girls are more likely to travel actively to school if there are perceived recreational facilities (such as a playground) close by, but that boys require a higher enjoyment factor to travel actively (i.e. meeting up with friends) than girls who are more likely to actively travel to school when they perceive the journey to be safe (Leslie et al, 2010). Traditionally, the journey to school was made by children walking or cycling to school without supervision. Yet, over time children have become less independent and resulting in the number of children walking and cycling gradually decreasing, whilst the number of children travelling to school by car is increasing (Fyhri et al, 2011; Hillman, 1993). Fyhri et al (2011) affirm that the distance travelled for the journey to school in Great Britain has increased for both primary school children (aged 5-10 years) and secondary children (aged 11-16 years) in recent decades and that this is parallel with the increasing number of children in England attending private schools. Thus suggesting that one reason for this increase in travel distance is as a result of the school choice policy which will be further discussed in the policy section of this chapter.

Much, (though not all) of the current literature notes that males travel more actively than females in the journey to school, this is apparently because females face more opposition from parents regarding concerns of safety more than males do (McDonald, 2011).

Ethnicity

Less research exists into how ethnicity impacts on how children travel to school. It is likely this is because specific details about children are difficult to collect in research studies. McDonald (2008) assumes that children from an ethnic minority background are more likely to travel to actively to school compared to white pupils as a result of coming from a poorer background, living in a high density area and having less access to a car.

Using a systematic review technique, Pont et al (2009) find a significant relationship between a child's ethnicity and household income with their level of active travel from an analysis of papers from multiple studies into child travel and health. They conclude that children from an ethnic background are more likely to travel actively to school than their white peers. Looking at US data, Hispanic children were 2.5 times more likely to travel to school by walking or cycling than white children. Dutch and New Zealand data also showed this trend in which children from an ethnic background were 2.5-3 times more likely to travel to school actively.

2.3.2 Individual Parent Factors

Thus far, the work investigated and reviewed suggests that parents are the main decision makers in child travel behaviour particularly for the journey to school. The following section explores the reasons why parents discourage more active and independent travel to school and aims to acquire a greater understanding into why parents dictate how their children travel to and from school.

Attitudes and Concerns

As Figure 2.2 shows, safety is dominant in the journey to school, and as a result there is surplus of research investigating the concerns and influences of safety regarding school travel.

The parental concern with a child's safety is paramount when determining how a child will travel to school and is one of the main barriers to them walking and cycling (Ridgewell, 2009). Children today are much more restricted than previous generations when it comes to travelling independently (Malone, 2007; Carver et al, 2008) because parents are particularly concerned with traffic levels which have increased over time and social dangers (Prezza et al, 2005).

On the 8th May 2009, one of the main news headlines was that the UK 'lags' on child road safety (BBC News, 2009) even though the number of deaths are relatively low and has fallen in recent years. The number of children (up to the age of 15) killed or seriously injured as a result of a road accident fell by 5% to 2,671 in 2008, including 1,660 pedestrians (a fall of 7% from 2007), and 81 children were killed on the roads (one third or 43 fewer deaths than in 2008). Against the 1994-98 average, which is commonly used to chart the longer-term trend, these latest statistics show a 61% fall in the number of road-related deaths and serious injuries among children (CAPT, 2008).

From taking more responsibility in their journey to school, children could learn more from alternate modes of transport to school than the personal car.

Meanwhile, in a recent New Zealand study, Lang et al (2011, p.509) note that "*in the minds of many parents, the negative ramifications of increased car travel are superseded by concerns for children's safety*".

Yueng et al (2008) also find in their Australian research that adult opinions and perceptions play vital roles in child independence, but add that even though parents claimed to be concerned with health, safety and supervision issues, their study claimed that only commuting distance was associated with increased odds of more active transport in children.

In a survey-based study into parental influence of school choice of Australian schools, Ridgewell (2009) lists the main reasons parents favoured their children being driven to school:

- Fear or concern regarding their children using modes other than the personal car
- Parents were already travelling to somewhere else
- The car was quicker
- The car was more convenient
- The distance was too far for the children to travel by other modes

Ridgewell (2009, p.53) notes that Australian parents claimed they would be willing to reconsider their views if "*there was less traffic*" or "*if my child were older*".

In another US study, based in South Carolina, Ahlport et al (2008) obtain similar findings in their focus group research investigating the barriers to sustainable school travel. Ahlport et al (2008) learn that the key issues of the parents interviewed were concerned about their child's personal safety (for instance, the potential abduction of the child during the journey) 'sibling factors' (such as young children being an embarrassment or difficult to travel with) and time management issues (particularly the parent's work schedule).

Christie et al (2011, p.946-947) list the main concerns derived from a focus group study listing the issues parents have with regards to allowing their children to cycle to school:

- Safety, especially in local traffic
- Their child's cycling and traffic awareness skills (or lack thereof)
- Security of their child's cycle and risk of theft

Yet, Christie et al (2011) conclude that many children would like the opportunity to cycle to school.

A Danish study conducted by Hillman (1993, p.9) determines that:

> "*when a comparison is made with the lifestyle of previous generations of children, it would seem to be a cause for concern that such a high proportion of parents should feel it necessary to escort their children (nearly all able-bodied) and to chauffeur them increasingly in cars*".

Hillman adds that this means the children have little exposure to the natural / outside world and finds that while most children researched owned a bicycle, not many were allowed to use it as their main means of transport regardless of the health benefits.

Research shows that parental travel behaviour is usually mimicked or repeated by children. For example, Emond and Handy (2011) state that if a parent was a regular cyclist, children were more likely to cycle to school. It is reasonable to assume that if a parent is a regular car user, the child will also be likely to be reliant on travelling by car.

Parental Employment

Recent research from around the world shows that parental work schedules and time limitations can result in children travelling to school in the quickest and most convenient ways, although this may not necessarily be the healthiest or more enjoyable modes of transport. Lin and Yu (2011, p.251) state that higher levels of employment lead to increased pedestrian numbers and level of activity on the streets and "*thus encourage children to travel by walking*".

O'Fallon et al (2004) find in a survey-based study that children are less likely to walk to school when parents work. They explain that in New Zealand current policies are trying to discourage the rise in car use (e.g. through workplace travel plans). However, policy makers do not always understand the needs of transport users and therefore behaviour does not always change, no matter what kind of 'carrots' or incentives the Government offers.

Cross-sectional research carried out in the US by McDonald (2008) highlights the significant impact a working parent had on a child's travel behaviour, finding that the likelihood of children walking or cycling to school decreased when their mother commuted to work (although this was not the case for children whose mother did not work outside the home). There was a less direct impact on travel when the child's father worked outside the home.

Gliebe and Koppelman (2005) confirm from a Seattle-based US study that parental employment directly influences how a child travels to school, noting that the younger a child is, the more likely they are to be dependent on their parents to drive them. This suggests that if McDonald's US trend continues, as more mothers become employed; the number of children travelling by car to school is likely to increase also.

Education

As already investigated, parental employment is a significant influence on how children travel to school, but in the research analysed, this appears to be more as a result of work schedules and timetables rather than income or education related. It is a common assumption that employment is linked to education levels. However, research undertaken by Kantomaa et al (2007) realise a positive relationship between parental education and how physically active a child is. The findings of Glick and Sahn (2000) also determine that the more educated a child's father was, the higher the academic achievement of the children.

Although still a contributing factor to school travel, parental education levels are a less researched area in child travel behaviour and appears to be less significant than the other factors which have been explored.

2.3.3 Individual Household Factors

This section aims to explore how the household in which a child lives influences how they travel to school because this determines how parents are likely to travel.

The following sections will explore how the household factors can influence travel behaviour to school.

Income

A higher income is usually associated with employment and thus longer working hours. While little research exists into how income affects school travel, it is likely all these factors that make up a child's parental structure affect a child's travel behaviour.

In the case of work based travel, Giuliano and Dargay (2006, p.18) state that income and employment notably increase daily travel, but note that travel per person decreases as the number of people living in a household increases "*presumably because household maintenance activities are shared*".

In school based travel, Kantomaa et al (2007, p.414) has conducted research into parental factors and school travel and whilst looking at levels of physical activity finds that "*high family income seemed to be a stronger determinant of sports club membership than parents' level of education, although this remained significant only in boys with respect to father's education after adjustments*".

Although not directly affecting how parents travel themselves, the level of physical activity demonstrated by the parent by means of joining a sporting organisation is usually determinant on their level of income and education. As already seen in other sections of this chapter, parental influence is one of the strongest affecting child travel behaviour. This is supported by a study of adult health in which Frank et al (2007) find there is a link between low income and obesity because those with lower incomes are less likely to travel actively. A further key finding was that white, higher income earning females, who moderately or strongly prefer a more pedestrian-oriented neighbourhood tend to have a lower likelihood of being obese (p. 1908).

In a New Zealand survey-based study, Collins and Kearns (2005) note that child pedestrian casualty numbers were higher in socio-economic deprived areas, suggesting that as well as parental income influencing children, higher incomes may also be linked to safety. Another explanation for this could be that in areas of higher socio-economic levels, car use is much higher thus reducing the number of child pedestrians and reducing the risk of injury.

It is also likely that high income leads to high car ownership, either as a result of having to travel more for work purposes, or by having more finances available to indulge in more non-work activities that require travel.

Car Ownership

It is a common assumption that higher levels of car ownership lead to higher levels of car usage or mileage. When the car is more available and easily accessible it is likely that both parents and children will tend to use this mode more frequently than other modes of transport. Research into trying to reduce car use goes back over 40 years (Fishman and Wabe, 1969). In recent years car use has steadily risen throughout the world for a variety of reasons such as rising income, convenience, independence and various psychological reasons, such as self-image and self-presentation (Van Acker and Witlox, 2010; Whelan, 2007; Gardner and Abraham, 2007; Davison and Knowles, 2006). Steg (2005, p.148) declares that the personal car is seen to be a status symbol and a representation of money and success and uses adjectives such as "*power, superiority, arousal, adventurous, thrilling and pleasurable*", to describe attitudes to owning a car.

Thus in the US, 4.6% of households owned three or more vehicles in 1969, but this figure has risen to 22.7% of households owning three or more vehicles in 2009 (NHTS, 2009). A similar trend has been seen in the UK with households owning three or more cars increasing from 4% in 1999 to 6% in 2001 (ONS, 2003)

Consequently, Giles-Corti et al (2011, p.549) state "*transportation planning that facilitates driving for the convenience of busy parents wishing to drop their child(ren) at school en route to work, increases traffic congestion on roads near schools reinforcing parental concerns about traffic safety and decreasing the safety of school routes".*

In a Swedish study of over 300 parents and pupils, Johansson (2006, p.167) finds that the most important socio-demographic variable which influenced how children travelled to school was the number of cars in the household "*which correlated positively with the attitude towards chauffeuring and the relative frequency of car journeys. Moreover, it correlated negatively with the attitude towards independent travel*".

As higher levels of car ownership continue to rise around the world, it is likely that more children will be transported to school by car than by other modes of transport because of convenience, cost and trip chaining purposes.

Working Hours

Getting children to and from school is usually part of a parent's daily routine. If parents have to travel to and from work, they need to combine getting their children ready for school alongside getting themselves ready for work or other activities they are partaking in that day. Ahlport et al (2008) state that time management, such as their work schedule or the need to transport siblings to other schools, can be some of the barriers to allowing their children to walk or cycle to school as opposed to driving them.

If children do not, or cannot, walk or cycle to school then they are usually driven by car or travel by bus (Wilson et al, 2007). The decision to choose the car as the main mode of transport for the journey to and from school is likely to be largely based on the parent's daily routine. McDonald (2008, p.324) says that "*parental time constraints need to be addressed if policymakers hope to increase rates of active school travel*".

Usually parents try and incorporate the school run into their daily journey to work. McDonald's US research shows that working mothers within families have the most impact on a child's travelling pattern. McDonald's analysis of the National Household Travel Survey (NHTS) shows that there has been a rise in the number of working women in recent years, with employment amongst mothers rising the most rapidly.

Using discrete choice modelling, Srinivasan and Ferreira (2002) find that families with children have higher levels of "non-work" travel and activity times than those without children and that single parent families and families in which both parents work usually have shorter non-work travel than households with one-worker. This could be a result of non-work travel taking place mostly on the weekend when everyone in the home has more time. This study suggests that when a family has a parent that works, trip journeys may be shorter as a result of time limitations but are also spread out more throughout the week and weekend than those of households with non-working parents. This is also supported by the findings of Chen and McKnight (2007) in which those who are unemployed generate less travel because the majority of their activities take place within the home unlike those who are employed and therefore have to leave home and commute to work.

Lastly, Pooley et al (2011, p.6) suggest that "*policy should focus on ways of making walking and cycling both easier and more 'normal' so that it can be more conveniently fitted in with necessarily complex household routines*".

Overall, children with parents who work are more likely to travel to school by car, as this is perceived as the most convenient mode to fit in with parents' routines. However, as Pooley et al (2011) point out, if policy makers focus on making it easier for parents to fit in active travel modes into the daily routine, the car may no longer be seen as the most convenient mode of transport.

2.4 Area Factors

The environment which children live in is a strong influence on how they travel to school. Area factors in this case include the type of region children live in, which determines the population of an area, the level of transport available and how accessible this transport is to children trying to access education.

Figure 2.2 highlights the area factors which influence how children travel to school. Factors such as distance travelled or journey length also links back to the safety issues explored in the previous section, but there are obviously trends in how children travel based on the distance they travel to school.

Table 2.3 shows how mode of travel and average distance travelled to school in the UK changes depending on the type of region which children live in. As expected, in more rural areas, where less transport is assumed to be available, the average distance children travel in higher than in other denser areas of England.

Table 2.3 Trips to and from school by main mode, region and area type: Great Britain, 2008/09

Percentage/miles/number

Type of area in which children live and attend school	Aged 5-16 years					
	Walk	Car	Bus	Other	Average Trip Length (miles)	Unweighted sample size (individuals)
Rural areas	21	38	37	4	4.4	916
Large urban (over 250k population)	51	29	15	5	2.1	812
Medium urban (25k to 250k population)	47	33	14	5	2.1	1,506
Small/medium urban (10k to 25k population)	53	29	14	4	2.3	473
Small urban (3k to 10k population)	47	34	18	2	2.7	430
Metropolitan built-up areas	50	28	19	3	1.9	911
London Boroughs	38	27	29	6	2.2	787
All England	44	32	20	4	2.4	5,113

(DfT, 2010)

According to the DfT; the average distance travelled to school by primary school pupils (aged 5-10 years) has risen from 1.3 miles in 1995/1997 to 1.5 miles in 2009. The average distanced travelled to school by secondary school pupils also increased from 2.9 miles in 1995/1997 to 3.3 miles in 2009. There has been a fall in the percentage of children walking to school from 47% to 43% over this time and a rise in car use from 25% to 31%. The following sections will explore these factors in more detail to understand how area factors influence modal choice in the journey to school.

2.4.1 Area Factors – Neighbourhood

Where children live plays a vital part in how they travel to school. There are several elements of the neighbourhood which affect the journey to school itself.

In a in-depth study of all Government maintained primary schools in one of the largest states in Australia, Giles-Corti et al (2011) explore the factors which encourage children to walk to school through a combination of GIS, survey, questionnaire and regression analysis. A random sample of 1,480 children from selected classes at participating schools provided their travel details to assist with this research.

The study determines that the main influences of walking to school include:

- Distance to school
- Traffic levels around the school and a child's exposure to that traffic
- Street design
- Street network connectivity

According to Gallimore et al (2011, p.184) to encourage healthier travel to school in form of walking, 3 barriers must be addressed:

- *Macro level environmental barriers*
  (e.g. long, indirect routes often associated with disconnected streets in low density suburban neighbourhoods)

- *Micro level environmental barriers*
  (e.g. insufficient crosswalks and traffic lights on a block)

- *Perceived barriers*
  (e.g., parent and pupil traffic concerns)

The following sections will focus on the perceived barriers (particularly safety and concern regarding local traffic levels) and the neighbourhood culture which can affect travel behaviour.

Perception of Neighbourhood Safety

Travelling to school by walking and cycling can be an important source of physical activity for children (Evenson et al, 2003). However, although these modes are the most healthy and cost effective ways to travel, there are barriers which prevent more children actively travelling to school, in particular a parent's concern with their child's safety travelling by these modes.

As already discussed, parental concern of safety is paramount in how children travel to school, but more can be done to educate children in how to travel to school safety by active modes to try and reduce the risk of injury (Nagel et al, 2003). Tudor-Locke et al (2001) adds that the promotion of active travel to school must consider a parent's real and perceived concerns for their child's safety as a pedestrian.

In two Australian studies conducted by Timperio et al (2004) and Carver et al (2008), 'stranger danger' was highlighted as a concern for parents when allowing their children to travel to school by walking or cycling. Carver et al (2008) explains that parents are particularly concerned with the issues of stranger danger, personal injury, bullying and road safety. Timperio et al (2004) also notes parental concern regarding 'stranger danger' and finds that 88% of parents of 5–6-year-olds and 81% of parents of 10–12-year-olds questioned were concerned about risk of assault from strangers showing that although the risk falls slightly as children get older, it is still a major concern of parents.

It is beyond the scope of this thesis to fully analyse the details of school travel decision makers. It is an issue that would be influenced by both the preference of the parents and/or guardian and also of the child making the journey. For the purpose of this thesis, the term 'user' will refer to the pupil travelling to school, but it needs to be remembered that the main decisions regarding mode of travel and distance travelled will inevitably lie with the child's parent. Throughout this thesis the term 'parent' refers to a child's legal guardian and the main decision maker in their travel behaviour.

Napier et al (2011, p.45) add that *"Societal pressures have created the expectations that children do not walk to school, in part due to parental and child perceptions that walking to school is neither safe nor convenient".*

This section shows that there is a significant difference between a child's perceived safety and a child's actual safety in the journey to school. Previous research suggests that perceived safety appears the more dominant factor for parents when deciding how their children will travel to and from school.

Local Traffic Levels

As safety and parental perception of safety is very important in school travel, it is important to understand the reasons behind these safety concerns. Giles-Corti et al (2011, p.549) find that *"the impact of traffic on children's walking behavior is amplified positively or negatively, depending upon neighborhood street network design"*. The higher levels of traffic in an area surrounding a school, the less likely children are to travel to school via walking or cycling due to safety concerns.

Morrongiello and Barton (2009) find that parental beliefs of the potential injuries that could occur to child pedestrians whilst crossing the road is one of the main barriers stopping them from letting children walk to school. Although traffic levels and road safety are often highlighted as one of the main concerns of parents, the level on injuries in children travelling to school is probably not as high as expected. Even though traffic levels rise, the number of child related injuries does not always reflect this (Kingham et al, 2011) In the UK ONS results show that very few child pedestrians are killed or injured in the UK. In 2006, 299 children in the UK under the age of 15 died as a result of injury or poisoning (CAPT, 2006).

Accidental injury is one of the biggest single causes of death in the UK but these figures are steadily declining. Although thousands of children are injured at home, around 1.1 million children were injured outside of their home with more than 360,000 of these accidents occurring at school. It is understandable that parents and guardians are concerned over their child's safety but also need to be concerned over their health and mental development, both of which benefit from physical activity and independence.

In Hillman's (1993) survey of school travel in the United Kingdom, only half the number of children in 1990 were allowed to cross roads on their own than in 1971, and even less were allowed to ride on the bus on their own.

Fyhri et al (2011, p.709) state that the main reason parents are concerned over children travelling to school is traffic danger and fears of assault, yet note that:

> "*Traffic danger as a reason is a paradox, since most of the local traffic around the schools is often generated by the parents themselves. By taking their children by car, other parents may feel obliged to do the same to avoid the risk of their children of being involved in traffic accidents by letting them walk or cycle*".

Children are not necessarily safer in a car compared to being a pedestrian and can lead to a catch 22 situation. Lang et al (2011, p.513) illustrate this by saying "*the heightened risks for child pedestrians in turn contribute to more parents driving their children to school*". Schofield et al (2008, p.75) find that cycling does have the highest safety risk in pupils travelling to school followed by walking (although wonders if high car activity is related to this) and warns that "*it is not risk-free, representing similar risk to walking, and is less safe than public transport*".

Panter et al (2010) find that in the UK, busy roads and direct routes are two of the main barriers to walking and cycling to school. Fotel and Thomsen (2004) ask: have dangers in neighbourhoods and cities increased so much that children need to be monitored in order to care for them properly, or is the monitoring of children's mobility done on behalf of parental perception with negative consequences to children's perception of space and place as a result?

Fotel and Thomsen (2004, p.2) acknowledge that trying to keep children safe from potential neighbourhood dangers can cause more damage by restricting children from travelling alone. Part of the decline in walking to school may be related to an overall decrease in children's "*independent spatial mobility*" (McDonald, 2008, p.325).

Lang et al (2011, p.513) also states:

> *"When a parent perceives the journey to school to be unsafe for a child to walk alone, whether they choose to drive their child or accompany them. Walking appears to be influenced by a perception of which option is more convenient. Most drivers perceived car use as quick and easy, despite time-consuming parking strategies".*

In a Swedish study of over 300 parents and children, Johansson (2006, p.166) found that "*a traffic environment characterized by few cars, low speeds, presence of pedestrian crossings and/or tunnels, correlated with a negative attitude towards chauffeuring, fewer car journeys and more independent travel*".

In a Canadian study conducted by Fusco et al (2011) even children have been found to express concerns about safety regarding the journey to school. Fusco et al (2011, p.6) reports:

> *"While cars were thought to be a necessary and important feature of social life, many children worried that drivers could hurt children by speeding or engaging in drunk driving. For some children (travelling to school actively and not travelling actively), cars were thought to make the travelling environment hostile, and for others (actively travelling to school) cars were just another part of their urban or suburban landscape".*

Overall, the previous two sections show that safety, and the perception of safety, are significant in determining how children travel. Much of the existing research finds traffic levels to be one of the main concerns parents have for their children's safety, or to be more precise, the risk of injury as a result of higher traffic levels. Paradoxically, this concern acts as a barrier to allowing their children to walk and cycle and usually results in parents taking their children to school by car thus adding to the current traffic levels. If this cycle continues, the likelihood of traffic levels reducing enough to decrease concerns regarding traffic levels seems rather improbable.

Culture

Stough and Reitveld (1997, p. 207) define culture in transport terms as "*a slow changing stable platform of values and rules upon which much faster economic and technical processes and activities occur".* This suggests that they way people travel is highly influenced by external effects.

Johansson (2006, p.166) states that

> "*The social urban environment i.e. sense of community ,was positively correlated with the attitude towards chauffeuring as well as car usage*" because "*neighbourhoods with a strong sense of community families may have better communication, which in turn could facilitate the organization of carpooling to children's leisure activities*".

Yet when comparing travel behaviour of people living in an urban area (i.e. New York City) to people living in a more suburban area, Chen and McKnight (2007, p.393) find that respondents living in the city performed less "dropping off / picking up" activities than suburban respondents.

Culture and social appearance also play a part in how children travel to school. According to Emond and Handy (2011), social environment factors are very important. In a study into cycling to school, Emond and Handy (2011, p. 4) explain that "*peer influences work both ways. Bicyclists are more likely to agree that their friends also bicycle and disagree that driving is the coolest way to get to school*". However, it was also noted that parental influence was much stronger than peer influence.

2.4.2 Area Factors – Built Environment

Where children live and their surrounding environment is another determining factor in how children travel. Over time as the global population increases, residential areas around schools are becoming more densely populated resulting in more homes, roads and traffic present.

All these elements together increase parental concerns over safety and therefore create more barriers to children travelling to school by walking or cycling than would have been the case in previous decades.

Handy et al (2002, p.72) suggests that more needs to be done to improve journeys for pedestrians through mixed use development, street connectivity and good design and adds that this would enhance the feasibility and make walking and cycling appear more attractive to potential users by "*reducing the physical and psychological barriers*" in an attempt to improve the health and quality of life of residents.

In a UK based study, Panter et al (2010) find that (when distance is not a considered factor) children travel less actively (by walking or cycling) to school in areas which are highly connected and more deprived with a route from home to school which was short, direct and included a busy road.

According to Gallimore et al (2011, p.184):

> "*To restore the option of healthy walks to school, communities must overcome three types of barriers: Macro level environmental barriers (e.g., long, indirect routes often associated with disconnected streets in low density suburban neighborhoods); micro level environmental barriers (e.g., insufficient crosswalks and traffic lights on a block); and perceived barriers (e.g., parent and student traffic concerns)".*

The following sections will explore in further detail how a child's surrounding environment determines how they are likely to travel to school based on the type of area they live in and the distance they are required to travel to school and explore how this affects mode choice in the journey to school.

Land Use

The neighbourhood in which children live in can affect how they travel to school. The UK is conventionally categorised into the following geographical groups:

- Rural
- Urban
- Metropolitan
- Inner London
- Outer London

(National Statistics, 2001)

Due to the nature of these areas and the transport mode available to pupils, the way that children travel to and from school is greatly influenced by the area they live in. Boarnet and Crane (2001) state that urban form and travel behaviour are key to trying to reduce car use in travel behaviour. It is expected that pupils who live in more rural areas are less likely to travel to school actively by walking and cycling, but would resort to motorised modes of transport that can carry them further distances faster and safely.

Srinivasan and Ferreiraland (2002, p. 227) explain that land use characteristics commonly used in analysis to predict household travel behaviour include:

- transit access,
- commercial-residential balance,
- cul-de-sac design,
- non-work accessibility and
- pedestrian convenience

This could be due to more rural areas having less accessible roads, less lighting, more isolated areas resulting in further travel and less accessibility to public transport and roads. In a Californian study, McMillan (2007, p.77) notes that "*neighborhood safety, traffic safety, household transportation options, caregiver attitudes, social/cultural norms, and socio-demographics*" also influence how a child travels to school and concludes that pupils living within an urban area are more likely to travel via non-motorised modes.

Kerr et al (2007) also finds that children who live in denser areas are more likely to travel actively than those who do not. Müller et al (2008) acknowledges the benefits of active travel in Germany but reminds us that this is not always possible for children living in rural areas. However, this is still an option for those living in urban and suburban areas. Johansson (2006, p.167) suggests that "*Urban planners should therefore aim to reach a standard where the majority of parents would come to trust the environment. Parents with a high level of trust in road users expressed a more favourable attitude towards independent travel*".

Johansson (2006, p. 167) concludes that:

> "...*planners and policy-makers should focus on improvements in the traffic environment and the promotion of a favourable attitude towards independent travel in order to decrease car usage and increase children's independent travel. Although it is vital to continue the on-going efforts to increase traffic safety, they are not likely to be sufficient to reduce the trend of chauffeuring children*".

Emond and Handy (2011) find that children are more willing to cycle to school provided there is a safe and direct route from their home to school. However, according to Gallimore et al (2011, p.184) adds "*residential density brings more students within walking distance of their school, and pedestrian-friendly street designs allow for short and convenient walks. Land use diversity, although important for adults' walks to multiple destinations, might be less important for children's walks to school*".

As Gallimore et al (2011) suggests, although land use is important in how children travel, the distance they travel is perceived to be more important and more of a contributing factor to which mode of transport children use to travel to school.

Distance to School

Distance to school usually helps determine mode choice in the journey to school; cycling is seen as more appropriate for shorter distances, but public transport is seen as more appropriate for longer distances to school (Müller et al, 2008). For instance, Marshall et al (2010, p.1539) report that in the US, when a child's school is close to home (approximately 1 mile) the likelihood that they will walk increases, but "*the odds of walking decline rapidly at longer travel distances: for travel distances greater than 1.6km*". This is also supported by the findings of Davison et al (2008) in a literature based study, in which children who live 1 mile (or 1.6km) from their school are 3-5 times more likely to walk to cycle to school than those who live further away.

In a study of pupil's travel behaviour in Davis, California, Emond and Handy (2011) determine (using bivarate analysis) that the distance children are willing to cycle to school varies between cyclists and non-cyclists. 67% of non-cyclists interviewed stated that 2.5 miles was too far to cycle from home to school, however only 23% of cyclists felt this too far to cycle to school.

When travelling further distances to school, children are more likely to use motorised transport than other modes.

In a German study, Müller et al (2008, p.342) state that *"[journey] distance strongly influences the travel-to-school mode choice, students switch from modes appropriate for short distances like cycling to modes appropriate for longer distances like public transport*". Rosenbaum (1994) acknowledges that the car does provide utility to the user and can have benefits for children as it can allow more accessibility as parents or guardians can drive them to places public transport may not go, as the car is also a more convenient for transporting particularly very young children.

Lang et al (2011) also link distance with time constraints in Australian pupils, and state that parents make their decision on which mode children will use in their journey to school based on how far they have to travel and how long this journey will take them by certain modes and state that an important factor is 'convenience' (p.513).

This section shows clear relationships between mode choice and distance to school. Active travel through walking and cycling (1 -2.5 miles) are more common transport modes for shorter distances whilst motorised transport is used more for further distances.

Population Density

To aid accessibility, schools are usually located in more densely populated areas. This generally leads to increased and complex traffic patterns involving both car drivers and buses leading to pedestrians and cyclists being more vulnerable (LaScala et al, 2004).

Falb et al (2007) have shown using Census data from 1700 schools in the state of Georgia (by means of multivariate regression analysis) that high population density, smaller schools and high street connectivity can lead to more children walking to school. Lower population density can lead to more safety concerns in areas which have reduced transport accessibility and less infrastructure and facilities available for pedestrians and cyclists (such as road crossings, pavements and cycle lanes) can lead to increasing safety concerns of parents and thus creating barriers to sustainable travel to school.

In contrast, the findings of Panter et al (2010) in the UK in which children who live in highly connected, but more deprived areas with short direct routes to school, which included busy roads are less likely to walk and cycle to school. According to Gallimore et al (2011, p.187) urban routes are considered more 'walkable' for children travelling to school than suburban routes based on "*traffic safety, accessibility, pleasurability, crime safety, and diversity but less housing density"*.

Boarnet and Crane (2001) add that people who prefer not to drive, tend to live in areas of higher density as mixed use neighbourhoods offer more transport alternatives which are readily available. Dalton et al (2011) support this and learn that pupils are more likely to travel actively to schools located in areas with higher residential densities (which hosted on-street parking, sidewalks or curbs, tall buildings and fewer trees).

Lin and Yu (2011) also determine that pupils are more likely to travel to school actively in denser urban areas than in rural areas as a result of safety concerns, vehicle speed and travel distance.

It is interesting that the previous studies discussed above find that parents claim that they feel children are safer in areas which are more densely populated, yet this has also been highlighted as a safety concern as higher population levels usually leads to increased traffic levels, which is yet another barrier to walking and cycling to school. Tranter and Whitelgg (1994) found that even in a city such as Canberra in Australia (which has been designed around the safety of pedestrians and cyclists) concerns of parents regarding traffic and 'stranger danger' still exist. This suggests that even if a residential area has low population density, or has sufficient pavements and cycle lane facilities, the parental concerns of attack or injury outweigh the population density factors.

2.4.3 Area Factors – Natural Environment

The surrounding natural environment in which children travel is another important aspect of travel behaviour. For example, in a Canadian study into active school travel Fusco et al (2011, p.4) find that is children are very aware of their surrounding environment, and feel safer and more willing to travel actively in an environment in which they feel comfortable as places such as home and school *"conveyed a sense of safety*".

However, changes to this environment can result in barriers to walking and cycling to school and a change to motorised transport. The following sections will explore how climate and topography affect travel behaviour.

Climate

Few of the studies on travel behaviour note the time of year the data collection took place. Only a few studies have taken place more than once a year to allow for seasonal comparisons to be made in travel (e.g. Kilpeläinen and Summala, 2007; Koetse, and Rietveld, 2009; Keay and Simmonds, 2005). However, it is common to assume that during warmer and drier weather, the likelihood to walk or cycle increases and when the weather is cold and wet travel via motorised transport increases.

In school travel, the weather influences walking and cycling to school the most as pupils tend to use the bicycle as opposed to car for travelling shorter distances to school depending on the weather as determined in the results of Müller et al (2008). This study focuses on distances travelled to school and models the impacts of changes in distances and climate on mode choice. Using a multinomial logit model the research was conducted using the details of 4,650 pupils from colleges from Dresden, Germany to determine the factors which influence mode choice. The results show that pupil's travel was influenced by distance and the weather (the number of pupils cycling particularly falls during colder weather) but the car gave the users maximum utility regarding both of these factors.

However, Nankervis (1999) states that a change in weather does not necessarily mean a user will switch from cycling to other modes of transport and that many cyclists will still cycle regardless of weather or climate.

Changes in the weather do not just affect the comfort levels of travel but wet weather reduces the level of safety, travel speeds and volume of traffic (Kilpeläinen and Summala, 2007; Koetse, and Rietveld, 2009) for all modes.

In a study of travel in Melbourne, Australia, Keay and Simmonds (2005) find that in many countries increased rainfall usually leads to an increase in road accidents. It is likely that this trend would also increase the parental concerns of children's safety in the journey to school. Keay and Simmonds (2005) find that rainfall in winter / spring has the highest impact on travel and reduces traffic volume and increases the risk of accidents and also note the reduction increases further when comparing day time travel and night time travel.

While researching travel behaviour in Brussels, Khattak and De Palma (1997) find that 69% of the total 1,218 respondents had access to an alternative transportation mode as well as their normal mode of travel, but that only 5% would actually change between transportation modes according to season. They also learned that if the accessibility of transport is high for school children (because their common modes of travel are always available), changes in the weather are less likely affect travel routines (e.g. time of departure).

Weather patterns between summer months and winter months appear to only have a small effect on mode choice, because many users do not change their travel habit during the year. However Koetse, and Rietveld (2009, p.216) note that such findings suggest there is a "*limited substitution between car and public transport*".

Topography

As already explored, parents prefer their children to have a safe and direct route to school when walking or cycling. However, not all areas can have a direct or straight route from home to school, particularly in rural areas. For example, when investigating travel behaviour in Northern England, Pooley et al (2011) found that walking and cycling rates reduce in areas with varying surfaces and which comprises of hills.

When the natural environment around a child's home and school does meet the idealised 'flat and straight' preferences, it is likely they will begin to rely on motorised transport especially during the winter months (Dalton et al, 2011). Typically, rural areas consist of more hills, winding roads and uneven surfaces than urban and suburban areas, and it would be expected that as a result the number of children travelling actively would be less in a rural area than an urban area.

Yet, in a literature review study conducted by Sandercock et al (2010), it appears that children who live in rural areas are significantly more physically active than children living in urban areas as a result of more open areas, but that rural children are less physically active than suburban residents. The authors suggest this could be due to parks, fields and sporting activities being more accessible to suburban children than for rural children. Less research has been carried into the natural environmental factors which affect school travel, however it is likely this is because there is very little policy makers and planners can do to encourage sustainable travel when poor weather or uneven terrain are a barrier to walking and cycling to school. However, it is still important to note that these factors influence school travel and that more motorised travel is expected in these less built up areas.

2.5 Institutional Factors

The previous sections of the literature review have explored the individual and area factors which influence school travel. However school and policy factors are also important elements in child travel behaviour.

Where and how children travel is often determined by the school they attend and the local authority policies available to them. The following sections will explore the school based aspects which influence school travel focusing mostly on school type and size. The second part of this section will explore the current school travel policies in place which affect how children travel and how policies are changing to try and reduce children's reliance on car use.

2.5.1 School Factors

From the literature, most of the studies focus on the individual pupil related factors in travel to school, but only a few investigate the school related factors which influence school travel.

The following sections will look at how school size and type influences child travel behaviour and how the school curriculum could help to encourage less car reliance and more physically active travel.

School Size, Type and Quality

In the past decade, the distance children (both primary school aged and secondary school aged) travel to get to school in Britain is gradually increasing (Fyhri et al (2011). This increase is at least partly as a result of "*bigger units and more children in private schools*" combined with "*an increase in car use and decrease in bicycling and walking*" (Fyhri et al, 2011, p. 703).

There are few studies into school size and type and the impacts this has on other areas. Newman et al (2006) note that the average secondary school size in England was gradually increasing from 820 pupils in 1992 to 1000 pupils in 2002 and the average number of pupils in a US high school had also risen from 684 pupils to 2000 pupils over the same timescale.

Findings from modelling exercises conducted by Foreman-Peck and Foreman-Peck (2006, p.157) suggest that larger schools have poorer public exam results in the long run and perhaps as "*school size affects attendance rates as well, and since attendance contributes to exam outcomes, there is an additional small indirect impact of size*". These findings are also supported by Jones et al (2008) in which larger schools also had higher dropout rates and poor attendance.

Kerr et al (2006) link back to the issue of distance and mode of travel and suggest that if more schools were developed within local neighbourhoods and communities, the shorter distances to school would allow children to have the opportunity to walk and cycle to school each day.

Currently, there are many different types of schools available to pupils. Parents are no longer restricted by catchment areas in many countries when choosing which school to send their child to (i.e. in the UK, US or Australia) and therefore have more choice in where they attend. Usually parents wish to send their children to the schools deemed the 'best quality'. Gibbons and Silva (2011, p.325) define school quality as "*measured by test scores tends to dominate parental perceptions of educational excellence*". This is also supported by the findings of Bast and Walberg (2004, p.438) which find "*parents put academic achievement at the top of their list of concerns when choosing a school, meaning they presumably are acting in their children's long-term best interests*". The importance of school quality is voiced by O'Shaughnessy (2007) adding that it is not only the quality of the school which parents consider, but also the quality of pupils each school attracts.

According to Gibbons and Silva (2011) when choosing which school to send a child to most parents consider academic performance and their child's welfare to be the most important issues to address. Using regression analysis, the study finds that a school's academic achievement or 'quality' is usually the main reason for selecting a school even though this does not directly affect how happy a child will be at the chosen school.

Gibbons and Silva state the school quality "*only moderately correlated with their child's enjoyment. More generally, most of the correspondence between child and parent perceptions is more easily explained by shared family attributes and experience, than by the observable characteristics of the school*" (p.325).

Walker and Clark (2010) find that in rural communities school choice can be a very complex process as some parents have familial ties with the local school in their local community and that they had a sense of duty to support that community and those travelling 'out-of-catchment' feel like 'outsiders'. However, other parents who did not feel the local school as 'right' have concerns over the incurring costs that required more flexibility particularly for the mother of children (who traditionally took the children to school).

From a negative point of view, Burgess et al (2005) note that school choice can also lead to too much demand on certain schools forcing them to have to ration places. Burgess et al (2005) add that originally value of homes would increase around schools considered to be 'high quality' but with the introduction of school choice in some cases this has changed. Finally, the school choice policy may lead to lesser quality schools not being monitored or receiving the attention needed when parents can choose for their children not to attend them. Burgess et al (2005) suggests there needs to be regulations or standards enforced to ensure this does not happen.

Burgess and Briggs (2010) state that the policy also opens up to parents trying to 'work' the system to ensure their children attend a certain school and not necessarily following the rules as others.

School size and quality link back to school quality and whether schools are perceived by parents to be of good quality. Schools of higher academic achievement and higher quality are seen as more attractive to parents who are willing to travel further to enable their children to attend. This is one result of the school choice policy which will be explored in more detail in the Institutional section of this chapter.

School Curriculum

Some studies touch on the issue that when pupils are physically active during the day (either by free play or sports or physical education lessons) they are more likely to be willing to travel actively to school.

Chodzko-Zajko et al (2008, p.605) list the main barriers to active travel as:

> *"Lack of funding for PE and physical activity programming in the school setting, lack of safe and affordable opportunities for afterschool physical activity, poor communication between the school and parents, and between the school and local community partners, environmental constraints that limit physical activity such as lack of sidewalks, traffic, unsafe conditions, lack of equipment, and inadequate/improper facilities".*

Merom et al (2006, p.685) adds that "*schools could take a leading role in educating children and parents and other members of the community of the transport options available and the multiple health benefits of active transport*". This is confirmed by Hammerschmidt et al (2011, p.63) who add that schools are a "*natural way*" to promote active travel.

Cooper et al (2005) suggest that children are more likely to travel to school by walking and cycling when they are more active in other areas of their daily life (e.g. lunch time activities or after school activities). If children are encouraged to be active in all aspects of their life by parents and school, it is likely that they will be more willing to travel to school in a more sustainable way. However, if the area in which children live in is more pedestrian friendly and thus accommodating the parental concerns, children are more likely to actively travel to school (Kerr et al, 2006). Hume et al (2009, p.199) add that "*programs that aim to increase active commuting throughout childhood and in adolescence may have a positive effect on children's accumulated physical activity*".

Zenzen and Kridli (2008, p.242) take this even further in their American study and declare, "*Schools are a critical part of the social environment that shape children's eating and physical activity patterns*". Procter et al (2008) also confirm this view of schools having a strong impact on child health. Their UK based study states that children spend much of their waking hours at school and that more focus needs to be in promoting healthy lifestyles within the curriculum.

More research could be done to determine how schools can encourage more walking and cycling to school as opposed to car travel. Although schools take responsibility for children's level of physical activities during the school day, it does not appear that schools do much to encourage active travel to school.

2.5.2 Policy

The last major subcategory identified in this review concerns policy influences. Within this, it is perhaps logical to first outline the issues that emerge from the literature before commenting on the effects of some of the policy solutions that have directly and indirectly affected school travel.

According to Riera-Ledesma et al (2011, p.391) "*Transportation of students to and from schools in the safest, most economical and convenient way is an important issue faced by local governments and administrations involved in its management*".

Children need to be able to access education if they are to attend school. In some instances, children struggle to access education due to location of schools, lack of public transport services and cost of travel (Vasconcellos, 1997). Kenyon (2011) finds that poor transport provision can negatively impact upon the academic achievement of pupils.

To ensure children can access education, most Governments have policies in place to aid children getting to and from school. According to Bray et al (2011, p. 522) the term 'transport policy' can be defined as "*the approach and underlying principles adopted by governments to fulfil their responsibilities in the transport sector*". However, even though children are the main users of school transport "*in the policy making/reform process, children's views are rarely taken into consideration*" (Fusco et al, 2011, p.7).

Bamberg et al (2011) adds that transport policy can be divided into 'hard' and 'soft' categories:

- Hard policies can include improvement to infrastructure, management of public transport services, increasing the cost of car use, or limiting or prohibiting car use
- Soft policies can include personalised travel planning (such as school travel plans)

Most examples of school transport policy are soft policies including the school choice policy, the statutory home-to-school transport provision policy, school bus policies and school travel plans. It is difficult for Government bodies to ensure that all services getting children to and from school are of high standards and quality when costs need to be restricted as a result of funding limitations. Inevitably there are issues which arise with school transport policies. As found throughout the thesis so far, most significant issues relating to school travel include safety, health, congestion, cost and operational constraints.

Safety

Safety issues mainly refer to three concerns: road safety / traffic related issues are mentioned by Hallsworth et al (1998, p.163) who find that policies have to adhere to parental concerns of their child's safety ('stranger danger' in particular) but as a result states that "*where possible, children are now kept off streets and placed into cars*". The high profile issue relates to urban traffic congestion particularly in the morning peak which is often blamed by motorists on the school run who note that traffic flows much more freely out of term time (Kingham et al, 2011).

Regarding non-motorised transport, Ridgewell (2009) lists the following concerns of parents:

- Child is too young
- The distance is too far for them to travel
- The child might be hit by a car during the journey
- The child might be assaulted during the journey
- The child might be bullied during the journey

Stranger danger and bullying is a great concern as found by Carver et al (2008) and Timperio et al (2004) and school travel policy makers need to have contingency plans in place to deal with issues as well as doing all they can to ensure children feel safe whilst travelling to and from school.

Health

Interestingly, the ONS and DfT (2008) note that while 18% of traffic is made up of home-to-school trips at 08:45, between 08:00 and 08:59 the proportion is just 15%. Moreover, during school holidays not only does home to school trips disappear from the network, but adult commuting trips in the peak hour fall by 15% too. The main health concerns relating to school travel include obesity, mental well-being / independence and air pollution.

Stough and Reitveld (1997) note that transport policies are heavily influenced by the interests of stakeholders in the decision making process. One of the main stakeholders in school travel is the school children themselves. The numbers of children travelling to school via healthy or active methods (such as walking or cycling) has fallen gradually over the last few decades. As a result, children are becoming more reliant on motorised transport resulting in an increase in health issues (Christie et al, 2011; Dreyer and Eagan, 2008) and declining independence (Johansson, 2006). School travel is a popular topic as childhood obesity is an increasing issue.

Many children are travelling by car and have high car dependency and some studies suggest that this could lead to numerous health and mental issues (Carver et al, 2008, Ells et al, 2005, Fyhri and Hjorthol, 2008, Hillman et al, 1993; Limbers et al, 2008; Mackett et al, 2005, and Wen et al, 2008). The car can been seen to offer more freedom and flexibility for the journey to school (Hillman, 1993) but this can lead to children becoming increasingly dependent on this mode of travel.

Ridgewell et al (2009) defines being car dependent as *"where driving has become a habit and often a perceived necessity"* (p.44). Ells et al (2005, p.441) acknowledge that obesity is a "*complex disease with different genetic, metabolic, environmental and behavioural components*". Therefore, lack of exercise cannot be blamed for all cases of childhood obesity, but it certainly plays an important role in keeping children fit and healthy.

However, Ells et al (2005) do state that less than 1% of obesity cases are a result of a direct generic disorder and that the main causes are from parental role models, physical activity, diet and psychological factors.

Once again, even though children are the main users or travellers, they still have less influence over how they travel than their parents. Even regarding safety Carver et al (2008, p.224) note that "*The limited evidence suggests that parents' views rather than children's are stronger influences on children's physical activity, including independent free play and active transport within the neighbourhood*".

McDonald (2007) notes that active school travel globally has taken a dramatic fall (particularly between 1969 and 1983 in the US), yet the rate of children being overweight grew during the same timescale.

If the change in how children travel to school is having such an impact on children's health all over the world then more needs to be done to understand why they are travelling the way that they are and whether anything can be done to encourage less car reliance.

Cost

Cost is one of the main issues when planning or implementing a transport policy (Brannigan and Paulley, 2008). Policy makers need to try and make sure that all the cost of implementing and assessing policy remain within the funding limits but also give a good quality service to users.

Browne and Ryan (2011) explain that many transport users are not aware of the external costs of travel activities. Vasconcellos (1997) states that to evaluate school transport provision there needs to be a clear definition of cost, safety and comfort through the form of cost per pupil and per mile, the number of accidents, average vehicle occupancy and average travel time.

Meanwhile, the cost of funding policies is also a major concern, particularly in the current economic climate. Hine (2009) for example, reports that in Northern Ireland during 2007/08 £65m million was spent on school transport, a rise from £57m in 2002. According to the Northern Ireland (NI) Department for Education (DE), school transport is at the top of the list facing a reduction in order to make savings in the draft 2011-2015 budget. School transport in NI is facing a reduction of £5m and offering a saving pro rata of 6-7% (Citizens Information, 2011).

As Table 2.4 shows, much funding is spent by developed countries on school policy and trying to ensure children can access education effectively. Although large amounts are spent around the world on providing school travel, Hine (2009, p.38) acknowledges that this spending is necessary in getting children to school and discouraging car use as an alternative: "*Evidence suggests that there is a surpassed demand for school transport and that reductions in school bus transport result in an increase in car journeys*".

Finally, Geerlings and Stead, (2003) and Vasconcellos (1997, p. 132) note the need to consider a whole range of other planning constraints namely:

- Land use planning
- Current environmental policies
- Pick-up and drop-off time, considering the daily schedule of families and the comfort and safety of small children;
- Total travel time cycling or inside the bus, defined according to pupil age;
- Walking time, considering the age of children, type of terrain, and environmental conditions
- Vehicle capacity;
- Safety, especially driver training vehicle speed, and road conditions;
- Location of vehicles overnight parking, according to pupils' final destination and drivers' working schedules;
- School hours and escorted attendance while waiting in school;
- Drivers' work schedules, feeding and resting.

In terms of policy relating to school travel specifically, the literature tends to focus on various direct and indirect policies i.e:

- Statutory Home-to-School Transport Provision
- Dedicated School Buses
- School Travel Plans
- School Choice

These will now be discussed in turn.

Statutory Home-to-school Transport Provision

Rye and Carreno (2008, p.242) define a concessionary fare as "*A concessionary fare is offered to defined groups of people to travel at a reduced fare on public transport*". Most concessionary schemes have a common goal to tackle accessibility issues (Rye and Scotney, 2004, Baker and White, 2010).

Although concessionary fares benefit those who are eligible for free bus travel, there is still a cost to be paid for the service. Bristow et al (2008) recognise the concessionary schemes come at a high cost and can lead to increases in bus operating costs and bus fares for other passengers as well changes to frequencies and timetables and impacting upon local communities. In the case of school travel, this funding comes from the annual funding distributed by the Government to each local education authority.

Some local authorities in England offer school children concessionary fares to try and reduce car reliance. London is one of the most built up cities with a unique public transport organisation. Transport for London (TfL) has an integrated transport scheme in which the same method of payment can be used on both buses and the underground trains.

TfL offers all pupils unlimited free travel on all public transport in London including bus services, underground services and rail services when travelling with a photo smartcard called an 'Oyster' card which they use for payment. The scheme was introduced in 2005 and (as expected) since then the number of car journeys has fallen by 6.4% or the equivalent to 3.3 million annual car journeys and 7.5 million miles (TfL, 2010).

Elsewhere in the UK, Metro is a similar organisation responsible for the transport of 2.1 million residents of West Yorkshire. Metro offers a School Plus Metrocard for a fee which allows unlimited travel throughout West Yorkshire any day of the week. These schemes are two examples of when local authorities offer a more 'generous' policy to encourage sustainable travel to school above the required home-to-school transport provision (Metro, 2011).

As a result of the current and changing laws regarding school travel, local authorities have put in place several policies specifically regarding school travel. The following sections will examine the current policies in place and how they impact upon pupils travelling to and from school.

In different countries, Government organisations try to enable all pupils of compulsory school age to access education. In many cases, pupils rely on Government provided transport, usually in the form of bus travel, to transport them to and from school each day.

Looking in more detail at the use of public school buses, Nutley et al (1990, p.190) find that there are three ways to meet the statutory obligations to provide school transport:

- Paying the local bus operator to carry on existing stage services, where the routing and timing are convenient.
- By contracting an operator to provide a bus exclusively for school pupils on routes and at times determined by locations of schools and pupil's homes.
- By exclusive use of the local authorities own vehicles.

Thornthwaite (2009) has undertaken extensive research into school travel policies and the mechanisms for the public funding for home-to-school transport provision. Table 2.4 draws on the work of Thornthwaite (2009) (and adds additional cases based on information from individual national education and Government websites) to summarise current experience in several developed countries in terms of eligibility criteria for receiving subsidised home-to-school transport.

From Table 2.4 it can be seen that the criteria for school transport provision is relatively similar for all of the cited examples, being based on the distance children have to travel to school from their home and the age of the pupil – a situation that suggests that any results will be of widespread interest.

Table 2.4 Public funding regimes for home-to-school transport provision in selected countries

COUNTRY	UK	IRELAND	BELGIUM	NETHERLANDS	GERMANY	FRANCE	USA	AUSTRALIA	NEW ZEALAND
SCHOOL POPULATION	12,671,000	700,000	2,428,000	3,380,000	14,065,000	12,265,000	68,041,000	700,000	900,000
POLICY SET / GOVERNED BY	Local Education Authority by county	DES national scheme - delegated to Bus Eirann	Public Authorities	Municipality	Lander - although some leave districts / municipalities with lots of discretion	Department (Regions)	School Districts by State	Legislative authority by State	National Ministry service agent and schools
COMPLUSORY SCHOOL AGE	5-16 years	6-16 years	6-18 years	5-18 years	6-15 or 16 depending on Lander	6-16 years	Between 5-18 years - depending on state	Between 5-17 depending on state / territory	6-16 years
SCHOOL TRANSPORT ENTITLEMENT / CRITERIA	Minimum walk distance - usually 2 &3 miles and sometimes depending on age, also unsafe route, special needs	If over distances may buy seat - Euros 46-71 depending on age of the child	Distanced based - 3/10 miles (3 miles) depending on age or max travelling time 2.5 hours	Distance based	Minimum walking distances, also unsafe route and special needs	Based on walking distances and usually free	Distance limit depending on state	Differs by state - generally based on age and distance limits to nearest school and availability of public services	Age and distance criteria

Sources: Thornthwaite, 2008; Zwerts et al, 2010; Citizens Information, 2010; US Department of Transportation, 2008; Department of Infrastructure, Planning and Natural Resources, 2004; NSW 2008/09 Household Survey, 2010; Ministry of Transport, 2009.

Meanwhile, Hine (2009) investigates the home to school transport policies in Northern Ireland. This study highlights the issue of cost in school policy (around 5% of the annual education budget is spent on school transport at around £65 million in 2008 as stated at the beginning of this section) and how local authorities are struggling to fund this policy even resorting to some travel rules which can be debated as unsafe (such as the 3 for 2 seating rule on buses in which one pupil stands on the bus for every 2 seated). Hine explores the concern regarding this policy but does not fully research the types of pupils travelling on Government provided transport. A greater understanding into which pupils rely on this policy to access education may help to re-assess the policy to ensure only those who cannot access education any other way still benefit, but others who could perhaps walk or cycle to school, find alternative routes to reduce overcrowding on the school buses.

The statutory home-to-school transport provision policy has been in place all over the world for many years. Although there are subtle differences, most developed countries around the world offer a similar policy with similar criterion. Even though these policies are in place, there is still a gradual rise in car travel in the journey to school occurring globally even though millions is invested into funding this policy. Considering this policy exists in developed countries, only Hine (2009) and Thornthwaite (2009) have explored this policy in detail.

Dedicated School Buses

When Government organisations provide transport to school, it is usually in the form of a school bus. School buses are delivered as either a 'dedicated school bus' (DSB) (which can be either owned or run by the school or neighbourhood authority) or a 'public service bus' (PSB) which serves the local community but where a pupil is provided with a bus pass or means of identification to allow them to travel on this service without paying a fare each day.

Meanwhile in England, DSBs were not so widespread until after the Transport Act 1980 councils were able to obtain permits to run their own DSBs and then when these are not in use, the vehicles can be utilised for others services during the day (White, 2009). Leicestershire County Council for example, in 2005 introduced a 70-seat yellow coach to transport school children to a Leicestershire village, but outside of the morning and afternoon service hours, it is available for other schools in the county to hire for school trips. (Leicestershire County Council, 2011). However White (2009) explains that after the Transport Act 1985 counties were required to consider school and public services together for best value for money.

Perhaps the most well known example of the use of the DSB occurs in the United States, where it is known as the Yellow Bus. The DSB in the US is a service provided, owned and operated either by school districts or by private contractors (McGuire and Van Cott, 1984). When travelling to school by bus, US pupils in urban areas tend to walk short distances to a bus stop to be picked up and pupils living in more rural areas are picked up at their homes (Riera-Ledesma et al, 2011). This style of bus travel is copied all over the world as varied as Dubai, China, Hong Kong and the United Kingdom.

FirstGroup introduced the American-style yellow school bus in the UK in 2003. Three pilot schemes were established in Hebden Bridge, West Yorkshire; Runnymede, Surrey; and in Wrexham, North Wales. Following on from this, further schemes were tested in Wokingham Aberdeen, Windsor and Maidenhead (DfT, 2003). The scheme sought to *"examine and quantify the costs and benefits of a nationwide network of dedicated home-to-school transport [across England, Scotland and Wales]"* (Yellow Bus Commission Report, 2003 pp.2).

However, in the UK this kind of system would be very difficult to introduce due to the built up nature of the country, the small roads and the costs involved. Yet the Government has attempted to re-create the US yellow bus system in some areas.

Parents appear less likely to allow their children to travel to school by bus when they are primary-school aged (10 and under) and are more likely to allow children to travel to school by bus when:

- A pick up close to home and drop off close to school - this was the most highly ranked attribute of the schemes by parents and students in the survey responses, but for differing reasons.
- The fact the yellow school buses are not available to the general-public was liked for security reasons by parents, but for secondary age students was seen as beneficial by reducing the friction between school users and other bus users.
- A driver regularly allocated to the specific route, with additional training who could get to know the pupils, schools and parents was a key factor for the schools and for primary pupils' parents.
- A guaranteed seat for each child was seen as a key attribute, as was the fact that standees were no longer permitted on these school routes. However, there was mixed response to pupils being allocated a specific seat - this was preferred if seating allocations were agreed by students themselves, rather than allocated by the school.
- CCTV equipped vehicles were welcomed by operators to reduce malicious allegations as well as vandalism,, by schools and pupils to maintain discipline and reduce bullying.

(YBC, 2003, pp.3)

The English Government believes that parents may be more willing to allow younger children to travel to school by bus if the current bus system was similar to that in the United States and incorporating all of the above points. The Yellow Bus Commission (YBC) was set up by the Government with the objective to: "*...to examine and quantify the costs and benefits of a nationwide network (across England, Scotland and Wales) of dedicated home-to-school transport*" (Yellow Bus Commission Report, 2003, p.2)

The YBC Report (2008, p.5) adds that "*Nationwide, a rollout of yellow school buses for primary aged pupils would offer children and parents a safe and attractive option for commuting to and from school, reduce local traffic congestion, benefit the environment and improve safety and wellbeing*".

The DfT (2003) evaluates:

> "*Initial reactions to the yellow bus schemes in all the areas were broadly positive from students, schools and parents. The commitment to improve quality was appreciated and the introduction of the schemes seen as being a very visible commitment by the local authority. Initial concerns largely related to operational issues such as timings of services. Overall, awareness of the schemes was high at all the schools in the three pilot areas, with few parents/pupils unaware that yellow buses were serving their school*" (p. 2).

The evaluation made by the DfT states that there was a modal shift experienced when the Yellow Bus scheme was introduced into an area and that the piloted areas saw bus use rise, but by May 2003, some of the rise was a shift from walking and cycling (rather than the car) to using the bus.

Although the Yellow Bus scheme offered everything that parents wanted for their children, parents were only willing to contribute around £1.00-£2.00 per day for the service. The Yellow Bus Commission Report recommends that "Bus Service Operations Grants" should be made available to help with the costs of Yellow Buses. Yet, in the current economic climate, it is very unlikely this will be made available.

Overall, the school bus offers one of the most sustainable modes of travel over long distances and a healthier and more environmentally friendly alternative to the personal car. Yet, there are health and safety concerns which arise through use of the school bus. When offering a bus service, schools, the Government and bus operators need to ensure that safety is maintained at all times. If more children were willing to travel to school by bus, the amount of car use, CO_2 emissions and congestion / traffic levels could be reduced thus giving a safer journey to school for pupils whose parents are concerned about their safety as pedestrians and cyclists.

School Travel Plans

Travel plans are a means of delivering sustainable transport measures through the organisations that generate the trips in the first place. For example, work place-related travel plans in particular are fairly common in several countries throughout Europe, North America (Enoch, 2012). Companies have developed travel plans to try and reduce car use and encourage more sustainable travel. Businesses are encouraged to promote a 'greener' image and believe this benefits them in the long run (Rye, 2002; Coleman, 2000; Dickinson et al, 2003).

In England, since the Education Act of 1996, school travel policies have evolved with much work undertaken to develop initiatives in a similar way. One area which attracted attention was the idea of "sustainable school travel" which includes both environmentally and physically healthy modes of transport such as walking and cycling.

From this, came the concept of the school travel plan as an aid to educate parents of children (as already noted, parents are the main decision makers in how children travel to school) on how to reduce car use in the journey to school and promote healthy lifestyles and active travel.

> *"A school travel plan is a document setting out a package of measures for reducing the number of car trips made to a school or a group of schools by parents and staff and for improving safety on the school journey. No two school travel plans are likely to be the same. They may range from a very simple statement of school policy through to a comprehensive document which deals in detail with every aspect of the journey to school and its consequences.*
>
> (DfT, 2002)

School travel plans (STP) have been encouraged to reduce car use and promote healthier travel to school both for children and for the environment, and school travel advisors were funded to work together with school to develop adapted plans and schemes to suit individual schools and pupils to try and maximise the effectiveness of STPs all over the UK. It has been shown that school travel plans can be very effective in reducing motorised travel to school (Hinckson et al, 2006 and Hinckson et al 2009) by comparing the travel of pupils from five primary schools both before and after school travels were introduced.

The UK Government enforced the policy that all schools would have an active school travel plan in place by 2010. Table 2.5 provides some examples of STPs from around England. Each example represents one of the geographical areas of the country.

The results of Table 2.5 support the findings of Hinckson et al (2006, 2009) in which STPs can help reduce motorised transport to school through educating children and parents in transport alternatives and by offering schemes to encourage sustainable travel.

Table 2.5 Examples of STP initiatives in England

Type		Council	Benefits of STP	Initiative	Details of Initiative
1	Rural	Leicestershire	By the end of the Summer Term in 2010, 80% of Leicestershire schools had a travel plan in place trying to reduce car use in the journey to school.	The Star Walker Scheme	Encourages pupils to walk to school. 'Star Walker' schools can identify and promote a 'Star Zone', an area surrounding the school where drivers are encouraged not to park, but care is needed to avoid moving the school gate congestion problem to another part of the neighbourhood.
2	Urban	North Lincolnshire	As a result of STPs, North Lincolnshire has claimed to have improved footpaths, improved road signs and markings, changed road layouts, put in safety zones, increased road safety training and reviewed parking and speed regulations.	Cycle Training Schemes	North Lincolnshire offers cycling training to primary school children in Year 5 or Year 6. The courses usually take place over a six week period and are run by trained volunteers within the schools. Most of the training takes place on road centred on a "T" junction. The course gives basic cycling and roadcraft skills, leading to safer cycling.
3	Metro-politan	Manchester	Schools within the local authority are running Walk Once a Week schemes such as Walk on Wednesday or cycle, scooter and bus, walk to school weeks, sustainable travel schemes that encourage all non-car modes running once a week, all week, all term, or all year.	Green Miles Competition	Established in Manchester in March 2005. The aim of the competition is to reduce the number of cars on the school "run" and to increase the number of pupils walking and cycling or catching public transport to school. Pupils collect "Green Miles" every day they travel to school in a sustainable mode. Each class uses these miles to "walk" around a map of Britain, stopping off at places on the way and learning about them.
4	Outer London	Kingston upon Thames	STP engineering projects have been running successfully in the Royal Borough since 1999. To date, the Council has worked with over 30 schools.	Debra the Zebra	The borough's Walking to School mascot, Debra the Zebra, has successfully been encouraging more children to walk and cycle to school in a safe manner. She has also launched her two story books - *Debra To The Rescue* and *Debra Has A Plan*
5	Inner London	Camden	Camden claims their STP target will "help to reduce traffic congestion and air pollution to make London a liveable city. Camden's LIP priority target seven, 'to maintain or increase the proportion of personal travel made by means other than the car".	WoW Walk on Wednesdays	Camden's chosen initiative to raise travel awareness and reward sustainable travel behaviour.

Sources: Leicestershire County Council, North Lincolnshire Council, Manchester City Council, Royal Borough of Kingston-Upon-Thames, Camden Council

School Choice Policy

As already seen in previous sections, the role of the parent is becoming more prominent in education and that parents are now expecting more involvement and choice schemes are "*now so widespread that parents are coming to more options variety*" particularly in the US and UK (Cooper, 1991, p.247). Cui et al (2011) suggest that parents today are more willing to drive their children further to school if it means they can attend a better quality school or a school with higher achievement rates.

In many countries across the world, 'school choice' policies have been established which allow parents to choose to send their children to any school instead of being restricted to sending their children to the school closest to their home (O'Shaughnessy 2007; Barrow 2002). The rationale for this approach is that encouraging school to become more diverse and to compete with one another for students raises the quality of education provided across the sector as a whole (Burgess et al 2006) and proponents would argue this is what has happened. Burgess and Briggs (2010, p.83) state that "*doing well at school is helped by attending a good school*", adding that originally only the children from richer backgrounds had access to better quality schools.

As a result, it is likely that the children and their parents take advantage of the school choice policy (and so are usually not eligible for free bus travel) and that this school is outside practical walking and cycling distances of 1-1.5 miles (Müller et al 2008; van Sluijs et al 2009) and therefore are increasing nationwide VMT and CO2 emissions. Overall, studies have been conducted that investigate the 'success' of 'school choice' (i.e. Burgress et al, 2005; Burgess and Briggs, 2010), but one area that does not appear to have been widely explored is the impact that the parental choice agenda has on travel patterns and the resulting impacts.

Müller et al (2008) models behaviour based on pupil-specific factors to determine which mode of transport offers the pupils in the sample the 'highest utility' or benefit to them. The main modes of travel to school analysed include the person car / motorcycle, walking, cycling and public transport and determines which factors lead to pupils receiving the highest utility from that mode and compares travel behaviour between the summer and winter months.

Two further exceptions to this have examined these issues in detail in the United States, both in St Paul, Minnesota. Marshall et al (2010) examined the effects of a school choice policy on CO_2 emissions using a multinomial logit model. The results show that children travel to schools further distances from home as a result of the school choice policy. In the study, parental school choice significantly increased CO_2 emissions – by between four and seven times. In a further study Wilson et al (2007) also explored this by analysing data from the US Census and timetables and details of local bus services, then using a proof-of-concept model technique to simulate changes in school travel when the school choice is offered and removed. The study concludes that changes in children's travel behaviour can result in considerable transportation and cost implications including pollution such as emissions. For example, in one scenario, if the bus was removed from school travel, cost, distance travelled and CO_2 emissions all rose by 4.5 times.

Therefore, as governments continue to push the school choice agenda, the time would seem right for assessing what the wider transport-related impacts of the policy may be as a consequence.

Wilson et al (2010, p.2181) state that:

> "*school choice substantially influences school commuting travel behavior, mainly by increasing travel distance, and subsequently, mode choice. School commute mode may also be influenced by urban form (specifically, local road density), demo-graphics, and parent mode choice. Our findings have direct implications for school district transportation budgets and parents, but also speak to local traffic congestion, childhood exercise levels, urban air pollutants, and greenhouse gas emissions*".

This research shows that policy, and the school choice policy in particular, has significant impacts on how children travel to school in the United States, but little research has been done into whether this is also the case in the United Kingdom.

2.6 Literature Review Summary

Getting children to and from school in a safe and sustainable way is often one of the most important objectives for school transport policy makers. In order to understand why children travel by certain modes, it is important to understand the underlying factors of their mode choice. Despite utility maximisation being at the forefront of most aspects of our daily lives, no current research exists into the factors which investigate utility maximisation in the common daily journey to school. Research into the policies behind why children travel they way they do remains fairly under researched.

This chapter has offered a broad review of the current literature on various factors affecting school travel, including the main influences on child travel behaviour (i.e. individual, area, and institutional policy factors) and the reasons and barriers to modal choice (especially looking at the personal car, walking and cycling and bus usage and finally examining the main policies which has had impact on school travel (including school travel plans, dedicated school buses, the home-to-school transport provision, and the school choice policy). It can be seen that the main factors affecting school travel include individual, area and institutional factors.

Overall the following research propositions emerge from this review as a result:

<u>Proposition 1</u>
Age appears to be a recurring issue surrounding school travel. Children travel less independently when aged 7 years and younger (Hillman, 1993) and are restricted in their mobility, thus resulting in the car becoming their main mode of travel (Rosenbaum, 1993; Cooper et al, 2003). Research conducted by Mackett et al (2005) also suggests that older children travel more actively (by walking and cycling) than younger children. From this, Proposition 1 has been developed to investigate this assumption that younger pupils are more reliant on motorised transport modes than older pupils.

Younger (primary) pupils are more likely to travel by motorised modes of transport in their daily journey to school than older (secondary / Post 16) pupils.

Proposition 2

The assumption that a pupil's gender influences how they travel to school has emerged from the literature. In particular, that female pupils travel less by walking and cycling than male pupils (Hillman, 1993; Loucaides and Jago, 2008; Leslie et al, 2010; McDonald, 2011). Proposition 2 seeks to address this issue and determine if this is also true for the pupils of England.

Female pupils travel less actively than male pupils.

Proposition 3

Research from McDonald (2011) and Pont et al (2009) determines that pupils from ethnic minority backgrounds travel less by motorised transport than white pupils and that white pupils travel less actively (by walking and cycling) than pupils from other ethnic backgrounds. Proposition 3 aims to establish if this is also accurate for English pupils.

The ethnic background of a pupil will have a significant effect on their travel behaviour.

Proposition 4

Results from the research of Giuliano and Dargay (2006) and Kantomaa et al (2007) suggest that pupils from richer households travel further to school than pupils from low income households. Frank et al (2007) also determine that people from low income households are generally less active and more likely to be obese than those with higher incomes. Proposition 4 has been designed to determine whether pupils from homes with lower incomes do not travel as far to school as pupils from homes with higher incomes.

Pupils from low income households do not travel as far to school as their higher income peers.

Proposition 5

It is assumed that areas more densely populated generate more travel (Kerr et al, 2007) due to more accessibility, infrastructure and facilities available to encourage walking and cycling (LaScala et al, 2004; Falb et al, 2007). Panter et al (2010) and Gallimore et al (2011) state that pupils travel shorter distances in areas of higher population density. Research Proposition 5 will investigate if pupils living in more urbanised areas of England travel shorter distances to school than those living in more rural areas.

Pupils living in less densely populated areas are likely to travel further to school than those residing in more urbanised locations.

Proposition 6

Müller et al (2008), Marshall t al (2010), and Emond and Handy (2011) show that length of the journey to school can either encourage active travel by walking or cycling (for shorter distances) or act as a barrier to active travel resulting in increased travel by motorised transport (for longer distances). For the purpose of this thesis, Proposition 6 will identify how distance affects mode choice in the journey to school.

Distance to school significantly affects mode choice.

Proposition 7

Research conducted by Wilson et al (2007), Müller et al (2008) and Marshall et al (2010) shows how the utilisation this policy has resulted in higher levels of motorised travel in the United States and Germany. Proposition 7 will also investigate this policy in and English context to determine if the same policy also increases travel to school by car and the additional impacts that occur as a result of this travel behaviour.

The policy allowing parental choice of schools leads to a considerable increase in vehicle miles travelled by car and associated wider impacts.

Proposition 8

Vasconcellos (1997) and Kenyon (2011) accentuate that pupils generally receive a better education when more transport to school is provided and available to them. Proposition 8 aims to determine whether local authorities in England offering more free and/or subsidised transport to school encourage more pupils to travel to school by bus as opposed to travelling to school by car.

Local authorities that offer only the statutory level of school transport provision experience lower levels of bus mileage per pupil on average than those with more generous policy guidelines.

Proposition 9

The cost of implementing and maintain transport policies is an important factor in travel (Brannigan and Paulley, 2008), yet even though active travel to school is preferable, the current Government is looking to cut funding for school transport provision (Hine, 2009). Proposition 9 investigates the impact of funding on travel to school by bus to determine if changes in funding would lead to changes in travel behaviour.

The higher the level of bus subsidy provided by a local authority per pupil, the greater the average bus mileage generated.

Perhaps, more specifically in terms of identifying a gap, the literature suggests that there is a lack of research in the area of school travel policies. In particular, in how such policies impact on travel patterns and on society more generally.

Accordingly, in devising a way forward, and in addressing these propositions, as a first stage it was felt to be useful to further explore the basis of these propositions by conducting a scoping study of the views of practitioners in the sector, the results of which are presented in Chapter 3.

CHAPTER 3 INTERVIEW SCOPING STUDY

3.1 Introduction

Chapter 2 explored the main issues and factors which influence school travel all around the world and found that there was a significant research gap into the effects of policy on school travel and on the broader impacts that result particularly in the UK context.

Therefore the purpose of this chapter is to gain further insight into the main issues and factors influencing school travel in England by conducting an exploratory study. This has been achieved through semi-structured interviews with 16 current experts in the school travel field who make, enforce or analyse school travel policies in the UK.

The experts were selected based on their experience and expertise from a variety of professions including school travel planners, transport consultants and academics. Each interviewee was asked a series of 18 open-ended questions to be analysed using thematic analysis to determine the main influences and issues regarding school travel. The roles and expertise of the selected experts have been labelled as expert A-K to maintain anonymity (see Table 4.3 in Section 4.3). Further details of the method employed to conduct this study is detailed in Section 4.3.

The chapter is structured as follows:

- Section 1: Stakeholders in school travel
- Section 2: Economic factors
- Section 3: Political / legal factors
- Section 4: Social factors
- Section 5: Technological factors
- Section 6: Environmental factors

3.2 Stakeholders in School Travel

The first part of this study explores the current stakeholders in school travel. The stakeholders are the people the interviewees design and provide their school travel services and policies for and therefore it is their requirements which need to be considered. Each stakeholder will be examined and how they influence each other to influence how children travel to school.

In the view of the interviewees, the key stakeholders involved with school travel (listed in order of influence as rated by the interviewees) are:

- Parents
- Local authorities
- Schools
- Bus operators
- The local community
- Children (pupils/students)

Figure 3.1 illustrates how each of these different stakeholders interact with each other and their 'relative level of influence'. Note, the darker the colour in the diagram, the greater the level of influence exerted.

Overall, the respondents are in broad agreement as to the main stakeholders. Thus parents are followed by local authorities and schools seen to be most influential according to the interviewees.

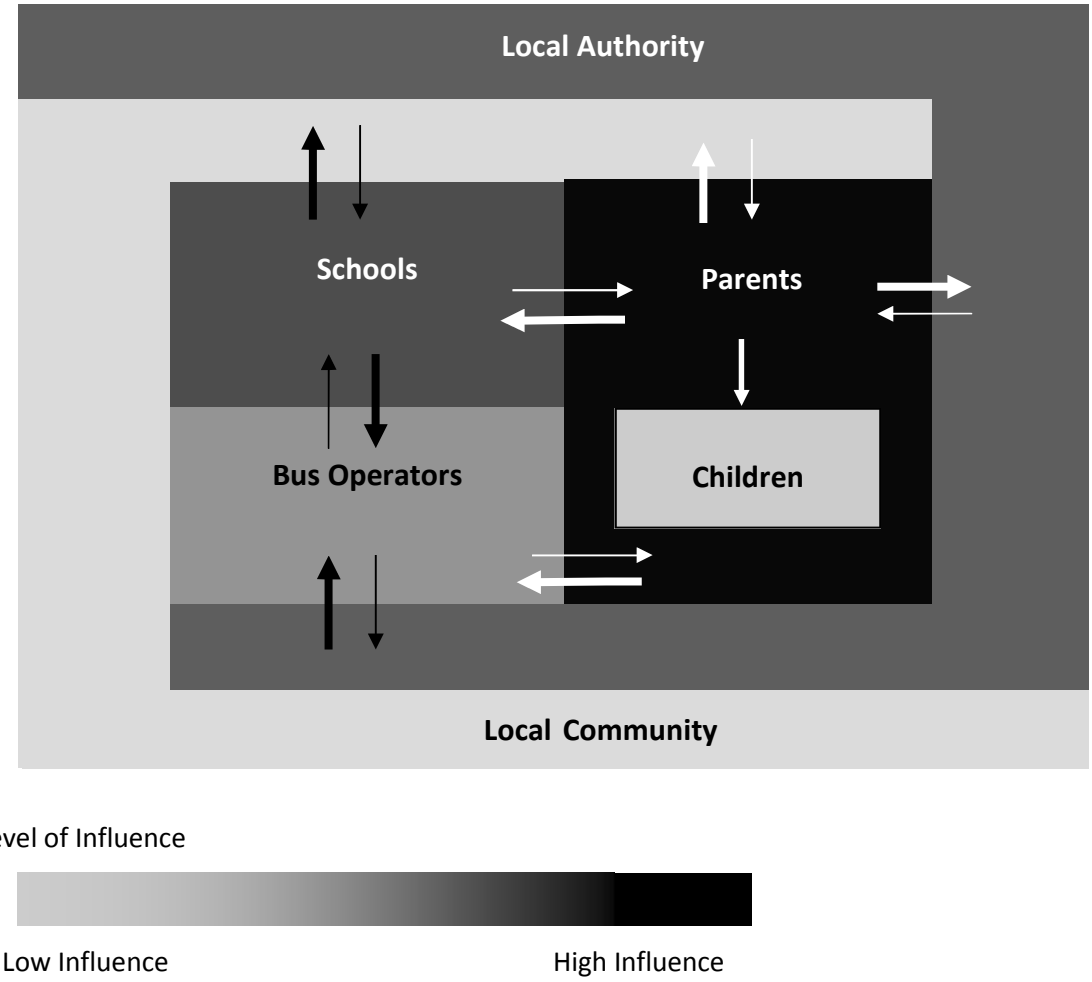


Figure 3.1 - The main stakeholders and their level of influence regarding behaviour

Parents

Parents have a profound influence over children and schools "parents are important stakeholders" (Interviewee F), whilst Interviewee P believes that one of the biggest issues regarding school transport is "parents acknowledging some responsibility in the school travel equation". This is because it is usually the parents who decide which school their children will attend and how they travel to and from that school. Younger children in particular are very influenced by their parent's views and opinions of how they should travel to and from school.

Interviewee O comments that one of the main issues he faces at his local authority with school travel is the danger perceived by parents who believe that their children "cannot walk, cannot cycle, cannot go on the bus; because of bullying, because it's unsafe, and because there are too many accidents".

Interviewee M concurs noting that "we need to get parents to see that sustainable travel *is* safe ... we need to try and change the mindsets of people". In general this situation changes as children attend secondary school and become more independent hence becoming more likely to walk, cycle or take the bus unescorted. This 'empowerment' trend continues when young people consider entering further education and choose which college they attend and what courses or qualifications they take. At this point too they can decide whether they want to drive/own a car. However, whilst the issue of increasing car ownership and use amongst teenagers is an interesting topic in its own right, the majority of car trips for school travel tend to be made by parents as drivers and their children as passengers – a point that was emphasised by some of the interviewees.

Consequently, most of the interviewees state that it is important to focus on the parents. Interviewee L explains that in his local authority he needs to "highlight choices to parents. Parents make all the decisions, but unfortunately can be blinkered and can't see beyond their own car". Interviewee K adds that "parent's expectations have risen" with regards to their view of quality between the car and the bus. Interviewee J agrees and reports that parents and schools have been too lenient on children and have allowed a car dependent culture to emerge.

The Local Authority

Local authorities have a responsibility to try to ensure the areas surrounding a school have appropriate walking and cycling paths and crossings to ensure the safety of pedestrians. Over recent years the local authorities around England were assigned to make sure each school within their jurisdiction had a School Travel Plan (STP) in place by 2010 to try and reduce car use in the journey to school.

For pupils who live too far from their homes to walk or cycle to school, local authorities exert influence over school travel in a number of ways. First, local authorities set out the criteria outlining which pupils can be offered free school transport. This is mainly dependent upon the distance between the pupil's residence and their chosen school and also the distance to the nearest school.

Second, the local authorities also have power over which schools are served by a bus service. Their responsibility lies more towards getting certain children to their nearest school as opposed to serving the school itself. This can result in lower capacity forms of transport such as mini-buses being used for smaller groups of children. If funding is available local authorities can then look into offering additional services.

Third, they put the school bus transport contracts out to tender to the local bus operators. Once a contract is accepted the local authority will work closely with the bus operator to ensure the service, vehicle and drivers remain at a high standard and that children continue to be picked up and dropped off on time. Any issues that occur during the contract are dealt with by the local authority.

Schools

Schools take some responsibility over travel to school. Schools have been required to work together with local authorities to produce School Travel Plans (STPs) to try and reduce car use in the journey to school. Schools cannot control much of anything that happens outside of school grounds, but schools try to help encourage sustainable travel by providing areas to store bicycles, some schools offer cycle training courses (to try and teach children how to ride a bicycle safely) and some schools provide information to parents on the safe and direct walking routes around the community to access the school.

When it comes to pupils using the bus as their main mode of travel, schools have a say over whether they want buses serving them or not. Some schools can choose to reject bus services (Interviewee M) and this can have a negative effect on which students attend that school.

Schools can also help the bus operators by monitoring the children getting on and off the bus at the school gate. Teachers can monitor students and ensure this is done in an organised manner. Both teachers and governors can work together with the local authorities in teaching the children how to use the bus appropriately. This can be done through workshops, leaflets, question and answer sessions with local authority staff and even through the use of drama groups and films.

Bus Operators

Bus operators put their contract to tender to the local authorities and they have the initial say regarding price and service levels. The operators also have a responsibility to the children on their bus to ensure the timetable is as strict as possible. Drivers need to be trained to handle an emergency that could occur on a bus and also need to be checked by the Criminal Record Bureau (CRB) and so are legally able to work with children.

The Local Community

The local community has little influence over school travel, even though it is are greatly affected by it. In some cases groups of residents or parents have raised the funds for their own school bus service when there was not one available.

The potential demand for bus travel by a local community can as a whole sometimes affect the number of school bus services available. Some operators are more willing to serve schools when they know others are willing to use the bus in the area outside of school hours (Interviewee N).

Children

As can be seen in Figure 3.1, children appear to have little or no influence over school travel. This shows how children on a school bus appear to have a far lower level of importance compared to an adult passenger on a regular bus service.

If asked who the main stakeholders of bus travel were, it is very likely all respondents would have stated the passengers themselves, yet this is not the view of the interviewees regarding children on school buses. This is due to parents being the prime decision makers in how children travel to and from school.

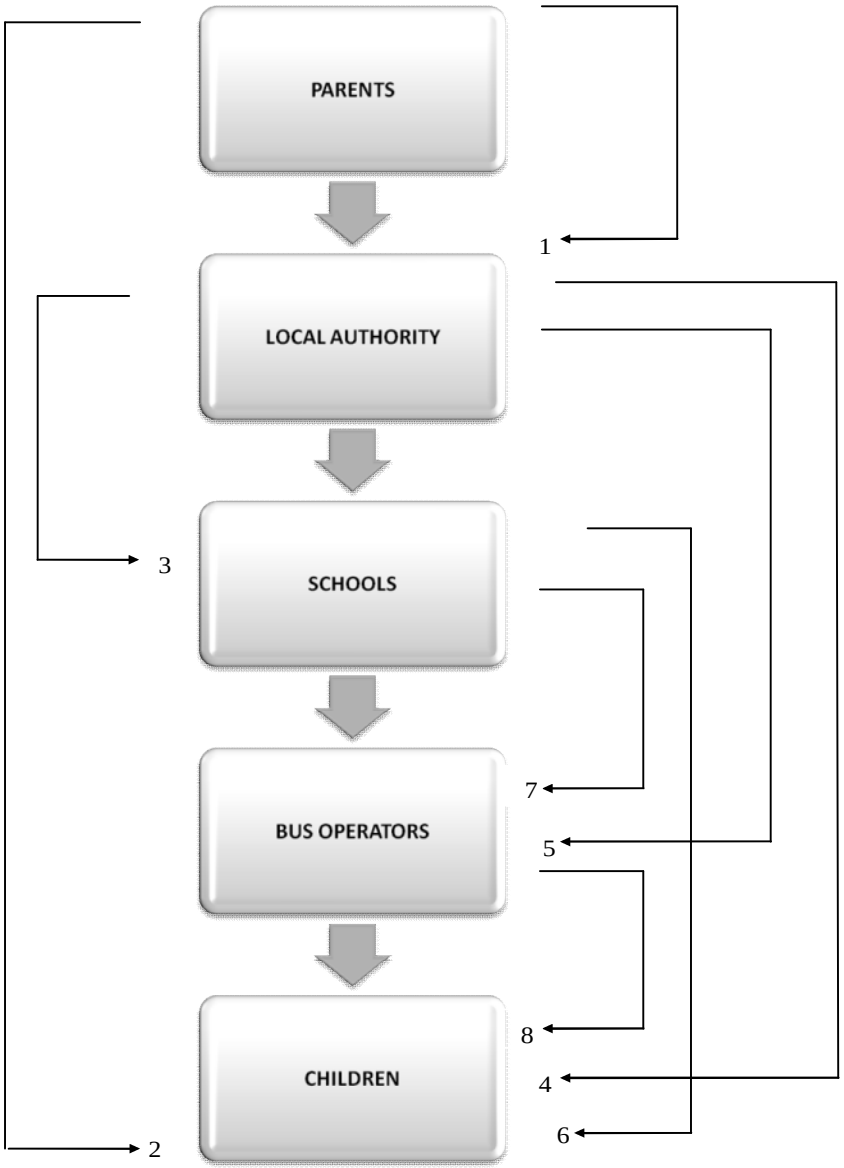
Summary

The fact that parents have a considerable more influence than children should suggest that local authorities target their policies and marketing schemes towards the parents as oppose the children. “Pester power [can help] to get parents to think about [bus use]” (Interviewee L). Yet is enough being done to communicate with the key decision makers?

Some interviewees state it is important to focus on the parents as they have the most control. Interviewee L explains that in his local authority he needs to “highlight choices to parents. Parents make all the decisions, but unfortunately can be blinkered and can’t see beyond their own car”. Interviewee K adds that “Parent’s expectations have risen” with regards to their view of quality between the car and the bus. Interviewee J agrees and suggests that parents and schools have been too lenient on children and have allowed a car dependent culture to emerge.

Figure 3.2 sums up how the interviewees say the control process flows resulting in children travelling a certain way. Each link represents how one stakeholder is controlled by the influence of another stakeholder.

Figure 3.2 – The Control Process



Number	*Stakeholder*	*Control*
1	**Parents – Local Authority**	Parents pay their council tax to the local authority. Some believe this gives them some right over the type of service offered and that their children should be entitled to free or subsidised bus travel to school.
2	**Parents – Children**	Parents have the ultimate say of which school their children attend. This will impact upon whether their child is eligible for free or subsidised bus travel provided by the local authority.
3	**Local Authority – Schools**	The local authority have the control over how much funding is provided for schools for their travel plans and infrastructure as well as workshops with the children regarding transport and behaviour.
4	**Local Authority – Children**	The local authority has a criteria which must be met if children are to receive free or subsidised travel. The LA also determines whether extra services are available for fare paying children and what kind of service (e.g. Yellow Bus, dedicated bus, SEN) is provided.
5	**Local Authority – Bus Operators**	The local authority has the final say over which operator is awarded a contract for school travel. There is a criteria to be met (e.g. CRB checks, training) and cost has a big impact on the length and demand of a contract.
6	**Schools – Children**	Schools have an influence over what transport is available to children as a result of their travel plans. Sometimes bicycles are not allowed on school property or bus services are refused.
7	**Schools – Bus Operators**	Schools and bus operators need to co-ordinate their timetables to allow for children to be able to catch the bus, especially in rural areas, limited services and extended school days.
8	**Bus Operators - Children**	The bus operators need to have training and systems in place to deal with bad behaviour, vandalism and other situations (e.g. lateness and delays, bus pass checks)

3.3 Economic Factors

The economic factors regarding school travel are some of the most significant influencing the stakeholders identified in Section 3.1. In the case of school travel economic issues are most evident in the form of 'cost'. This section applies particularly to school bus usage as walking and cycling denotes less cost to the school travel stakeholders.

All school travel schemes require funding, even walking and cycling schemes. For example, walking buses require escorts, safety jackets and school crossings. Cycling schemes require promotional workshops, cycling proficiency lessons and infrastructure and bus schemes require vehicles, bus stops, drivers, sometimes escorts and fuel. Interviewee L explains that making routes to school safer comes at a high cost to local authorities through engineering work and infrastructure, "However if parents don't feel routes are safe, the children won't travel on them".

With most school transport, there are issues of:

- 'who pays for what'?
- 'what is a reasonable amount to charge'? and
- 'how much funding is available'?

More specifically, 'cost' can have a range of different meanings. According to the interviewees partaking in this study, these are:

1) Cost to school bus users (i.e. school children and their parents) paying a fare or paying for a subsidised service in the form of a bus pass.
2) Cost to local authorities from their transport budget for:
    - the contracts to bus operators;
    - specialist vehicles; and
    - staff (wages and training).
3) Cost to bus operators (staff costs, fuel costs and vehicle maintenance expenses).
4) Cost to Central Government in the form of funding to local authorities.

3.3.1 Cost to Users

The interviewees identify the cost travel to be one of the main barriers and also one of the main incentives to school children using the school bus as a mode of transport to and from school. "The thing that will influence most people... is cost" (Interviewee D). Interviewee H states that "the way to encourage everyone to travel by bus is to offer a service for nothing. Once a charge is in place, demand will start to fall. It is simple economics".

For those pupils that are offered free transport from their local authority, the bus obviously is a very economical choice. Interviewee I states "the most effective way to encourage anyone to do anything is to give it away for free – look at the effect on the elderly and their subsidised transport". Conversely, for others who need to contribute towards a bus journey the bus cost can become the main deterrent from sustainable travel. "The more you charge for something, the less demand there will be for your product" (Interviewee K).

Local authorities are beginning to reduce the amount of free school travel available to pupils. For example, parents who chose to send their children to a religious Faith school or Specialist school are usually required to contribute any transport for their children. Some local authorities used to provide transport to these schools, but the priority for funding lies in providing transport for pupils living further than 2-3 miles away from their closest school and for special educational needs (SEN) pupils.

For parents wishing to send their children to a school outside of reasonable walking and cycling distance, they need to decide whether they prefer their children to travel to school by car or bus. Not all schools have their own dedicated school bus, but most service buses will provide subsidised fares or other special rates to children under the age of 16.

In this case it is likely the car will be seen to be the 'cheaper' option because there is no regular daily payment to be made. However, as Interviewee L reports, "there is still a cost – a hidden cost – of using the car. Yet, speak to any parent and they will say cost [is the main issue of sustainable travel] even if the bus is actually cheaper".

Clearly it is up to both parents and children to decide which mode of transport they believe is better value for the cost of travel to and from school. If the car is believed to be cheaper, bus operators need to ensure they are making their services good value for money, especially for school children.

3.3.2 Cost to Local Authorities

Interviewee A states that "local authorities are spending about a billion pounds a year on home to school travel". Local authorities realise this and so do their best to minimise costs wherever possible.

Interviewee A explains that most local authorities follow the guidelines of the Education Act of 1944 in which primary school children living 2 or more miles away from their closest school are offered free transport to that school. Secondary school children that live 3 or more miles away from their closest school are entitled to school travel to that school provided by the local authority.

Interviewee N comments that "I think if you have a free pass to travel on the bus, you use it ... and as a parent that's how you send your children to school". Interviewee K explains that his local authority abides by this, but (like most local authorities) this benefit does not apply to those pupils attending a Faith or Specialist School where free travel is not offered as this is not the allocated community school.

This particular authority also tries to encourage sustainable travel alongside the current bus operators through offering subsidised fares and bus passes, but a contribution is required from a child's parents towards this service. "The ideal situation is going to your local school" (Interviewee L).

With the introduction of school choice and specialist schools the criteria for free transport is not as simple as it used to be. The free transport limit of 3 miles from home to school has been in place since the Education Act 1944. Interviewee A explains that some local authorities have the budget available to change this to 1.5 miles and 2 miles but the majority of local authorities have kept to the original 3 mile limit. Interviewee A strongly believes this limit is restricting a lot of sustainable travel.

Interviewee F states "where bicycling or walking is not feasible due to most students living further than a ½ mile from school, bussing should be offered, and walking to bus stops encouraged". Interviewee I explains that "there are powers now for authorities to move away from the old model of a provision of transport and a strict dividing line about who pays nothing for it and who gets nothing. There is a lot of opportunity for this but no one will because there are no votes in it!" Interviewee A adds "if you reduced the [provision of free school transport] limit, blanket across the board within one and two miles, it isn't that expensive [to local authorities/provide school bus services] when you take into account parental time savings, congestion savings, the environmental savings and safety benefits you are not looking at a substantial cost".

The funding that is available to local authorities determines what services can be offered. Local authorities claim they can only supply free transport to a certain number of children as the funding usually just is not available to offer free bus travel to all. Interviewee B explains that funding to local authorities is never pre-set. It has been known to be cut without much pre-warning. More parents choose not to take advantage of this offer of transport. Interviewee O explains that a lot of funding can be wasted when parents apply for free bus passes, but then still choose to drive the children to school "some buses are never full [because of this] and we have the records to prove it". Interviewee P adds that the investment in mapping and scheduling software can also help to make current routes as financially efficient as possible. Interviewee K's transport department has a team for identifying any areas where costs can be reduced, but he does note "at what cost of [the] quality of service"?

It is up to the transport planners to try and offer as many services as they can to encourage less travel by car, but at the same time trying to keep costs down. To achieve this, Interviewee O's local authority has begun to monitor school bus usage to ensure that buses are running to capacity, to make the bus services more accessible and to check that those pupils issued with bus passes are using them.

Another element is that bus services in some areas cost local authorities more than in other areas (perhaps due to a less competitive bus operator market or more difficult operating conditions) and therefore some local authorities may be less able to offer free or heavily subsidised transport to and from school than others.

Interviewee A adds that a lot of local authority funding is spent in SEN travel and that "this large allocation means less funding is available to extend the current offer of free transport, such as reducing the 3 mile limit to 2 miles or less".

This is confirmed by a member of Interviewee K's team who states that the cost of SEN transport can range from pupils requiring access to a standard vehicle (with a vetted driver) to those who need a specialised vehicle with medically trained escort and driver. It is therefore often difficult to save costs in this area.

Interviewee B states “a lot of money has to be spent on non-direct forms of transport such as school travel advisors”. This reminds us that cost is not only in direct services or infrastructure but also in the costs of planning and consulting that needs to occur beforehand. However, Interviewee I hints that “it is usually the case when local authorities are procuring vehicles and contracts that cost usually plays a bigger part in decision making, than quality. The authorities that try and show good quality vehicles on the road usually can’t meet their budgets due to cost”.

3.3.3 Costs to School Bus Operators

As much as school travel revolves around children and local authorities, from the bus operators perspective school travel is still business based and therefore, tries to be profitable. This also affects the quality of service offered, the cost of this service, training investment and vehicle maintenance. Interviewee M explains that some bus operators put on old stock to reduce the costs of maintenance if the “kid’s wreck it” and that a damaged vehicle comes at a very high cost to operators but also asks “would newer vehicles encourage the children to show more respect?” Newer vehicles inevitably come at a higher cost to operators, but are also viewed as more environmentally friendly and as providing a better quality service.

Interviewee I states “[buses] have the most to offer as an industry where [the operator] can combine provision for school transport with general public transport services. So if you have a good successful public bus (in a town country or city area) service which you can bolt schools on to so that [the operator] can offer good value”.

Bluntly, it is often not financially efficient to only serve schools. By driving two journeys empty, but only receiving a fare for one journey, operators are losing out financially. Interviewee O explains that this not only benefits the operators but increases accessibility for people living in that area. There usually isn’t much that can be done to relieve the impact of an increase in fuel costs but perhaps predictably the travel behaviour of children and the interviewees warn that future rises in fuel prices could reduce the demand on school bus travel.

3.3.4 Funding Issues

To summarise, economics play a vital role in school travel. The issue of ‘who pays for what’ is clear in almost all of the interviews as it affects who uses and who does not use the bus as their main mode of transport to and from school. It is also evident that ‘cost’ is one of the main influences over whether the bus is a child’s main form of transport to and from school.

Figure 3.3 outlines the main questions asked by the key stakeholders regarding the cost of a school bus service.

Fundamentally, each stakeholder wants a service provided at the lowest cost possible, but still want vehicles of good quality, trained drivers and a service being as close to door-to-door as possible.

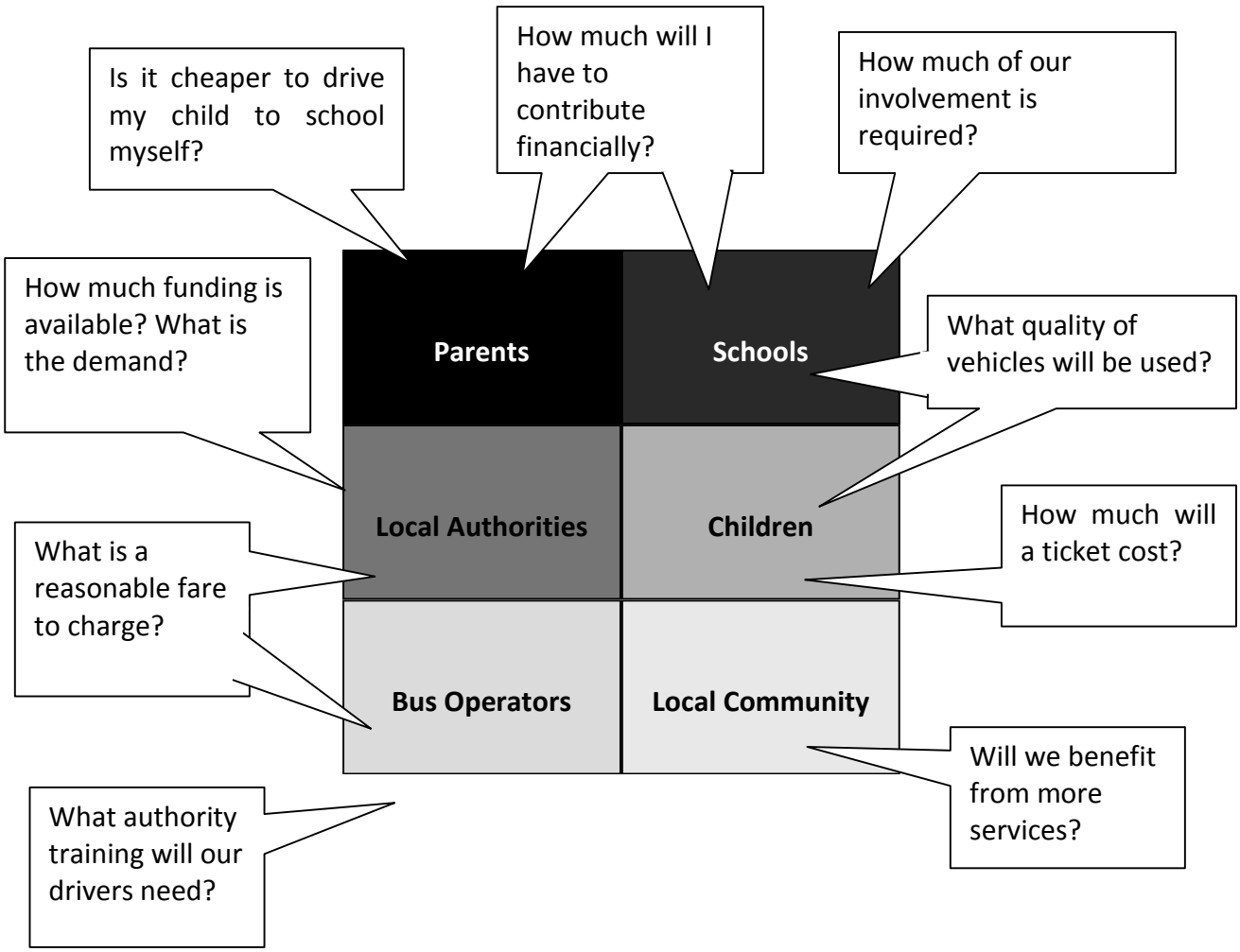


Figure 3.3 - Key Cost Related Questions

Who is given free transport is a big issue. Interviewee A feels very strongly about the 3 mile limit of free bus travel, yet Interviewee K also feel strongly that the funding to local authorities is already stretched with free transport offered at this limit. It is very difficult to determine what policy would be feasible.

Reducing the limit would surely encourage more people to use the bus, just as free bus travel encouraged more elderly passenger to travel by bus instead of car when the concessionary fares were introduced. However, given that both funding for school bus services from central government and the costs of provision vary (sometimes significantly) year on year, even maintaining existing arrangements cannot always be guaranteed (Interviewee B).

3.4 Political / Legal Factors

In addition to financing school travel, central government and local authorities also set the institutional and policy frameworks that affect the current travel of children to school.

This section will first look at two core policy issues to do with:

- Parental choice and;
- The duty of care local authorities have in getting children to school

It will then look at

- The effect current services and policies are having, and then at;
- Potential policies that could have an effect on school travel in the near future.

3.4.1 Parental Choice

Interviewee A explains that by law, in the United Kingdom all children between the ages of 5 years and 16 years of age are required to attend school. Parents have the option to send their child to any school of their choice and are not restricted to catchment areas. The introduction of parental choice has led to many other changes including the more specialist schools, central 'super schools' as opposed to local schools and therefore an increase in congestion as a result of children having to travel further to get to their chosen school.

Places at preferred schools cannot be guaranteed by either the school or the local authority. Parents and guardians must apply for their child to attend the schools of their choice and these applications pass through each schools admissions criterion and then places are offered to the child. By having more choice of which schools to send their children to, parents can decide to send their children to schools outside of practicable walking and cycling distance thus increasing car use and therefore causing more congestion around school and surrounding communities."The average length of a journey to school is increasing as a result of being encouraged to send your children to a school other than the closest to your house. What we have now is an education policy that is encouraging people to travel further and further" (Interviewee A).

Interviewees from a mixture of consulting, academic and planning backgrounds state that parental school choice has a negative impact on school travel (i.e. by increasing the amount of travel) and is one of the main issues in preventing sustainable school travel. School choice has greatly added to an increase in car travel as parents are choosing to send their children to schools further away and this has led to more congestion in local communities and the areas around schools.

This could affect the number of children travelling sustainably, as it is unlikely that a child under the age of five years will be allowed (or mentally capable) to walk, cycle or travel by public transport to and from school without an adult escort. This could impact on the number of cars on the roads if parents prefer to drop the very young children to and from school directly.

To avoid this, it will be up to the local authorities to design school travel policies which ensure the safe journey of very young children.

Interviewee C feels that even though the cost of providing buses is quite high at peak capacity it might be cheaper for society as a whole that the energy costs and running costs of all of those cars and the congestion that those driver cause during the morning peak". Interviewee D warns that "the more choice [of school] that is offered; the more difficult it will be to offer services for so many different choices".

The main factors affecting parental choice include:

- Type of school (e.g. Grammar, Faith, Specialist)
- School position in league tables and Ofsted reports
- Cost of attending a particular school
- Age of child
- Distance from home to school

There are many school related factors that influence the choice parents make when selecting and applying for their child's school, yet how they will travel there does not appear to be a high priority. Interviewee P says that "if parents decide to take their children to a non-catchment area school they need to take some responsibility for that". Interviewee L suggests that the choice of travel needs to be highlighted to parents so they know what is available for their children at their chosen school.

Several interviewees feel that parents believe that that bus has a negative image but tend to focus more on the safety issues and statistics – even if car safety is much lower than bus!

Typical statements are:

- "Parents believe services are not reliable or convenient" (Interviewee L)
- "We need parents to see that [the bus] is safe" (Interviewee M)
- "There is a perceived danger for parents [regarding school travel in general]" (Interviewee O)
- "We need to give parents a better understanding of operations" (Interviewee P).
- "Some parents have not used a bus themselves since they were a school and some need to see the new buses used and the quality of the vehicles used in school travel today". (Interviewee H)

Parents have now not only been identified as the main stakeholder of school travel but are also the ones that need encouragement to change their opinions of what services are available. Interviewee M believes this can be achieved through "drawing their attention to the positives" as oppose to the negative issues of the bus and "parents who have never used the bus, need to see what buses are like". This issue is discussed further with more potential solutions offered by Interviewees in Section 4.

3.4.2 Duty of Care

There are 4 main stakeholders that have a duty of care to children as they travel to and from school:

- Local Authorities
- Schools
- Parents
- Children

The Local Authority

The Education Act of 1944 states that local authorities have a duty of care to transport children who live beyond the statutory minimum distance (typically 2 miles for primary school children and 3 miles for secondary school pupils) from their selected school from their place of residence to and from school. Interviewee P explains that parents can sometimes find this difficult to understand and ask why their children (who live within this boundary and are not eligible) cannot use the free service also.

Other than these national regulations, local authorities generally have their own criteria about who is entitled to what kind of transport and what services are available to children to travel to and from their allocated or chosen school. These include rules on eligibility for SEN transport and on how extra capacity on services is offered.

Unsurprisingly such regulations are heavily influenced by two major factors: an understanding of what constitutes an 'acceptable' level of service and the resources available to the local authority to pay for that. Contracts are let accordingly and then are closely monitored thoroughly throughout the school year and any conflicts with the contract are tackled immediately by the local authority to ensure the child's safe and punctual journey to school.

Interviewee K comments that on a day to day basis the local authority must work also closely with the operators to ensure a duty of care during the journey. His authority offers an anonymous service to leave complaints or issues so that the council are aware of any situations that may occur on the bus trip and can act accordingly.

Schools

Interviewee E adds that "schools have a duty of care to children, particularly at primary school level where they are taught about road safety". Schools have a responsibility to children once inside the school gate, but local authorities are trying to create school travel plans alongside schools to ensure children's safety from home to school throughout the whole journey. "If you went to any school, anywhere, one problem they will all have will be congestion at peak times" (Interviewee O). This means schools working together with the local authority to design a school travel plan and to monitor it, and abide by it. "Schools have to take a responsibility for planning and need a cooperating attitude" (Interviewee M).

Interviewee F explains that “Schools should take every opportunity [to enable] students to lead active, healthy lives by incorporating active transportation into their everyday lives. This requires educational programs for both students and their parents that teach safe ways of crossing the road, riding in the street, and other issues”.

Parents

Parents can also take some responsibility in getting their children to school safely without the use of a car. “Parents need to acknowledge responsibility” (Interviewee O). Interviewee P suggests they could help by “walking the children to the bus stop”, and Interviewee L explains that sometimes parents travel on the bus themselves and act as escorts. Parents can also teach their children how to behave on buses and how to take responsibility for themselves.

Children

Finally, children themselves have a duty of care for themselves to get to and from school safely. Interviewee O explains how his local authority operates a scheme to teach children how to use the bus properly and safely to ensure good behaviour and a pleasant trip for all. Interviewee P adds that parents also need to acknowledge some responsibility for their children.

3.4.3 Policy Objectives

The main objectives of a school travel service or policy identified were ‘improving social skills’ and ‘improving health’. However perhaps more importantly, the majority of responses refer to a reliable service and getting to and from school safely. Interviewee D elaborates that safety is important but in multiple forms thereby ‘reducing congestion by the school gate so there are less hazards, less fumes and reducing pressure on families”. These might include encouraging more sustainable travel.

Parents (and therefore schools and local authorities) are also very concerned with the safety of children and if a safe journey can be promised then parents are likely to allow their children to travel to school in a sustainable way. 9 out of 11 interviewees stated that a focus on marketing and changing attitudes towards the bus were key in policy design and solutions to the issues stated earlier.

3.4.4 Future Policies

Half of the interviewees suggest that the school bus schemes need starting again from scratch. Interviewee H states that “everyone is just better off starting afresh and looking at the bus situation with a clean slate”.

However, the rest of the interviewees believe that returning more to the ‘old system ‘that existed before parental choice would be more effective. They feel that going back to the arrangement of children going to a local school could mean the introduction of more traditional bus transportation in the style of the Yellow Bus transport as used in the United States.

Interviewee A believes this should be taken further and that the three mile limit should be reviewed and potentially reduced so that more children will be encouraged to travel by bus by having more transport options available. Extending this idea, Interviewee P suggests “buying [pupils not eligible for free bus travel] a bike and cycle proficiency lessons [instead]?”

One of the main changes in the future that could impact upon school bus travel is changes in school setup. There are changes ready to be put in place by the Government that could greatly affect school transport. As already identified by the interviewees, school choice is very important in the travel behaviour of children. Moreover with the policy announcement of May 2010 encouraging more schools to opt out of local authority control, the impact of parental choice on average travel to school distances is likely to increase.

3.4.5 Political and Legal Factors Summary

From this section it can be seen that the Government and local authorities have a great responsibility to children in providing them a place in a school between the ages of 5 and 16 years. According to the Education Act of 1944, for children attending their nearest school which is 3 miles or more away from their home free transport must be provided.

However, now the Government have allowed parents to choose the school their children attend, free school transport will not necessarily be provided if the school is not the closest one available to them. Partially as a result of this, many of the interviewees state that school choice greatly reduces sustainable travel as children are travelling further to attend school and this is likely to result in an increase in car use and dependence. From the interviews, parental choice appears to be the biggest barrier in reducing car travel to and from school. Fewer parents appear to want to send their children to their local school. This not only has a negative effect on the local community and environment through increased car use and congestion, but also on their children and therefore has a negative effect on congestion.

Parents need to take a more active role in how their children travel to and from school. Through taking more responsibility and teaching their children how they should act and use the bus, parents could greatly reduce the risk of bullying and vandalism on buses thus making bus journeys pleasant for all children.

They are likely to have increased health risks by having their journey greatly reduced by travelling by car, they have their have their social circle reduced outside of school as many of their friends are not likely to live in their area, and finally, they also have their chances of independence reduced as they will not be taught how to travel on their own and will rely on their parents and their cars.

Overall, to tackle this issue is seems improvements need to be made to both the local schools to attract more pupils to them, and for those who will insist on travelling further to go to a different school, more needs to be done to show parents the quality of the buses used, and how safe they really are.

3.5. Social

School travel is not just about economics and politics. It is part of the daily routine of children, parents and schools and therefore each group has their own expectations regarding school travel by bus. This is not only related to what they expect but what is expected of them also (for example, children behaving appropriately). The following section explores the bus specific issues for children, parents and schools and looks at what can encourage or discourage them from using certain modes of transport for the school run.

3.5.1 Children

Children are key as the main users of school transport. They have the power to make the services work and they can be the main cause in them not working. The three main issues regarding children and the bus are related to safety, behaviour and health.

Children want a safe, social and sustainable journey. Interviewee K notes many children are happier with the social interaction the bus gives as opposed to the option of walking alone to and from school. According to Interviewee H, "because no one is quite clear about where responsibilities start and finish with young people, there are concerns over health and safety". Interviewee F adds "increasing traffic congestion decreases safety around the school for students who walk and bike. There is also an increasing fear of 'stranger danger,' which discourages parents from allowing their children to walk or bike to school".

This attitude usually extends to using the bus and walking to and from a bus stop as well. Interviewee C suggests that the bus is more appropriate for children around the secondary school age group because of parental concerns regarding safety.

These concerns increase, the further children have to travel, thus making it very difficult to encourage sustainable travel for children when parents are choosing to send them to schools even further away from home and do not want them to travel without an adult escort. Interviewee G states "the bus can be fantastic part of a kid's education". Children can greatly benefit from using the bus. Interviewee N adds, "It [using the bus] is a life skill for once they leave school and go on to college".

The concern over safety has greatly changed over time. Interviewee C states that "Child safety and security are some of the main issues of school travel and children are now being escorted to a greater degree than in previous generations".

Figure 3.4 outlines the factors that can both encourage and discourage children from using transport other than the car as their main form of transport.

Figure 3.4 Influences on School Travel

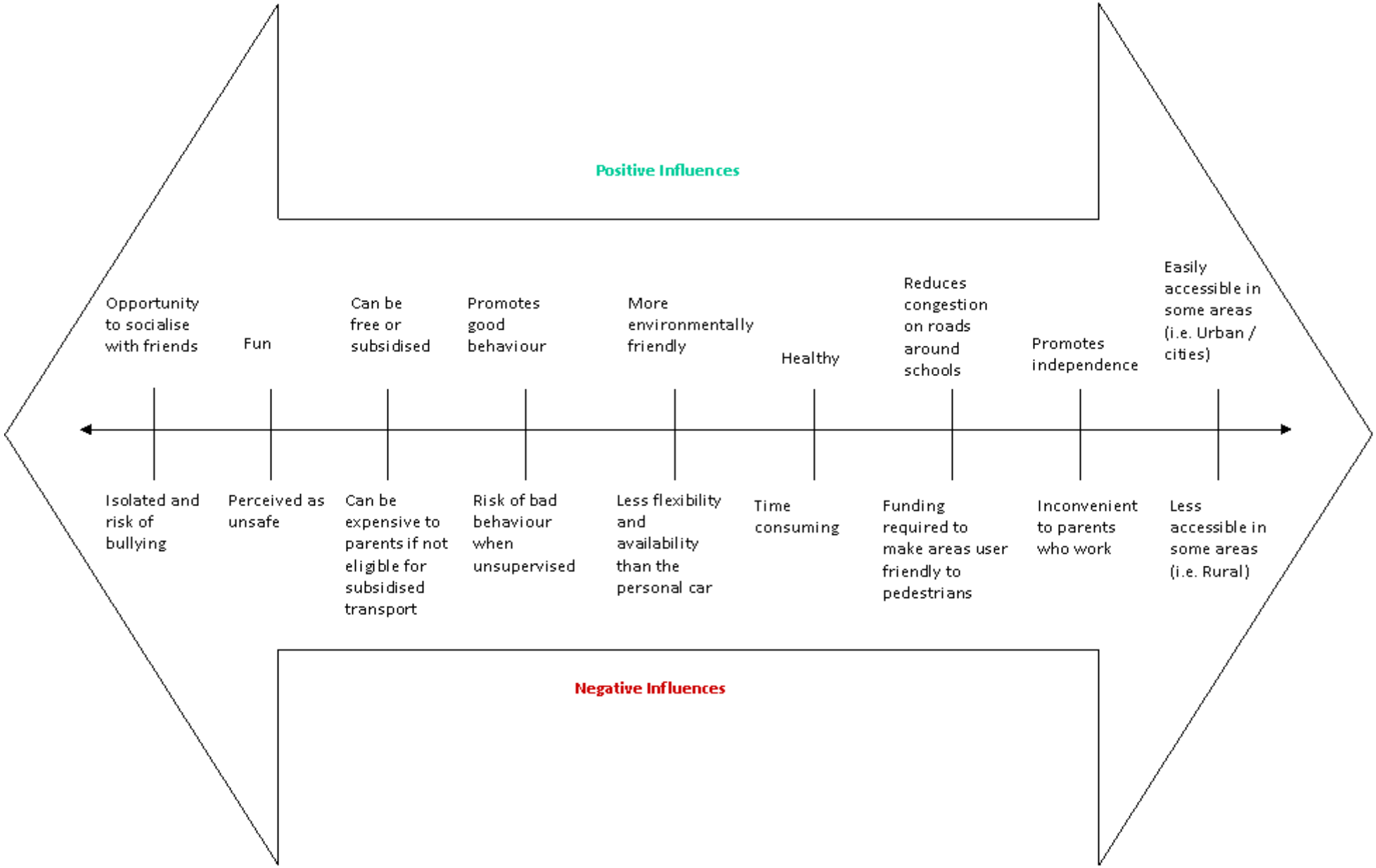


Figure 3.4 shows the popular concerns or positive influences of non-car travel as suggested by the interviewees. However, it is difficult to compare one issue to another as children may rate some points higher or more important to them than others.

The issue of bullying is a concern to many of the interviewees. Interviewee J believes the bus can raise the risk of bullying, especially on double-decker buses where children are away from the driver direct view. Interviewee J suggests that more bullying is more likely to occur in the confined space of the bus as oppose to cycling or walking as the children cannot escape from others on the same bus every day. Interviewee H disagrees that cycling and walking can allow children to become isolated and become more of a target for bullying, and bullying may go unnoticed in the space between home and the school gate where there is no monitoring of behaviour. This shows the difficulty determining which mode of travel reduces the chance of bullying. Schools need to continue to be aware of potential bullying incidents and on bus journeys work together with bus drivers and local authorities to try and reduce bullying incidents as much as possible to ensure continued use and a pleasant journey for all users.

The transport planner interviewees explain that it is vital that children know who they can speak to about these issues and who they can feel safe reporting bad behaviour to. By working together with local authorities, children can help to ensure their journey is a safe and pleasant one.

Promoting Good Behaviour

Children's behaviour is understood to be a major issue regarding school travel. Behaviour is a particular issue for the school bus and is a concern for children, the bus driver and; in the case of service buses, other passengers. Interviewee D comments that in a previous study a passenger on the bus researched claimed she preferred to travel during school hours and tried to avoid the bus with children travelling to school as she was concerned about how they behaved on the bus. Additionally, Interviewee C explains that poor behaviour not only creates issues for parents but also bus operators in terms of vandalism, abusing the driver and other problems and "if you look at bus statistics most attacks on staff occur around four o'clock in the afternoon, not late at night".

In addressing the issue Interviewee K finds that CCTV is one of the key tools in encouraging good behaviour on buses and to work with the schools regarding behaviour and that workshops and lessons explaining to the pupils about acceptable behaviour on buses is very effective in encouraging good behaviour. Interviewee P explains that his local authority has seen improvements in behaviour over time. Schemes and workshops have started to work as bus use becomes more common and children know how they need to act while on the bus.

Interviewee I states that frequently behaviour on buses is an issue when working with school travel. He adds that behaviour concerns lead to more issues such as "if there are escorts on buses, what kind of powers they can have, what part does that school play in behaviour policies and do you have it as part of the learning agreement with parents?"

Health Issues

Physical and mental health issues are becoming increasingly high profile thanks to media attention focused on childhood obesity and environmental issues. The Government is trying to encourage healthier lifestyles. Interviewee E notes “the heath agenda is becoming increasingly linked to travel”. Interviewee J states that in most cases walking and cycling are always promoted first as these are the healthiest modes of travel to school. The school bus is also seen as a healthier alternative to the personal car as Interviewee D states “even a short walk from the bus stop to school and again from the bus stop to home is better than being driven from doorstep to school gate and back again”.

Interviewee J wonders whether “the bus may actually end up being unhealthy. If a child is offered free transport for longer than 3 miles they will use that as opposed to riding their bike which is obviously the more healthy option”. The interviewees have mixed feeling about the health impacts of using the bus as it can both encourage and discourage walking and cycling. However, from an environmental point of view Interviewee H states “[the bus] is definitely the most sustainable mode of transport for [transporting] a large group of children from further distances at a single point in time”. Interviewee I adds that the bus industry has “a strong hand in moving people around in an environmentally efficient way”.

Overall, using the bus is still healthier for children and produces less pollution per person. Interviewee N notes “in a rural area, it is some children’s only way to independence”. By learning to use public transport early on, they may be discouraged from using the car later in life. However, as seen in Chapter 2, non-motorised transport to school offers the most health benefits to children especially at a time when childhood obesity is becoming a greater concern.

3.5.2 Parents

As seen in Chapter 2 parental influence appears to play a very vital role in school travel by any mode. This is a view shared strongly with the interviewees. As noted earlier, parental influence not only affects transport mode, but also school choice which directly affects transport mode. Parents want their children to get to school safely and on time and a safe and reliable journey home.

“Parents need a deeper understanding of how school transport works” (Interviewee P) Communication between parents and local authorities isn’t the only essential communication required. Interviewee B states “it’s about finding out what pushes people’s buttons. Know your market, know your parents and know what changes their minds and adopt a much more social market” to be able to change attitudes. The next problem lies in getting the message over to busy parents and ensure they have understood, but the children can be a key tool in doing this. “Pester power can be very effective!” (Interviewee L).

As stated earlier, safety is a great concern to parents especially if children walk or cycle to school alone. The school bus offers a more social and supervised journey to school but is still a concern to parents.

Interviewee K states that parents need a lot of convincing that the bus is a suitable and safe mode of transport for their children "parents can even be willing to follow the bus in their car to make sure it goes along a safe route and that their children are seen to get to school safely before they are convinced the service is safe" and further points out that safety can be better ensured when the school trip is recorded on CCTV on a bus, rather than when children are isolated in walking or cycling to school.

Interviewee K elaborates that council do try and work with parents to encourage them to change their perceptions of bus use. "Many parents have not used the bus since they went to school. Councils need to tell them exactly what to expect from buses and the services offered otherwise they won't know how high the quality of school bus services are today". Interviewee I says "I know that sometimes buses can be seen as being unattractive to people but I'm not convinced that's the case for young people because for young people the bus can just be seen as a point of independence, Therefore sometimes there is conflict in bus perspectives and this stores up problems for the future".

Interviewee I adds "you've got to make the service right" if you want to change behaviour. Interviewee B states "Attitudes can be changed, but there will always be the hard core that won't but the vast majority is easily influenced".

3.5.3 Schools

Although schools have less influence over pupils walking and cycling to school, schools do have some responsibility regarding school bus services. Communication between bus operators and schools is also necessary to ensure safe journeys to and from school and good behaviour from children. Schools need to work together with bus operators to provide what Interviewee B described as "a safe journey not only to and from the school gate, but one that extends into the schools gates all the way from home". Interviewee L states that schools should be more involved in promoting bus use "if they're supporting a service going to their school".

Interviewee M adds that schools can help by showing more flexibility in their timetabling. Extended school days are becoming more popular for working parents in the form of breakfast clubs or afternoon homework clubs or after school activities. However, this can be difficult for bus operators. Interviewee O explains that in a rural area when "the only service serving the school *is* the school bus service," and there is only one bus, the extended school day "can be a huge problem" (Interviewee N).

Interviewee O continues that the new 14-19 diploma scheme will cause further problems for the school transport industry, especially for rural areas as they face "policy conflict" when trying to reduce the number of cars on the road whilst simultaneously encouraging more travel during the school day.

Schools and local authorities can benefit by working together. For example, school timetables can be designed around service bus schedules (if available). This should also extend into the before and after school hours.

Interviewee N explains that the school is normally the first point of contact and “It’s our commitment, we’re committed to working with them [schools] and helping them. We show how [our school travel plans] fit in with healthy schools , fit in with eco-schools, fit in with sustainable schools and if you can go in and show them those links they [schools] don’t see it as another stand only project they have to do”.

Interviewee O adds that a lot of work is needed to build a relationship with schools “it needs to be a very hands-on exercise – especially for the first 12 months. That can be the key to success”.

3.5.4 Social Summary

This also links to the issue of children’s behaviour on buses. Several interviewees make the point that children can be trained to use the bus appropriately making their journey pleasant for themselves, other students, and the bus drivers [through the use of technology and parental and school support].

Parents need to take a more active role in their children’s travel. If they do decide to send their children to school by bus, they can help by reinforcing the lessons taught by the schools and local authorities about how to behave appropriately on the bus to allow all children to enjoy a pleasant journey to and from school.

The key to improving the social aspect on school travel is communication and cooperation from children, parents and school with their local authority. Local authorities have the foundations in place through workshops, leaflets and help lines but these will only be effective when children, parents and schools use them and take advantage of the services available.

3.6 Technological

Many car dependant travellers are not aware of what the current quality of bus travel is and information on the service and quality and reliability of services available could result in more adults and children being willing to travel by bus more often. Interviewee C adds that “not all parents drive their children to school and head straight back home. About 60% of these go on to other journeys” suggesting that some attitudes will not be influenced at the car is the most convenient form of transport for both children and parents.

Theory and communication alone are not enough to help planners, bus operators and policy makers in delivering school travel. There are other elements which, when in place, can help delivery effective school travel by bus. Bus-based instruments such as regulatory, fiscal, informational and technological instruments can aid in providing a good service.

The majority of interviewees suggest that better education and information were key elements in providing a better bus service for school travel. Interviewee I says that improvements in technology will help in delivering better services and that bus technology has improved greatly in the last few years but still has room for improvement, “we could one day develop a swipe-in system that links to the school so teachers know who have gotten on to the bus and who to expect in school”.

Interviewee K has the view that “the system doesn’t have to be complicated. It can be simple, just have set places to be picked up and dropped off, a reliable service that sticks to its timetable and route, and give children a mobile phone as a backup”. Interviewee H is less enthusiastic saying that “Everything has been tried already” and suggests that there isn’t much more scope to be able to improve school bus services.

Buses have changed dramatically in the last decade and are continuing to improve. Today buses can have seat belts installed, have hydraulic mechanisms to allow for easier accessibility, global positioning system, real-time information and automated payment facilities.

As much as changes in technology are helping to deliver a good bus service, only four of the interviewees believe that technology is a key bus-based instrument in ensuring bus use. Instead the majority of interviewees feel that readily available information and education is the main bus-based instrument that can encourage more bus travel for school children.

Technology on buses is always being improved. However, this then has an impact on other issues already explored in this study. For example, Interviewee I explains that some bus operators can spend longer improving the vehicle used in school travel but this then increases the costs to both the local authorities through contracts or to parents through a rise in fare prices. However, investment in the vehicles can also help to save money in the long run. More economical vehicles can help to reduce the impact of fuel cost rises. The installation of CCTV can also benefit if there are any insistences of damage or abuse to the vehicle by children. By being able to identify the person/s responsible, the bus operator can be reimbursed by the guardian of the children. Also, parents may be willing to send their children by bus if they feel the vehicles are of high quality, even if the cost of fares has risen. If the service is believed to be of high standard, parents are very likely to be willing to pay more for their children to travel on safe and comfortable vehicles.

Several of the interviewees have suggested that the introduction Oyster style swipe cards could make bus use much more efficient for school children. Interviewee I explains that electronic records of who uses the bus and when would help with many safety issues. “Parents will know their child was on the bus, schools will know who to expect”. Future technology could drastically improve bus services and make them safer and more efficient.

It is difficult to determine the best use of technology without further research into individual cases; however cost again is almost always the main factor in any decision made.

3.7 Environmental

Interviewee E notes “most schools have an environmental policy and the school travel plans need to fit in with that”. Interviewee I adds “there are people today who are very concerned with their carbon footprint”, especially if parents are choosing schools further away from their homes and therefore increasing average journey time.

Interviewee M adds that children can be a very useful tool in encouraging their parents to be more environmentally friendly. This current generation of children have grown up with environmental issues and are constantly encouraged to recycle and be wary of the effect of emissions and greenhouse gases.

By being aware of the environmental issues of car use, children are more likely to choose bus travel over car travel to and from school. However, once more it is cost that is a big issue. Specifically as operating costs rise (and funding levels fall) then either fares will increase and/or services levels will decline. The issue of costs rises for the operator and local authority and therefore impacting upon parents and children may result in a fall in demand, especially if parents are choosing schools further away and therefore the longer the journey on the bus, the more a ticket will cost.

3.8 Conclusion

Overall there is a feeling that change is needed regarding travel to school. The interviewees have highlighted the main issues preventing car dependent school travel.
These are:

- *Cost* In the form of the amount of funding offered by the Government towards providing school transport. The willingness of parents to pay for a service. “Speak to any parent and they will say cost [is the main issue of sustainable travel] even if the bus is actually cheaper” (Interviewee L)

- *Attitudes and perceptions* of parents play a vital role in how children travel to school and that it is very likely that those who regularly use a personal car are not aware of the quality of current bus services or alternatives available.

- *Limited services* in which not enough pedestrian facilities are available, sometimes the bus timetable does not match the school timetable and this can lead to children missing a service, or having to wait a long time for a bus to arrive. The extended school day (both morning and evenings) can also be an issue and act as a barrier to children using the bus to travel to and from school.

- *Behaviour issues* as bad behaviour can result in vandalism, bullying and disruption and become a barrier to children wanting to use the bus.

- *Policy / legal issues* as the current policies in place (particularly the school choice policy) appear to encourage more school travel by car.

Figure 5 outlines these issues and illustrates potential solutions that could be introduced in the future to try and break down the barriers to children travelling to school by modes other than the personal car.

Figure 3.5 Barriers to reducing car use in the journey to school

Possible Solutions:

- Change or remove the school choice policy
- Change the eligibility criteria for statutory home-to-school bus transport provision

Policy

Cost

Possible Solution:

- Bus passes
- Operators offering concessionary fares
- Free travel (if eligible)
- Subsidised fares
- Government funding

Possible Solution:

- CCTV
- LA organised workshops
- LA and schools working together with bus operators
- Rewarding good behaviour

Behaviour Issues

Attitudes & Perceptions

Possible Solution

- Market the product
- Communications with parents and schools
- Ensuring information is readily available and easy to understand
- Showing the vehicles to parents and children
- Get children to encourage parents to allow them to use other modes of transport

Limited Service

Possible Solution:

- Getting schools and operators to work together to create a timetable that coordinates with school start/finish time and extended school days.

There are certainly many issues that have arisen during this study (outlined in Figure 5) that prevent the effective use of the bus in school travel. “The bus operators don’t like the current system, the council’s don’t like the current system, the kid’s don’t like the current system, the parents don’t like it, schools don’t like it - there is nothing good about how the way we are running bus travel” (interviewee G).

15 out of 16 interviewees firmly believe that the bus does have a future in school travel. Interviewee E states that the bus has a temporary future but is unsure as to how long it may have a future for “the bus does have potential, but so far this has not been realised and the bus should really be able to compete more effectively than it is [at the moment]”.

The issue of safety appears to be the main issues highlighted by the interviewees as the main factor which affect many aspects to bus use to all stakeholders. This supports the findings in Chapter 2 in which much of the previous literature states that safety and parental concerns is a key factor in school travel. As many of the studies found, few parents were willing to change their behaviour based on their views of their child’s safety.

The school bus is still viewed as an environmentally sustainable form of transport and can help tackle the issues of physical and mental health issues in children, by allowing them to have some social interaction with others, a taste of independence and more physical exercise than the door-to-door routine offered by using their parent’s car. The bus clearly still has a very relevant place in school travel as part of the wider range of transport available to children. If non-motorised modes are not practical in a journey, the bus is still a very important tool in school travel.

Cycling and walking to school are perceived as the preferred modes from a public policy perspective. Interviewee J states “I think for schools it’s the easy option to say to parents ‘just get the kids into the back of a car or bus and get them here’. For the long-term well-being of the children they should be encouraged and facilitated to make more independent journeys”. Yet, as Interviewee stated, “what we have now is an education policy that is encouraging people to travel further and further” (Interviewee A), a sentiment widely shared by Interviewees from a mixture of consulting, academic and planning backgrounds who see parental school choice as one of the main issues in preventing sustainable school travel. Interviewee D warns that “the more choice [of school] that is offered; the more difficult it will be to offer services for so many different choices”. With the potential expansion of parental choice of school, walking and cycling are not always practical and therefore the bus is the most sustainable option for longer journeys for transporting large numbers of children at one time.

The issue of school choice also leads to children not being eligible for free school transport as part of the local authorities’ statutory bus travel provision. As Interviewee P noted the main view of the Government regarding this is that “if parents decide to take their children to a non-catchment area school they need to take some responsibility for that”. Interviewee A also comments that as so much is spent on SEN travel, there is little funding left over to spend if the mile limit was reduced to encourage more children to travel to school by bus.

In conclusion, the findings of the scoping study confirm that the school travel policy area is relatively under-researched. In particular, it recommends that the home-to-school transport provision policy and school choice policy provide two highly topical and politically relevant examples to investigate in the current UK context.

Specifically, as the school choice policy (in the views of the interviewees) appears to encourage more car use in the daily journey to school it would be useful to investigate whether the removal of this policy in England would significantly improve the overall journey to school for children, encourage more environmentally friendly and healthier travel and improve quality of life for communities and residents living close to a school.

It will also be of benefit to further explore the statutory home-to-school bus provision policy to see if this is being of benefit to school children and does help to reduce car use in England. If this policy is not fulfilling its full potential as funding is already limited, the annual spending as a result of this policy could be redistributed to improving other areas of school travel.

The evidence from the scoping study helped confirm the importance of the propositions as identified in the literature review.

Proposition 1

Younger (primary) pupils are more likely to travel by motorised modes of transport in their daily journey to school than older (secondary / Post 16) pupils.

Proposition 6

Distance to school significantly affects mode choice.

Proposition 7

The policy allowing parental choice of schools leads to a considerable increase in vehicle miles travelled by car and associated wider impacts.

Proposition 8

Local authorities that offer only the statutory level of school transport provision experience lower levels of bus mileage per pupil on average than those with more generous policy guidelines.

Proposition 9

The higher the level of bus subsidy provided by a local authority per pupil, the greater the average bus passenger mileage generated.

Whilst no new facts emerged to support:

Proposition 2

Female pupils travel less actively than male pupils.

Proposition 3

The ethnic background of a pupil will have a significant effect on their travel behaviour.

Proposition 4

Pupils from low income households do not travel as far to school as their higher income peers.

Proposition 5

Pupils living in less densely populated areas are likely to travel further to school than those residing in more urbanised locations.

The next chapter of this thesis will outline the methodology of this thesis, re-visit the thesis aim and objectives and outline how the above policies will be analysed.

CHAPTER 4 METHODOLOGY

4.1 Introduction

The review of current literature in Chapter 2 established that school travel is a valid area of research and impacts upon society in many developed countries. The scoping study conducted in Chapter 3 supports this overall finding that school travel is an area in which more research needs to be undertaken to gain greater understanding into travel behaviour and mode choice and concluded that the following points require further research:

1) allowing parents to choose the school that their child(ren) attend(s), and
2) the policy that determines the levels of statutory home-to-school transport provision

This thesis will therefore examine the effects of the school choice policy on school travel and the consequences that arise as a result of this policy on all vehicle miles travelled (VMT) and the environment (i.e. CO_2 emissions, fuel consumption and transport energy) when children are allowed to travel to any school as oppose to the school closest to them.

It will then explore the policy of the policy offering free bus travel to pupils who live within 2-3 miles of their nearest school, the current costs incorporated with this and how much bus passenger mileage is generated by this policy and whether in a time of economic constriction, the costs and grants which fund this policy could be saved.

This chapter will firstly present the research design for this thesis which gives an overview of the research stages and methods utilised throughout the thesis. It then presents the details of the four key elements adopted over the course of the study.

4.2 Research Rationale

As stated in Chapter 1, the aim of this thesis is to investigate the transport related impacts of policy on school travel.

Meanwhile, the objectives are as follows:

- To identify the current issues and factors affecting school travel around the world.
- To determine the current opinions of academics, consultants and travel planners in the transport sector, regarding school travel.
- To quantify the transport related impacts of the school choice policy across England.
- To evaluate the impacts of the statutory home-to-school transport provision policy and determine the effectiveness of this policy in school travel today.
- To provide recommendations for policy makers and practitioners relating to school travel in England.

Research Design

In order to realise this aim and the associated objectives, a research approach comprising of 4 elements was adopted, namely:

- Interview scoping study
- Econometric analysis
    - Multinomial logit modelling
    - Mixed multinomial logit modelling
    - Multilevel modelling
- Impact inventory
- Internet survey

These elements were explicitly linked to each of the objectives as shown in Table 4.1.
Table 4.2 then further details the structure of the thesis on a chapter by chapter basis.

Table 4.1 Research Design

Objectives	Methods	Chapter(s)
To identify the current issues and factors affecting school travel.	Literature Review of factors influencing school travel.	Chapter 2
To determine the opinions of academics, consultants and travel planners in the transport sector, regarding school travel.	Interviews of current experts and policy makers in the school travel field	Chapter 3
To quantify the transport related impacts of the school choice policy across England.	The use of multinomial logit and mixed multinomial logit models and an impact inventory to quantify the impacts of the school choice policy.	Chapter 7 and Chapter 8
To evaluate the impacts of the statutory home-to-school transport provision policy and determine the effectiveness of this policy in school travel.	Multi-level modelling technique used to test the impact of removing the home-to-school provision policy.	Chapter 9
To provide recommendations for policy makers and practitioners relating to school travel in England.	Identify the main variables which influence school travel and review results and findings for potential policy implementations	Chapter 10 and Chapter 11

Table 4.2 Structure of the Thesis

Chapter	Chapter Objectives	Tasks Undertaken
Chapter 1 Introduction	Set the foundations of the thesis.	Explore context of school travel in England.
Chapter 2 Literature Review	Review of literature exploring the current issues and factors affecting school travel around the world.	In-depth review of current research into school travel looking at the key issues regarding child travel behaviour and identifying a clear existing gap in research.
Chapter 3 Interview scoping study	Report the views of current experts in the school travel field.	Gathering the views and opinions of current experts in the school travel field and supporting the identified research gap.
Chapter 4 Research Approach	Validate of the research propositions.	Formulation of research propositions.
Chapter 5 School transport policy in England context	Explore two of the current policies which affect school travel in England.	Gained further understanding of the 2 policies indentified by the previous studies as significant influences of school travel.
Chapter 6 Data collected and used in this project	Outline the data collected for this project and the variables used in the analysis.	Summarising and integration of the data collected for this project.
Chapter 7 Analysis of the school choice policy	Quantify the impacts of the school choice policy in England using econometric modelling.	Used a combination of multinomial logit and mixed multinomial logit modelling techniques to quantify the impacts of the school choice policy.
Chapter 8 Analysis of the statutory home-to-school transport policy	Measure the impacts of the statutory home-to-school transport provision policy in England.	Used a multilevel modelling technique to quantify bus use generated by the statutory home-to-school transport provision policy.
Chapter 9 Discussion	Revise of results obtained and comparisons to previous work done.	Examination of the results of he previous analysis compared with the findings of the literature review and scoping study.
Chapter 10 Conclusion	Provide the conclusions and present the recommendations for practitioners and policy makers.	Final thoughts, project limitations and future work.

Each of the four methodological elements referred to earlier will now be considered in turn in section 4.3, 4.4, 4.5 and 4.6. Specifically, a justification for the principles of each mechanism will be presented followed by details of exactly how the data was collected and analysed.

4.3 Interview Scoping Study

As explained in Chapter 3, the purpose of the interview scoping study was to help address the lack of research conducted into school travel factors from a policy maker perspective and to validate the research gap proposed.

For this reason a qualitative exploratory study was conducted to provide greater insight into school travel in England from the point of view of 'experts' who make, enforce or analyse school travel policies in the UK context based on the findings of the initial findings of the literature review. The term 'expert' can mean individuals with specialised knowledge in a specific field with demonstrated experience and involvement (Hagerman et al, 2010) which is of particular interest to a specific study (Gläser and Laudel, 2004). The roles and expertise of the selected experts have been outlined in Table 4.3. The 16 experts have been labelled as expert A-K to maintain anonymity.

Table 4.3 Interviewee Expertise

Role / Position	Ref	Expertise
Transport Planner	B	Working in the field of sustainable transport promotion and in particular School Travel Planning and London School Travel.
	F	Transport planner with experience of the Safer Routes to School Program in the US
	K	Team leader of the transport department of a county council in central England.
	L	Works within a large council in the school transport planning department in the North of England.
	M	Works within a large council in the school transport planning department in the South of England.
	N	Works within a large council in the school transport planning department in the North East of England.
	O	Works within a large council in the school transport planning department in the North East of England.
	P	Works within a large council in the school transport planning department in the North East of England.
Consultant	A	Experience in public policy and management across transport, planning, education.
	G	Experience of transport planning and project development working within research, consultancy, central government and local government.
	H	Divisional director of a medium sized transport consultancy, specialising in passenger transport and accessibility.
	J	Runs a sustainable transport planning consultancy with significant experience in developing travel planning initiatives for schools and workplaces.
Academic	C	Professor and researcher in bus, coach and rail systems.
	D	Previous School Travel Adviser, and has researched the ability of Quality Bus Partnerships to reduce car use.
	E	Researcher of design processes of cleaner transport and cleaner vehicle technologies, low carbon transport systems and sustainable travel behaviour.
Government Advisor	I	Representative of bus operators and advisor to Government.

Those selected to take part included School Travel Planners (usually from a council or Government body), transport consultants (from both the UK and US) and academics whose research pertains to the transport industry and Government advisors.

These individuals were selected using co-nomination, in which the first interviewees suggest further experts to be included in the study (Vaharo and Tapio, 2007) and from a purposive sampling strategy based on the needs of the researcher (Trochim, 2008 and Miles and Huberman, 1994) which in this case was their experience and in-depth knowledge of school travel and their reputation in the school travel field from a range of backgrounds:

- School travel planning
- School travel / transport policy
- School travel schemes and initiatives
- School bus operations and services

The semi-structured interviews (conducted both face-to-face and via telephone communication by the author) were in-depth and exploratory allowing flexibility for the interviewees to elaborate where necessary on their own experiences and expertise, and enabled new themes to develop whilst maintaining control when required (Drever, 1995).

A number of core questions were asked on the initial literature review findings (or lack thereof) but a degree of flexibility was incorporated to allow the interviewees to elaborate further on areas based on their knowledge and expertise. While there are some limitations to interview studies, e.g. the data can be too broad and difficult to analyse (Davis et al, 2009, p.1398), Boyatzis (1998) notes that this technique allows themes to be identified by direct observation from the information or by lessons learnt. In this research themes are related to the structured questionnaire design, whilst more specific information has been gathered from the experts individually based on their experience, the overall theme of the questionnaire has remained unchanged.

The analysis of the interviews was based on a thematic analysis technique which is widely used in qualitative studies (Braun and Clarke, 2006; Denzin and Lincoln, 2000; Silverman, 2006; Crabtree and Miller, 1992).

Braun and Clarke (2006, p.78) explain this technique is widely used to analyse qualitative data as it provides "*theoretical freedom*" and "*provides a flexible and useful research tool, which can potentially provide a rich and detailed, yet complex, account of data*".

The interviews were designed to address issues relating to:

- Context: definition and characteristics of school travel in general
- Outcomes: issues related to school travel, and focusing on the school bus
- Process: reasons for school travel plans and current bus provision
- Future of school travel: does the school bus have a future in school travel?

The results of this study have already been discussed in Chapter 3 and the list of questions is presented in Appendix 1.

4.4 Econometric Methods

Behavioural analysis is important when seeking to understanding trends and patterns as to why people in society act in certain ways. Econometric modelling is particularly useful in analysing economic, business and transport applications allowing the modellers to forecast changes in behaviour and impacts of these changes (McKenzie and Thomas, 1984; Williams and Smith, 1979).

Maximising benefit has been a major motivation in all kinds of sectors. Businesses are always trying to maximise sales and profits, consumers try to get value for money from products and services, whilst manufacturers seek to offer good quality goods but at the smallest price possible. Heliporn et al (2009, p.110) states "*The issue of setting the right price for a product lies at the core of the economics*". In other words, everything comes at a price, whilst the consumers expect to receive value for money.

General travel behaviour has always been an area of interest for behavioural analysts (Bhatta and Larsen, 2011), with many studies investigating which modes of transport offer the user more utility in their journey (Diana, 2008; Schmöcker et al, 2008; Sener et al, 2011). From the few specific studies of school travel behaviour that exist (i.e. Müller et al, 2008; Marshall et al 2010), it is interesting to note that many of them employ econometric modelling techniques to simulate and predict child travel behaviour.

The primary focus of this thesis is to analyse school travel using selected econometric models, particularly models suitable for developing relationships: (1) mode choice of children travelling to school and (2) total school-level bus usage of children where schools are nested within local authorities. Suitable models to develop such relationships are briefly discussed later.

To do this, the econometric analysis used in this thesis follows the methodology outlined by Gujarati (2003):

1. Statement of theory / hypothesis
2. Specification of statistical model of the theory
3. Obtaining the relevant data
4. Estimation of the parameters of the model
5. Hypothesis testing
6. Forecasting or prediction
7. Using the model for policy purposes

The review of literature and the interview responses in the scoping study both highlight a common issue, namely that parents want what is best for their children regarding the journey to school. They want their children to have the journey to school which benefits them the most. This can be in the form of convenience, flexibility, comfort, health, independence or what their children enjoy.

This is reinforced in the scoping study, where interviewees frequently stated that parents are increasingly trying to ensure the best possible journey to school for their children. Thus parents evaluate all modes of transport their child can access for their journey to school and select the mode which offers the most personal benefits. This can include such expectations such as flexibility, comfort, safety, cost, social interaction, and health and/or environmental benefits. Chorus and de Jong (2011) explain that there are two groups of people: the 'utility maximisers' and the 'regret minimisers'. A person either wants to create more benefit for themselves and try to minimise the disadvantages. In the case of parents, regret minimisers may reject certain modes of travel based on cost, safety issues, timetable issues, personal opinions, risk of bullying and accident statistics (Hillman et al, 1993).

According to Lefevre (2002) it has long been in our nature to choose products and services based on value for money, yet it is very difficult for the policy makers to be able to offer bus services to children at low costs whilst still meeting the parent's expectations regarding the quality of service. The idea of maximising utility as long been researched in the financial field, but is significantly under researched in the transport field.

As a result, the following section will first investigate the concept of discrete choice modelling before the subsequent section sets out the hierarchical modelling approach used for the second modelling exercise.

4.5 Discrete Choice Modelling

Discrete choice analysis is a popular method for modelling transport behaviour (Srinivasan and Ferreira, 2002; Bowman and Ben-Akiva, 2000; Bhat, 2008; Ben-Elia and Ettema, 2011) as it allows for a modeller to identify trends in a sample as well as predict changes and outcomes in behaviour if scenarios are altered.

In a discrete choice model, an agent (i.e., person, household, firm, travel mode) face a choice or a series of choices among a set of options. Ben-Akiva and Lerman (1989, pp. 31-32) define 'choice' as an outcome of "*sequential decision-making process"* which follows the subsequent steps:

- definition of the choice problem
- generation of alternatives
- evaluation of attributes and alternatives
- choice
- implementation

The set of alternatives (i.e., the choice set) needs be mutually exclusive, exhaustive and the number of alternatives must be finite (Train, 2009).

According to Ortúzar and Willumsen (2001, p. 200) the factors influencing choice behaviour can be categorised into 3 groups and add that a good choice model should include the most important of these factors:

1. Characteristics of the trip makers (e.g. household structure, car ownership, income)
2. Characteristics of the journey (e.g. trip purpose, time of day)
3. Characteristics of the transport facility
    - Qualitative factors (e.g. convenience, reliability, security)
    - Quantitative factors (e.g. travel time and cost)

As well as allowing a researcher to observe and understand behaviour, discrete choice modelling allows for simulations to take place. Simulations allow the researcher to approximate the choice possibilities that occur (Train, 2009).

Underlying the discrete choice model is the random utility theory (Domencich and McFadden 1975; Williams, 1977; Ortúzar and Willumsen, 2001 and Greene, 2008).

According to Ortúzar and Willumsen (2001, p.223), random utility theory assumes that:

- Agents belong to a homogeneous population
- There is a certain set of alternatives available and a set number of vectors of measured attributes of the individuals and their alternatives
- Each option available to the agents has an associated net utility.
- The agent selects the alternative that offers them maximum utility.

In most behavioural analysis it is common to assume that an individual makes a decision based on what offers them the most benefit or advantage (utility). In the case of travel this is sometimes in the forms of trip cost, travel time, comfort, flexibility, convenience and security. Ben-Akiva and Lerman (1989, p.2) explain that discrete choice analysis allows a decision maker to be modelled "*as selecting the alternative with the highest utility among those available at the time a choice is made".*

Train (2009) explains how Random Utility Models (RUMs) can be derived from the utility maximisation theory. In a random utility model (RUM), Train (2009) assumes that a decision maker (say *n*) faces a choice among *J* alternatives. The decision maker would obtain a certain level of utility (or profit) for choosing an alternative (i.e. U_{nj} ; $j=1,2,3,\ldots J$). This utility (U_{nj}) is only known to the decision maker, who selects an alternative that is associated with the greatest utility. Therefore, according to the utility maximisation theory, the decision maker only chooses an alternative *i* if and only if $U_{ni}>U_{nj}$ (in which j≠i).

A modeller, on the other hand, does not observe the decision maker's utility but observes some attributes of the alternatives (i.e. time and cost in the case of transport mode choice) as faced by the decision maker (X_{nj} for every *j*) and some attributes of the decision maker (such as age, gender, income for the case of transport mode choice) (S_n). This is known as 'observed' or 'representative' utility and is denoted by V_{nj}. Therefore, the decision maker utility (U_{nj}) has two parts (i.e. V_{nj} and a random component ε_{nj}) :

$$U_{nj} = V_{nj} + \varepsilon_{nj} \quad (1)$$

Where the random component (ε_{nj}) captures the unobserved factors that are not included in the observed utility (V_{nj}). The logit model is therefore is derived by assuming that each ε_{nj} is independently and identically distributed (iid) extreme value known as Gumbel and type I extreme value distribution (Train, 2009).

Therefore, the probability that a decision maker *n* chooses an alternative *i* can be denoted as:

$$P_{ni} = \text{Prob}(U_{ni}>U_{nj} \text{ for every } j\neq i)$$
$$=\text{Prob}((\varepsilon_{nj} - \varepsilon_{ni})<(V_{ni}-V_{nj}) \text{ for every } j\neq i)$$

The logit choice probabilities are obtained by the following formula:

$$P_{ni} = \frac{e^{V_{ni}}}{\sum_j e^{V_{nj}}} = \frac{e^{\beta x_{ni}}}{\sum_j e^{\beta x_{nj}}} \quad (2)$$

In equation (2), representative utility is specified as the linear in parameters in which x_{nj} is a vector of observed variables associated with alternative *j*. The choice probabilities for all alternatives sum to 1 i.e.

$$\sum_{i=1}^{J} P_{ni} = \frac{\sum_i \exp(V_{ni})}{\sum_j \exp(V_{nj})} = 1 \quad (3)$$

The logit models have been extensively used to investigate transport mode choice (Srinivasan and Ferreira, 2002; Bowman and Ben-Akiva, 2000; Bhat, 2008; Ben-Elia and Ettema, 2011) and therefore such models are considered the most appropriate form of analysis to use in this thesis, as travel behaviour (and changes in this behaviour) as very likely to be as a result of utility maximisation based on the school transport policies available.

There is a whole range of different types of discrete choice modelling techniques that can be used to model behaviour which are classified as 'discrete ordered' and 'discrete non-ordered' models.

According to Wang (2010) these can be organised into the following 2 categories of discrete ordered and discrete multi-nomial (i.e. non-ordered) models including:

1. Discrete ordered:
    - Ordered logit model
    - Generalised order logit model
    - Partial proportional odds model
    - Random coefficient ordered logit model
    - Mixed generalised ordered logit model

Ordered discrete choice models allow the researcher to estimate conditional probabilities and the main advantage of discrete ordered models is that they allow for results due to unobserved factors, are suitable for binary and ordinal outcomes (Wang, 2010).

2. Discrete multi-nominal:
    - Multinomial logit model
    - Nested logit model
    - Mixed logit model

Discrete multi-nomial models consist of a flexible functional format, and can accommodate complex patterns of correlation and accounts for unobserved heterogeneity (Train, 2009).

For the purposes of this project, discrete non-ordered modelling techniques were chosen as the most appropriate models for school travel behavioural analysis. The reasons for this will be detailed in the following section.

4.5.1 Multinomial Logit Modelling to Determine the Impacts of the School Choice Policy

The multinomial logit model is the most practical discrete choice model (Ortúzar and Willumsen, 2001). Here, a multinomial logit was developed to show the relationship between mode choice and distance travelled by children travelling to their current school while controlling other factors such as: cost of travel, age, gender, ethnicity, proxy for household income (i.e. eligibility for free school meals and Income Deprivation Affecting Children Index score (IDACI) and road density.

For the purpose of this thesis, developed discrete choice models can be used to show which modes of transport offer maximum utility based on the pupil, school and LA variables available. This thesis adopts the multinomial logit (MNL) model and mixed multinomial logit (MMNL) model for analysing school children's mode choice. This model has been widely used in modelling nominal response data. The MNL model can be written as (Long and Freese 2006):

$$P_{ni} = \frac{e^{V_{ni}}}{\sum_j e^{V_{nj}}} = \frac{\exp\left(\beta_i X_n + \gamma z_{ni}\right)}{\sum_{j=1}^{J} \exp\left(\beta_j X_n + \gamma z_{nj}\right)} \quad (4)$$

In equation (4)**,** $\mathbf{z}_{ni}$ is a vector of alternative specific variables for mode i and pupil n; $\boldsymbol{\gamma}$ is a vector of the effects of the alternative specific variables; $\mathbf{X}_n$ is a vector of pupil specific variables for individual n; $\boldsymbol{\beta}_i$ is a vector of pupil specific coefficients for the effects on mode i relative to the base mode.

The MNL model is one of the main utility-maximising models used in transport modal choice research (Ben-Akiva and Lerman, 1989; Bhat, 2008).

Bhat (2008) also explains that that there are 3 basic assumptions underlying the MNL model:

1. *Random components of the benefits or utilities of different choice alternatives are independent and identically distributed (IID).*

The standard MNL model has the assumption of independence of irrelevant alternatives (IIA). The critical part of the assumption is that the unobserved factors (i.e. ε_{ni}) are not correlated across alternatives. In reality, unobserved factors related to one alternative (i.e. ε_{ni}) might be similar to those related to another alternative (i.e. ε_{nj}).

Train (2003, p 18) explained this by stating that "a person who dislikes travel by bus because of the presence of other riders might have a similar reaction to rail travel; if so, unobserved factors affecting bus and rail are correlated rather than independent". For example, a pupil may assign a higher utility to all public transport modes (i.e. bus, rail) because of the opportunity to socialise or if the pupil assigns a lower utility to all the transit modes because of the lack of privacy. In such situations, the same underlying unobserved factors (i.e. opportunity to socialise or lack of privacy) impacts on the utilities of all public transport modes. If this assumption is violated the model estimation results may be biased (Long and Freese, 2006).

2. *Does not allow sensitivity or taste variations and keeps all alternatives homogenous*

This suggests that decision makers' tastes do not vary for reasons that are not linked to representative utility (i.e. variables related to the decision maker). In reality, it can be said that two pupils with the same sex, income, educational attainment may make different mode choices, reflecting their individual preferences and parental concerns. The MNL model does not allow taste variations to an attribute (such as travel cost in the case of a mode choice model) due to unobserved individual factors. If this assumption is violated then parameters and choice probability estimates are biased and inconsistent (see Chamberlain, 1980).

3. *The error variance-covariance structure of alternatives is identical.*

This is known as an assumption of error variance-covariance heterogeneity suggesting that the error variance – covariance structure of the alternatives is identical across decision makers. In reality, it is difficult to justify the identical variance across individuals (see Bhat, 2008 for details).

This model can successfully represent school transport mode choice as illustrated in the first work examples, but there are issues that occur with this type of model. For instance, it can be seen as being unrealistic to assume that the utility of the choice alternatives are independent and identical. For this reason, a more sophisticated model was used in this thesis to gain more insight into child travel behaviour and modal choice utility maximisation.

By relaxing the above three assumptions a number of new logit models have developed in the literature (e.g. Ortúzar and Willumsen, 2001; Bhat, 2008; Train, 2003). The two notable ones are: nested logit models and mixed logit models. Among these two classes of models, a mixed logit model offers more flexibility and accuracy in the context of a mode choice model. Train (2003) states that the mixed logit model is more powerful and can accommodate complex patterns of correlation among transport modes and unobserved heterogeneity. It is able to simultaneously address a range of issues and has the following benefits (Bhat, 2008):

1. The MMNL is flexible and able to capture taste variation and flexible substitution patterns
2. The MMNL can show temporal correlation over time
3. It can employ non-normal distributions for random coefficients
4. It is simple and straightforward to simulate different scenarios

The mixed logit model can be expressed as follows:

$$\Pr(y_i = j) = \int \frac{\exp(\boldsymbol{\beta}_j \mathbf{X}_i + \boldsymbol{\gamma}\mathbf{z}_{ij})}{\sum_{m=1}^{M} \exp(\boldsymbol{\beta}_m \mathbf{X}_i + \boldsymbol{\gamma}\mathbf{z}_{im})} f(\boldsymbol{\beta}) d\boldsymbol{\beta}, \qquad j=1,2,3\cdots M \qquad (5)$$

Where: $f(\boldsymbol{\beta})$ is a density function.

Some parameters of the vector **β** may be fixed or randomly distributed. The standard MNL model is a special case of the mixed logit model when **β** are fixed parameters. For random parameters, the coefficients **β** are allowed to vary over different pupils and assumed randomly distributed. In this paper the random coefficients are specified to be normally distributed, e.g. $\beta_1 \sim N(b, W)$ where *b* is the mean and *W* is the variance. Similarly, **γ** may also be specified as random parameters. A parameter is determined as random if the estimated standard deviation (S.D.) is statistically significant. Similarly some parameters of **z** could be considered as random.

Based on the estimated model, predictions for each pupil using different transport mode can be obtained. Market share for each of the four transport modes can be calculated using the following equation:

$$\hat{S}(j) = \frac{1}{N} \sum_{i=1}^{N} P_{ij}$$

where $\hat{S}(j)$ is the predicted share of transport mode *j*; *N* represents the number of pupils modelled; and P_{ij} is the predicted probability of pupil *i* choosing mode *j*. Therefore, unlike Müller et al (2008) and Marshall et al (2010) who used MNL models in their analysis of school travel behaviour (see Chapter 2), this thesis will be able to model mode choice more accurately with the MMNL as the utility of each alternative will not be considered fixed, which is a more realistic view of school travel behaviour. Based on these findings, this thesis employed both techniques, but the MMNL was considered for the main results section. The purpose of this modelling was to determine the transport and environmental impacts of the school choice policy in England based on utility maximisation of modal choice in the journey to school.

Overall, MNL and MMNL approaches were both then used to estimate the modal share of the sample of the census data for children travelling to their current school. Currently, only 42.5% of pupils in England attend the school closest to their home.

The same model can also be used to estimate the modal share of the same sample if all those children travelled to their nearest school. This can simply be achieved by replacing 'the distance to the current school' in the calibrated discrete choice model with 'the distance to the nearest school'. Fig 4.1 further illustrates the utilisation of the discrete choice modelling used in this thesis. The details of distances travelled from home to school were introduced into the School Census in 2009 to aid the Government in its school travel plan initiative. The distance to school is generated from the postcode of the child's to the postcode of the child's school (i.e. they are measured along the shortest available route along which a child, accompanied by an adult if necessary, may walk in reasonable safety).

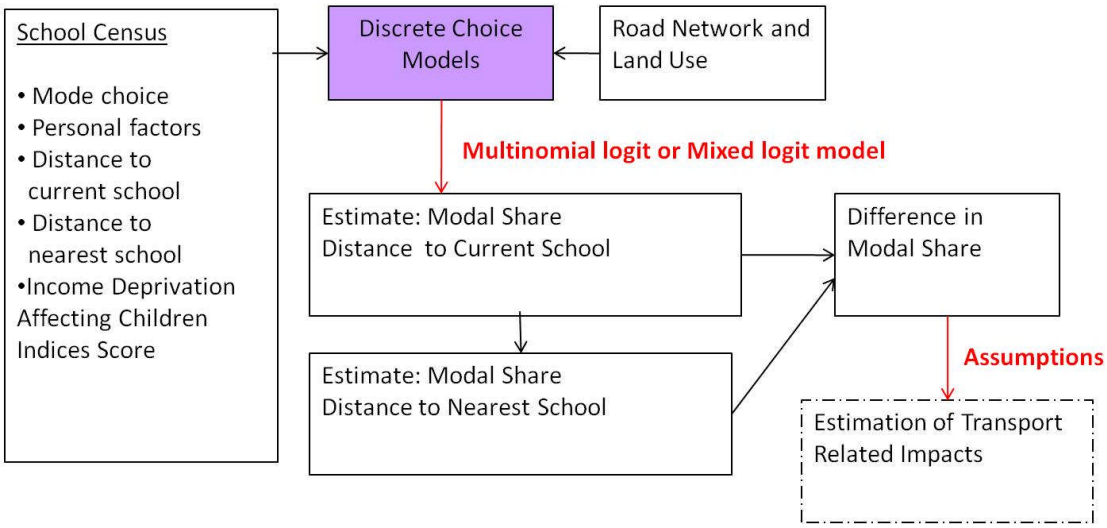


Figure 4.1 Research methodology to quantify the transport related impacts of school choice

As Figure 4.1 illustrates, the data analysed in this study was obtained from 2 key sources namely the School Census 2009, road network and land use data as obtained from the 2001 Census and area classification of Super Output Areas database. These were integrated and analysed using both a MNL and then a MMNL discrete choice model to estimate the differences in modal share for the children in a sample of 1% of the School Census (or 69,910 pupils).

The sample of 69,910 pupils has been randomly selected from the School Census population of 7,484,001 pupils. The random sample was taken using a simple random sampling process which means the selection probability of each unit is the same. Due to the size of the dataset, a full analysis was not possible due to computer and software limitations; yet the random sample represents an accurate picture of the dataset as seen in the percentage share comparison of the pupil's main mode of travel in Table 4.2. Based on the pupil's age, they will be placed in either the primary school (age 5-10) or secondary school (age 11 and above) category. As stated in Chapter 2, age has an influence on how children travel and for this reason the pupils in the sample will be separated into these two categories.

The School Census dataset presented 11 different categories of transport (see Table 4.3) as the pupil's main mode of travel. Modal shares for some of these modes are very low and given the complexity of a choice model increases with the increase in choice alternatives (Train, 2003), therefore, similarly to the study by Marshall et al (2010) the 11 modes of travel were combined into 4 mutually exclusive categories consisting of:

- *Car* (including travel by car and car sharing)
- *Bus* (including travel by dedicated school bus and public school bus)
- *Non-motorised transport* (NMT) (including travel by walking and cycling)
- *Other public transport* (including train, taxi, metro tram, London underground and other transport).

In this study investigating travel to school, references to journeys and travel only refer to the journey made by the individual child. Any travel made by their parents after the journey to school is complete is not considered in this study because the journey patterns or purpose of the parents is not available.

As the aim of this study is to quantify the transport-related impacts of allowing parental choice of schools on personal travel behaviour, traffic levels, fuel use, and CO_2 emissions; the modes of travel of walking and cycling have been combined into the category of '*non-motorised transport*' as neither of these modes have a cost, produce CO_2 emissions or contribute towards vehicle miles travelled. Moreover, cycle trips only constitute 1.8% of the total school trips.

This was achieved through the use of an impact inventory created by collaborating facts and figures from a variety of different sources (further details of which can be found in Chapter 6). Once the modal change and distances travelled have been calculated and compared, the transport and environmental impacts of this change were measured.

4.6. Hierarchical Linear Modelling

The second modelling element of this thesis looked at the statutory home-to-school transport provision policy in England.

Interestingly, this does not follow a discrete choice modelling approach, but instead a multilevel modelling technique was selected as being more appropriate in this case. Multilevel modelling is a type of hierarchical linear modelling or nested modelling. This means that it allows more than one level of analysis to take place. This is unlike the MNL and MMNL where individual pupil variables are analysed.

The MNL and MMNL were not considered appropriate for this section of thesis because these types of models present the following concerns (Ortúzar and Willumsen, 2001, p. 230):

- The alternatives are not independent (the groups of alternatives are similar to each other).
- There are taste variations among individuals, in which case the random coefficient model are required.

According to Wang (2010), the nested model relaxes the assumption of independence of irrelevant alternatives (IIA). The hierarchical models do have limitations also including the fact that unlike the MNL and MMNL, it cannot cope with 'taste variation' amongst individuals and does not allow alternatives in one level to be correlated with another level which can reduce the number of factors which can be modelled (Ortúzar and Willumsen, 2001).

However, multilevel techniques can give more specific insights into why behaviour changes (Stoolmiller and Snyder, 2004) and enable the context of social and organisational hierarchies to be viewed (Heck and Thomas, 2009).

According to Heck and Thomas (2009, p. 43) the use of multilevel analysis can add substantive information about how organisational processes can be affected by the hierarchical nature of the data and by the features of the organisations and their context. In this case, the organisations analysed include schools and local authorities.

Reassuringly, multilevel modelling originated in the study of schools due to their hierarchical structure. Schools are considered hierarchical as they made up of different levels such as different classes, different teachers, types of classes within an age group, the same class with different age groups, and different types of schools for various age groups (Goldstein, 2003; Field, 2009). Structure of the model allows the hierarchical nature of the data to be modelled because it assumes that individual members (e.g. schools) within a group (e.g. local authority area) will exhibit some similar (i.e. highly correlated) characteristics.

In this case, the primary objective was to examine the policies relating to the funding criteria that affect the level of bus passenger mileage by school (for a single home-to-school trip) in England. Since the school-level bus passenger mileage is affected not only by the factors related to the school (e.g. school quality, pupils, ethnicity) but also the factors associated with the local authority (e.g. home-to-school bus fare policy, the level of funding and land-use patterns) where the school is located, a multilevel model seemed to be most appropriate.

The home-to-school policy has been analysed using two levels, the school level and local authority level data. Table 4.4 illustrates the variables which will be analysed in both levels.

Table 4.4 - Data and variables used

Level	Sources	Dataset	Variable	Description
School	Department for Education	School Census	Age	Age of pupil at the start of the academic year
			Ethnicity	Ethnic profile of pupils
			Free School Meals	Proportion of pupils entitled to free school meals
			Per 1 mile	Proportion of pupils living within 1 mile of their current school
		Key Stage Achievement and Attainment Tables	School Quality	Average Key Stage results (including Key Stage 2-3, Key Stage 4 and A-level per school in 2009
			School Ref	Full school address including postcode
			School Size	Number of pupils attending each school
		LA Budget Allocation Datasets	LA Budget	Annual budget 2009-2010 for home-to-school transport for primary and secondary schools. (excluding SEN travel). The budget for secondary and Post 16 pupils is a ratio of number of pupils within each academic year group.
	Census 2001 and Edina Digimap	Census 2001 and area classification of Super Output Areas	The Level of Car Activity	All car activity around the school derived by using a gravity model
Local Authority	Census 2001	Census 2001 Area Classification	Land Use Ref	Geographical categorisation of local authorities
	Local Authority Database	Individual local authorities	LA Policy	Outline of all home-to-school travel policies offered by local authorities in England

The data above has been obtained primarily from the School Census 2009 data, the LA Budget Allocation Datasets, Key Stage Attainment tables and the local authority policy database (see Chapter 6 for more details).

Figure 4.2 illustrates how the multilevel model fits into analysing the statutory home-to-school transport policy.

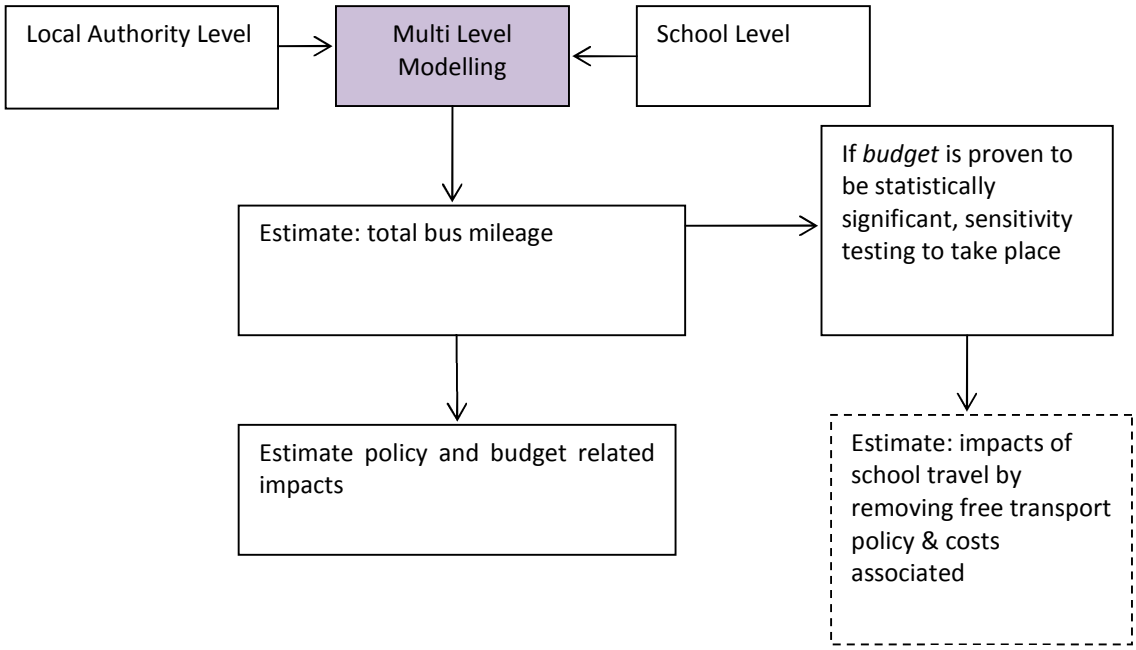


Figure 4.2 Provision of home-to-school transport multilevel method

Under a multilevel modelling framework, it was possible to examine how much variation in school-level bus passenger mileage is due to school-level factors and how much variation is attributed to local authority-level factors.

Accordingly, a multilevel model was developed to best represent the relationship between two hierarchical levels of data i.e. schools nested within the local authorities. In the case of schools, it is clear that the school-level bus passenger mileage is influenced by factors at the local authority level where the school is situated. Crucially, multilevel modelling allows correlation in school-level bus usages within each local authority (Goldstein, 2003).

A single school-level (i.e. Level-1) linear regression model for bus usage can be written as:

$$\mathbf{Y}_i = \beta_0 + \boldsymbol{\beta}\mathbf{X}_\mathbf{i} + \boldsymbol{\varepsilon}_i$$

In which Y_i represents the total bus passenger mileage for school *i*, $\boldsymbol{\beta}_0$ is the model intercept and $\boldsymbol{\beta}$ is the model parameters to be estimated and ε is the residual.
A multilevel linear regression model can be written as:

$$\mathbf{Y}_i = \beta_0 + \mathbf{X}_i\boldsymbol{\beta} + u_{0i} + \mathbf{Z}_i\mathbf{u}_i + \boldsymbol{\varepsilon}_i$$

where $\beta_0 + \mathbf{X_i}\boldsymbol{\beta}$ is the fixed part; whereas $\mathbf{u}_{0i} + \mathbf{Z_i}\mathbf{u_i} + \boldsymbol{\varepsilon_i}$ is the random part of the model. $\mathbf{Y_i}$ represents a vector of responses in local authority *i*; β_0 is the fixed effects intercept; u_{0i} represents the random intercepts corresponding to local authority *i*; $\mathbf{X_i}$ is a covariate matrix corresponding to local authority *i* for the fixed effects coefficient $\boldsymbol{\beta}$; $\mathbf{Z_i}$ is a covariate matrix corresponding to local authority *i* for the random effects $\mathbf{u_i}$; $\boldsymbol{\varepsilon_i}$ represents a vector of errors for local authority *i*.

In this model, schools within the same group (i.e. local authority) could be correlated as a result of a shared random intercept (u_{0i}), or through a shared random slope ($\mathbf{u_i}$), or both. Therefore random effects at local authority level can then be specified. In this way, local authority specific characteristics, such as their policy and other factors that were not observed by the data can be controlled for.

The fixed portion of equation (2) is equivalent to the standard linear regression model estimated using the ordinary least square (OLS) method. Such model is also referred to as mixed-effects model as the model contains both fixed and random effects. The random effect could happen in intercept (u_{0i}) only, which forms a *random intercept model*; and the random effect could also happen in the coefficient ($\mathbf{u_i}$), which forms a *random slope model*. The multilevel model can be estimated using the maximum likelihood or restricted maximum likelihood method, the latter of which is used in this thesis.

The developed multilevel model has been used to estimate total bus passenger mileage for all three year groups (1) Primary School, (2) Secondary School and (3) Post 16. Within each model, the impacts of changes in budget on bus passenger mileage were estimated.

4.5 Impact calculations

The multinomial logit modelling techniques will give sufficient results into how pupil's travel behaviour changes when policy is altered. Meanwhile, the second part of this analysis seeks to measure the traffic and environmental impacts of this model shift and so indicate how this would impact on the rest of the country.

To do this, a table of assumptions is formulated. This was based on a combination of Government and scientific sources (i.e. including assumptions such as average vehicle occupancy, average fuel consumption, CO_2 emitted from both diesel and petrol vehicles for both education travel and all transport sectors) entered into a spreadsheet model. The details of this table can be found in Chapter 6 (Section 6.7).

By inputting the modal share of pupils for each of the scenarios tested in the econometric models, the traffic and environmental impacts of changes in policy can be measured in terms of vehicle miles travelled and the CO_2 emissions generated per school day and per year in England. The results of these impacts are detailed in Chapter 7.

4.6 Policy Review

Finally, a primary data gathering task was completed to obtain details of all the school transport policies offered by LAs in England.

An internet based review was undertaken to help address the lack of research and available information on what kind of specific school transport policies are offered to pupils around England. Details of school policies must be produced and published by local authorities and these publications have been collected, reviewed and analysed for the purposes of this thesis. The research was designed to gather information on types of policy available to pupils (at primary, secondary and Post 16 age) and the motive or issue that these policies address in the school travel context namely:

- Walking distance
- Safety
- Low income duty
- Special Needs
- Statutory provision
- Assisted places
- Transport subsidy
- Other requirements

These eight categories covered all of the current school transport policies offered to pupils in England.

This work was completed by collecting published work from all 152 LAs in England and enabled a full database of all school transport policies in England to be constructed and used in the analysis of school transport policy for this thesis. Further details of this are discussed in Chapter 6.

4.7 Chapter Summary

This chapter has outlined of the methodology conducted in this thesis, with the research design and then detailing the methods involved for each of the four core methodological elements.

Specifically, the expert interviews and the two econometric modelling (MNL and MMNL) methods, hierarchical modelling (ML) to be used in measuring the travel to school and the transport impacts of this change in travel will be analysed and discussed.

The next chapter will explore the current school policy context and will be followed Chapter 6 which will present the data used in the thesis. The results obtained from these models have been explored in Chapter 7 and 8.

CHAPTER 5 SCHOOL TRAVEL POLICY CONTEXT IN ENGLAND

5.1 Introduction

To be able to analyse the school choice and statutory home-to-school transport provision policies effectively it is important to firstly understand the structure and curriculum of schools in England as well as where the responsibilities of school transport lie.

The second part of this chapter will explore the origins of the school choice policy and the statutory home-to-school transport provision policy. Finally, the current travel patterns undertaken by pupils on their journeys from home to school will be examined.

5.2 School Structure in England

In 2009 there were over 26,000 schools attended by more than 9 million school aged pupils residing in England, of which 7 million are of 'compulsory school age' (aged between 5 years and 16 years) and are therefore required to attend school by law (ONS, 2010).

Of these schools, 22,000 were 'Government maintained' or 'state' schools which are funded through the auspices of a local authority (LA) – a part of local government. In total, there are 152 LAs in England which are responsible for education. Specifically, LAs are responsible for local implementation of national policies and the raising of achievement and standards in schools (Fletcher-Campbell and Lee 2003).

LA 'maintained' schools include:

1. Community Schools – Previously known as county schools, in which the LA employs the staff, own the buildings and land and has primary responsibility for admission arrangements.

2. Foundation Schools –The governing body employs the staff and has primary responsibility for admissions arrangements and land and buildings are owned by the governing body or a charitable foundation.

3. Voluntary Aided Schools –The governing body employs the staff, decides admission arrangements and also contributes towards the cost of running the school. The school land and buildings are normally owned by a charitable foundation.

4. Voluntary Controlled Schools – VC schools are almost always church schools, and the land and buildings are often owned by a charitable foundation. The LA employs the staff and has primary responsibility for admissions arrangements.

The ‘grant maintained’ schools include:

- City Technology Colleges (CTCs)
- City Academies
- Pupil Referral Units (PRUs)
- Grammar schools
- Independent schools
- Trust schools

(Army Families Federation, 2007)

The above are not funded by the LA but instead directly from central Government or through school fees paid by parents. However, as they are not funded directly from the local Government they are not included in the School Census and therefore are not covered by the statistics used in this study.

Schools in England are (mostly) divided into three main age groups of primary school (ages 5-11), secondary school (ages 11-16) and post 16 (usually ages 16-19). Pupils are required by law to attend school between the ages of 5 and 16 years[1].

Children are generally educated on the basis of a national curriculum (National Curriculum, 2011), and assessed as follows:

Age 5-7	Key Stage 1
Age 7-11	Key Stage 2
Age 11-14	Key Stage 3
Age 14-16	Key Stage 4 (GCSE or GNVQ)
Age 16+	GCE ‘A’ Level or NVQ

Overall, spending on education accounted for roughly 13% of UK national expenditure in 2010 (Chantrill, 2011).

5.3 School Transport Responsibilities

Legislation plays a vital part in schooling, and the area of school travel is no exception. In England, the most influential policy affecting school travel is the 1944 Education Act from which the majority of English local education authorities still abide by today.

[1] In some schools between the ages of 11-16 pupils attend Middle School between the ages of 13-16.

However according to Thornthwaite (2009, pp.62-63), the responsibility of implementing this legislation and producing school transport services falls to 4 key groups:

- Policy makers
  - Determines where standards or entitlement should be more generous than the statutory minima
  - Understand the impact of changes to policy and policies to non-eligible pupils

- Budget holders
  - Determines which pupils are entitled to receive free or subsidised transport
  - Determine the transport requirements of individual entitled pupils

- Transport organisers
  - Decide the mode of transport which meets individual pupil's needs
  - Design transport routes
  - Procure transport provision
  - Determine the allocation of escort / supervision
  - Monitor transport services

- Transport providers
  - Responsible for planning, procurement and budget (and can be either private and in-house)

Thornthwaite (2009) continues that the main responsibility of school transport is that of local authorities (LA) and lists the LA duties regarding school transport as providing children's services / education, setting and managing budgets, ensuring attendance at school and the provision of sustainable school travel.

The provision of transport also includes concessionary fare schemes. According to the Transport Act 1985 persons eligible for school travel concession under any such scheme include:

- Pupils 16 years of age and under
- Pupils whose age exceeds 16 years but does not exceed 18 years and are in full time education
- Blind persons
- Persons suffering from any disability or injury which impairs the ability to walk
- Any other classes of persons as the Secretary of State for Education may specify.

As stated above, LAs can have policies in place which are more relaxed than the statutory minima, which for the purpose of this thesis, these will be referred to as being 'generous' so as to differentiate them from the standard statutory minima.

Although there are a number of LA policies in place which could impact on school travel behaviour, 2 have been selected to analyse in this thesis namely the school choice policy and the statutory home-to-school transport provision policy.

5.4 Local Authority Funding

Public transport requires a lot of financial investment to ensure a successful service in both England and all over the world. Although there are many private bus companies in existence, a large sum of public spending goes towards funding and supporting public transport (White, 2009). In 2009/10 £2,400 million was paid by the UK Government to fund public transport support, concessionary fares, and bus service operator grants (DfT, 2010, TSGB). Government provided school transport is one such concessionary fare and requires Government financial support.

After nearly three decades of sustained economic growth in the western world, difficulties in the US housing market emerged during 2007 thus precipitating a major banking crisis which subsequently led to a global economic recession (Stiglitz, 2010).

Accordingly, on the 20th October 2010, the UK Government announced that it is to cut £81bn of public spending by 2015 (BBC, 2010). Such a decision will clearly impact on local authority budgets, and hence there is a focus is on potential areas where savings can be made. One such budget area is the subsidising of home to school transport by local authorities which in 2009-2010 amounted to more than £1 billion (DfE, 2010).

The total funding allocated by Government to LAs is distributed to many different areas of education. According to the DfE:

> "*Local authorities (LAs) are required, under section 251 of the Apprenticeships, Skills, Children and Learning Act 2009, to prepare and submit annually to the Secretary of State separate budget and outturn statements about their planned and actual expenditure for their education and children's social care functions. The statements are the primary means of informing schools and the public in general about LA funding and expenditure plans. The statements are intended to give detailed information on each LAs planned expenditure on their education and children's social care functions in a form that allows benchmarking, by schools forums and authorities*".

As explained in Chapter 2, and Chapter 3, LAs have a legal responsibility by law to provide transport to pupils who are of compulsory school age, attending the nearest available school and live within the statutory distances (2 miles under the age of 8 and 3 miles aged 8 and over) and for pupils unable to walk or travel to school via other modes as a result of SEN. In 2011 the Department for Transport initiated a review entitled Home to School Transport: Efficiency and Practice aiming to investigate the statutory home-to-school transport provision policy and school transport planning of LAs (from rural, urban and metropolitan areas). The aim of the review is to identify where high costs are generated and where savings can be made to reduce costs (DfE, 2011). As cost is so vital to school travel this thesis will use current spending data to determine how much LAs spend on school travel and this key statutory transport policy.

Moreover, this money is granted based on legislation that has remained largely unchanged since the Second World War (Thornthwaite, 2009). Unsurprisingly perhaps, the Government is thus reviewing the current system so as to highlight areas in which savings or changes can be made (Local Transport Today, 2011), although the indications are that the scope of this report falls short of recommending changes to primary legislation.

In addition, it is understood that the commission is not conducting its own quantitative study on the detailed transport-related impacts of any proposed changes on local authorities or schools.

Work by Thornthwaite (2009) and the Commission looks at the mechanisms for the public funding for home-to-school transport provision, and in neither case are the detailed impacts of changing such policies explored. Thornthwaite (2009) has conducted extensive research into the spending of Governments on school travel and has particularly focused on the home-to-school transport provision around Europe.

To summarise, school travel costs the Government millions each year and this cost is continually rising. For this reason, part of this thesis will investigate whether the removal of this well established policy and the budget that funds would have any kind of impact upon how children travel to school. As other factors may have more influence on travel (as examined in Chapter 2) perhaps millions of public spending could be saved, but only if the change in policy was not at the detriment of school travel. If the removal of this policy resulted in the change of travel for thousands of pupils this could impact negatively on communities. The origin and nature of these polices will now be examined in turn.

5.5 The school choice policy

In England policy enabling parents to choose the school to which they send their child was implemented from the 1980s and subsequently successive Governments of both major parties have continued along the increased school choice path. Prior to this, pupils were generally attending state schools close to their home. This trend is set to continue (Burgess et al 2007).

According to the Education Act 1996 (section 14) it states "*a local education authority in England shall exercise their functions under this section with a view to (a)securing diversity in the provision of schools, and (b)increasing opportunities for parental choice*."According to the School Census, in 2009 only 43% of pupils attended the school closest to their home.

The school choice policy was introduced in England to oblige schools to publish exam results and introduce and assisted places scheme to subsidise the fees of poorer homes. Interestingly, over the same period GCE 'A'-Level (i.e. the English High School national examination) pass rates have continually improved for 27 years in a row in England (JCQ, 2009) and the numbers of students applying for further education at universities have also continued to rise in England (UCAS 2009). Burgess and Briggs (2010) highlight the benefits of the school choice policy in England noting that it allows social mobility through children from poorer families able to access to higher quality schools without being restricted by where they live.

The Government published findings in 2005 that state the school choice policy has benefited schools across England between 1997 and 2005 by increasing funding to schools (by £16 billion) increasing the average pass rate of exams (by 11%) and increasing the number of teachers in England (by 32,700). It also claims "*To respond to parental demand, we need to expand choice, create real diversity of provision, and to ensure that the benefits of choice are available to all*" (DFES, 2005, p.20).

Overall, the school choice policy seemingly offers clear advantages to pupils in England from an academic point of view. That said, Chapter 2 and 3 also presented strong arguments against the policy as it can result in negative environmental impacts (Müller et al, 2008, Marshall et al, 2010) and supporting the following propositions, Hallsworth et al (1998, p.162) go as far to state: "*It is hard to believe that, in framing British education 'reforms' in favour of parental 'choice' that the authorities thought over much about the extra travel [the school choice policy] would generate".* These support the following propositions presented:

Proposition 6

Distance to school significantly affects mode choice.

Proposition 7

The policy allowing parental choice of schools leads to a considerable increase in vehicle miles travelled by car and associated wider impacts. The results of the analysis of the school choice policy are discussed in Chapter 7.

5.6 Statutory home-to-school transport provision

As referred to earlier, the 1944 Education Act states that the LA has a responsibility of aiding those living within certain distances of their nearest school (2 miles for primary school age and 3 miles for secondary school age) in the form of free transport (Headicar, 2009).

This is usually in the form of a bus pass, unless the pupil is considered to have special medical needs (SEN). Interestingly though, if pupils do not attend to the school closest to their home, then transport provision does not apply – an important point to note given that some 57% of pupils in the UK no longer attend their nearest school due to the adoption of a school choice focused regime.

Yet despite this and broader societal changes (e.g. car ownership), very little has changed regarding the provision of free travel to school for almost 70 years in England. The different Education Acts can be viewed in Table 5.2.

Table 5.1 Political Changes to Schools and School Transport

Act	Education Act 1870	Education Act 1944	Education Act 1980	Transport Act 1985	Education Act 2002	Education and Inspections Act 2006
Compulsory Attendance	Children aged between 5 and 13 years must attend school	School leaving age raised to 15				LAs to promote education for 13-19 year olds (up to age 25 for SEN)
Costs	Financial support offered to low income parents	LAs required to provide school meals and free milk and regular medical inspection to low income pupils	LAs no longer required to provide free school meals but facilities for eating must be provided			Local authorities to provide free meals, including breakfast, if they wish to do so.
School Structure	Schemes in place to ensure more elementary schools in place (i.e. School boards)	Schools organised into primary, secondary and further education (now Post 16).	School choice introduced			
Transport		LAs required to provide transport to pupils living within distance limit	LAs to pay for 'equivalent fares' for travel to school at a 'discretionary basis' as a result of school choice	LAs consider private and public bus services for pupils. Bus operators tendering services to get best value for money	LAs required to provide transport to Post 16 pupils	LAs to provide free transport for some of the most disadvantaged pupils (those eligible for free school meals or parents are in receipt of the maximum level of Working Tax Credit) suitable secondary schools closest to their home, where these schools are more than two (and less than six) miles away

Sources: White 2009, Thornthwaite 2009, Headicar, 2009, Farrell et al1995, DfE, 2011 and UK Parliament Website, House of Commons, 2011

Section 55 of the 1944 Education Act clearly states:

"(1) A local education authority shall make such arrangements for the provision of transport and otherwise as they consider necessary or as the Minister may direct for the purpose of facilitating the attendance of pupils at schools or county colleges or at any course or class provided in pursuance of a scheme of further education in force for their area, and any transport provided in pursuance of such arrangements shall be provided free of charge.

(2) A local education authority may pay the reasonable travelling expenses of any pupil in attendance at any school or county college or at any such course or class as aforesaid for whose transport no arrangements are made under this section".

Section 39 states:
"..." walking distance " means, in relation to a child who has not attained the age of eight years two miles, and in the case of any other child three miles, measured by the nearest available route".

This was further developed in the 1996 Education Act to:

(*1) A local education authority shall make such arrangements for the provision of transport and otherwise as they consider necessary, or as the Secretary of State may direct, for the purpose of facilitating the attendance of persons* not of sixth form age *receiving education—*

(a) at schools,
(b) at any institution maintained or assisted by the authority which provides further education or higher education (or both),
(c)at any institution within the further education sector,
"walking distance":
(a) in relation to a child who is under the age of eight, means 3.218688 kilometres (two miles), and
(b) in relation to a child who has attained the age of eight, means 4.828032 kilometres (three miles), in each case measured by the nearest available route.

To summarise the rules regarding home-to-school transport provision have more or less remained the same from 1944:

- A child must be registered and attending the school closest to their home
- The distance from their home to school must be over a 'walking distance' of 2 miles (if aged 8 or under) or 3 miles (if aged over 8 years)

The walking distance condition is found in the compulsory attendance section of the Act. This policy has been researched extensively by Thornthwaite (2009) who explains that the distance limit was introduced in the 19th century and that the term 'distance' was simply the measurement of the nearest route from a child's residence to their school. Even today this is not always clear to parents who have difficulty determining how far their home is from their child's school.

Thornthwaite clarifies that the 'route' is measured along roads and does not include footpaths. The distance limit criterion is very similar around the world between 2 miles and 3 miles depending on age, which is interesting as many of the academic studies into school travel stated many children did not walk distances over 1 mile to school. The UK has less variety within the country, as other countries such as the United States and Australia have different criteria by state. However, for the purpose of this thesis the following sections will focus mostly on England as oppose to the UK as a whole.

Interestingly, recent events have now heralded anew environment where such previously stable areas of policy are suddenly vulnerable to changes being made.

Unsurprisingly perhaps, the Government is thus reviewing the current system so as to highlight areas in which savings or changes can be made (LTT, 2011), although the indications are that the scope of this report falls short of recommending changes to primary legislation. In addition, it is understood that the commission is not conducting its own quantitative study on the detailed transport-related impacts of any proposed changes on local authorities or schools. In Great Britain travel to school accounts for 16% of all bus journeys (totally 49,000 miles per year) which is a significant amount of travel and cost (DfT, 2009).

For this reason the following propositions will explore the effectiveness of this policy:

Proposition 8

Local authorities that offer only the statutory level of school transport provision experience lower levels of bus mileage per pupil on average than those with more generous policy guidelines.

Proposition 9

The higher the level of bus subsidy provided by a local authority per pupil, the greater the average bus mileage generated.

The results of this analysis will be presented in Chapter 7.

The following section will explore the current school travel patterns, modal share and average distances travelled in the journey to school in England.

5.7 Current School Travel in England

In 2009, over 9 million children made the journey from their home to their school using various modes of transport. The number of trips made by children between their home and school (aged 5-18 years) in the UK accounted for 11% of daily personal trips, but only 4% of daily journey distance as average journey lengths tend to be relatively short compared to other journey purposes (DfT, 2009).

Trips to school by children (aged 5-18 years) in Britain make up 11% of daily personal trips. Of these, 44% are by walking, 20% by bus, and 31% are made by car (DfT, 2011). The average time spent per trip to school related journeys has risen from 11 minutes in 1995/99 to 13 minutes in 2008. The average trip length has also risen in 2008 to 3.3 miles from 3 miles in 1995/97. As these journey lengths increase, so does the impact on transport related impacts such as traffic levels, fuel use, energy use and the environment. Over the last decade, trends have remained fairly constant in the UK as Figure 5.1 illustrates. The highest percentages of children walk to school or travel by car, although as Figure 5.1 shows walking has reduced and car use has risen between 1997 and 2009.

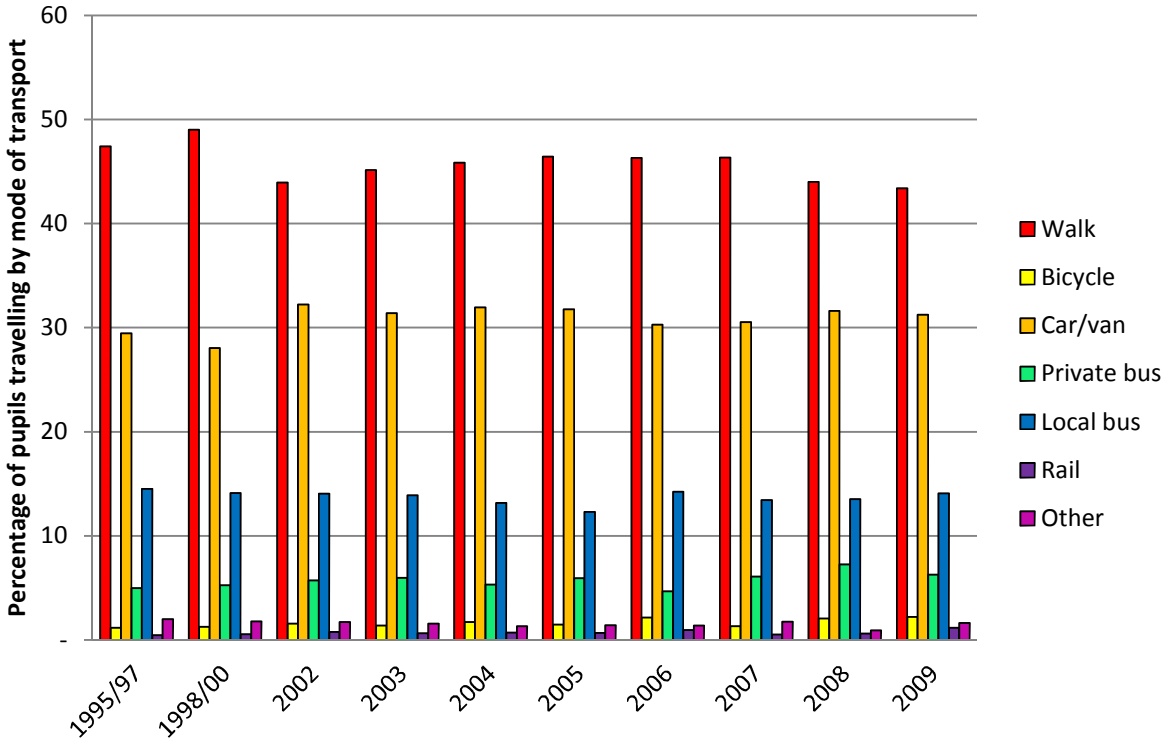


Figure 5.1 Trips to and from school per child per year by main mode (adapted from DfT, 2009)

Car ownership has remained fairly steady in the UK between 1995/07 and 2009 (DfT 2009). It is perhaps only to be expected that school travel has followed similar trends of car use levels increasing steadily and walking has fallen gradually. The Department for Transport (DfT 2009) examines the changes in school travel in the last decade and the percentage change in children travelling to school and report that the average walking trip to school has reduced by just under 9% between 1997 and 2009, while the average number of car trips rose by 6% over this time. Figure 5.2 illustrates the modal split between the common modes of travel to school in 2009.

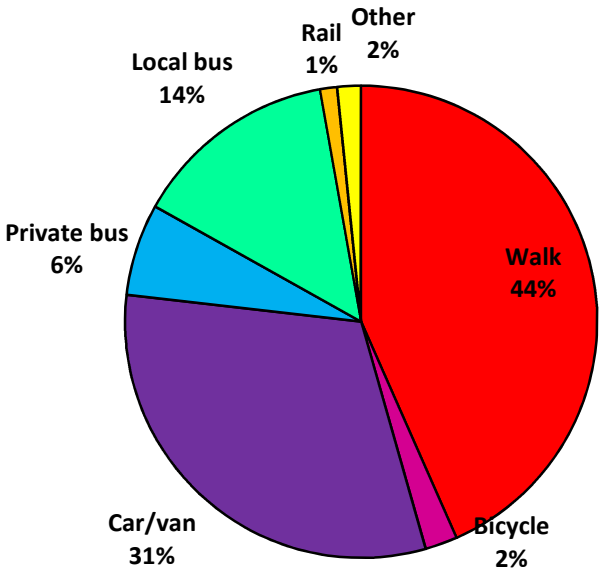


Figure 5.2 Percentage of Modal Share for the Journey to School in Great Britain 2009 (adapted from DfT, 2009)

Table 5.1 looks at the average distance travelled to school by mode in 2008-2009. As expected, children are more likely to walk shorter distances to school. In 2008-2009; 82% of children aged 5-10 years and 90% of pupils aged 11-16 years walked less than 1 mile to school, yet only 4-10% walked distances over 2 miles. Motorised transport appears to be a more popular mode of transport for distances to school over 2 miles.

Table 5.2 Percentage of trips to school by main mode, trip length and age in Great Britain 2008/09 (adapted from DfT, 2011)

Primary School Travel (aged 5-10 years) %					
Mode	**Under 1 mile**	**1 to under 2 miles**	**2 to under 5 miles**	**5 miles and over**	**Total**
Walk	82	31	4	0	49
Bicycle	1	2	1	0	1
Car/van	16	62	76	69	42
Bus	1	5	18	25	7
Other	0	0	1	6	1
Secondary School Travel (aged 11-16 years) %					
Mode	**Under 1 mile**	**1 to under 2 miles**	**2 to under 5 miles**	**5 miles and over**	**Total**
Walk	90	62	10	0	39
Bicycle	2	6	3	0	3
Car/van	7	21	32	22	22
Bus	2	11	51	67	33
Other	0	0	3	11	3

Current traffic patterns suggest that traffic congestion is higher during school term than during school holidays. Figure 5.3 shows the traffic generated by school travel during the course of the day.

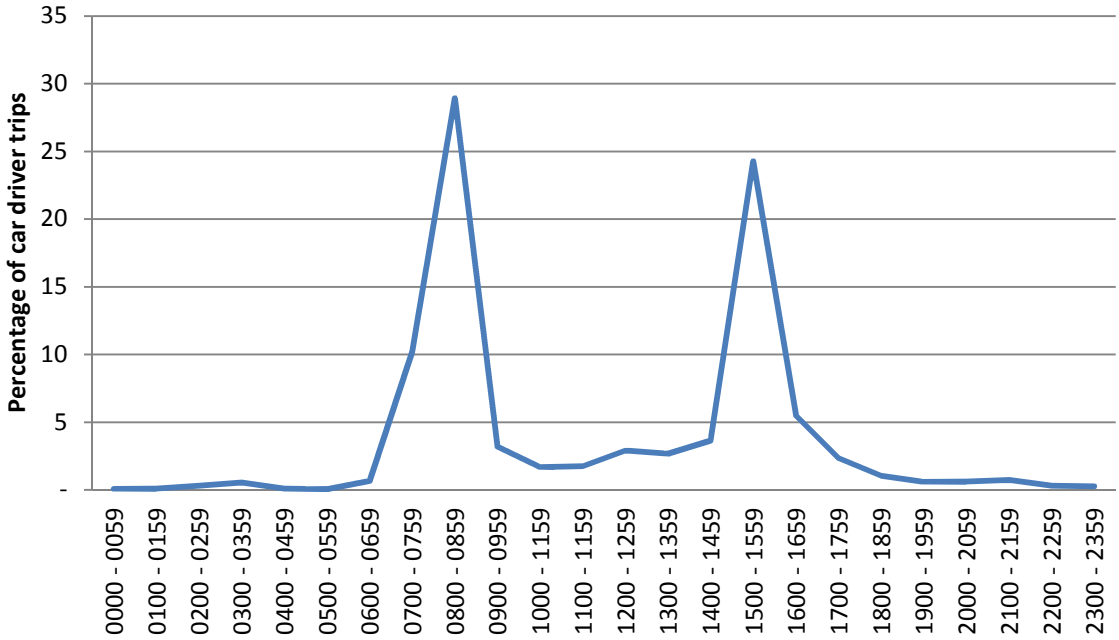


Figure 5.3 Trip start time for school related journeys (Monday to Friday only) (adapted from DfT, 2009)

White (2009, p.24) reports that most school related commuting travel is concentrated between 08:00-09:30 and again at 15:30-16:00 and notes that "*in many areas, it is the school 'peak' which causes almost the entire additional peak vehicle demand above 'base' level from 08:00 to 18:00*". Most dramatically, at 8.45am some 18% of the traffic on the roads is due to travel to school, and during this time traffic levels nearly double the average level due to commuting (DfT 2011).

Overall, it is clear that although many children are still willing to walk to school and travel sustainably, large numbers of children are relying on motorised transport, particularly the personal car in their daily travel, and this is having four significant impacts on society in the form of congestion, traffic and emissions.

The subsequent chapter will explore the data used in this thesis in detail and explain how it will be applied in the analysis.

CHAPTER 6 DATA DESCRIPTION

6.1 Introduction

This chapter details all of the data which has been collected from different sources and used in this thesis to address the objectives and research propositions described in Chapter 4. Even though the data is varied, it all links together to help build an overall understanding and depiction of how pupils in England travel to school and the factors which could contribute to their travel behaviour.

The different sources of data used to analyse the school travel behaviour are listed in Table 6.1

Table 6.1 Data collected and used in this thesis

Study Element	Data	Details	Source	Analysis in which data has been applied		
				Interview Scoping Study	School Choice Policy Analysis	Home to school Policy Analysis
1	Expert views	Semi-structured interviews	Primary Data	**X**		
2	Individual characteristics	Details of school travellers (i.e. pupil age, gender, mode of travel, distance travelled)	DfE School Census 2009		**X**	**X**
3	Geographical area factors	LLSOA, car ownership, car activity	ONS Census 2001		**X**	**X**
4	School characteristics	Annual examination results and full school address and location	DfE Achievement Attainment Tables			**X**
5	LA spending	Annual spending on home-to-school transport	DfE LA Budget Allocation Datasets			**X**
6	LA policy database	Review of school travel policies offered by 152 LAs in England	Primary Data			**X**
6	Impact inventory	Current vehicle travel, fuel and emission factors	Various Sources		**X**	**X**

The application of the three sets of data listed in Table 6.1 has proven fundamental to the analysis conducted in this thesis. The following sections will look at each data source individually. Note the expert views and the impact inventory have been reported already in Chapter 3 and 4 and will not be reported here.

6.2 The School Census

In England, the Department for Education (DfE) is the Government body which in responsible for the organisation and maintaining of English schools. The DfE (known as the Department for Children Schools and Families from 2007 until 2010) carries out an annual survey on all LA maintained schools in England which is known as the School Census.

The School Census includes the details of:

- primary schools (including middle-deemed-primary schools)
- secondary schools (including middle-deemed secondary schools, and academies)
- nursery schools (maintained and direct grant nursery schools)
- special schools (maintained and non-maintained special schools including hospital special schools)

The School Census is a survey of all the schools run by their local authority or LA, and this data has been analysed for the purpose of this study. The details of the distance travelled by each of the pupils have only been collected since 2009 due to the Government requiring a basis for monitoring school travel plans. For this reason, this thesis will predominantly use data from the 2009 School Census.

The data is collected by each school by class to ensure all students are included in the Census. Most of the data required for the Census is found in each school's database, however, details specifically on mode of travel have been collected by a member of staff in the classroom. In 2009, the survey had a total of 7,484,001 students from the 21,695 schools which receive Government funding or are known as "maintained schools" in England.

Non-Government maintained schools are excluded from the survey including denominational or Faith schools, private or grammar schools and some specialist schools. However, the Government maintained schools account for 80% of the total schools in England.

The details of each individual child are recorded including variables such as their main mode of travel to school, how far they travel, whether they are entitled to free school meals, the distance to their closest school and basic personal and individual details such as age and gender. The distance to school is generic and based on the postcode of the child's home to the postcode of the child's school. Within the Census the gender distribution of pupils is very even with 3.6 million female pupils (49%) and 3.8 million male pupils (51%) with the majority of pupils aged between 3 years and 18 years. The age distribution of the pupils in Census is shown in Table 6.2.

Table 6.2 Distribution of Age in the School Census 2009

Age of pupil (at the start of academic year 2009)	Frequency	Percent	School Age
0	52	.0	Nursery School Age
1	211	.0	
2	44547	.6	
3	280919	3.8	
4	563946	7.5	
5	552991	7.4	Primary School Age
6	533970	7.1	
7	537190	7.2	
8	547329	7.3	
9	562398	7.5	
10	568756	7.6	
11	576784	7.7	Secondary School Age
12	567458	7.6	
13	574956	7.7	
14	586761	7.8	
15	579919	7.7	
16	217030	2.9	
17	167884	2.2	Post 16 Age
18	19292	.3	
19	1228	.0	
20	246	.0	
21 and over	128	.0	
Total	7483995	100.0	

As seen in Table 6.2, the main distribution of pupils lie within the primary school and secondary school ages which is the compulsory school age of English children as explained in Chapter 1 Introduction and Context. For this reason the majority of the analysis of this thesis will focus on primary school pupils aged between 5-10 years of age (44%) and secondary school pupils 11-16 years of age (42%) and Post 16 pupils (3%).

The key data to be used in this thesis is the recordings of the pupil's mode of travel to school and the distances they travel via these modes. Fig 6.1 outlines the distribution of how all pupils in the Census 2009 travelled to school by age.

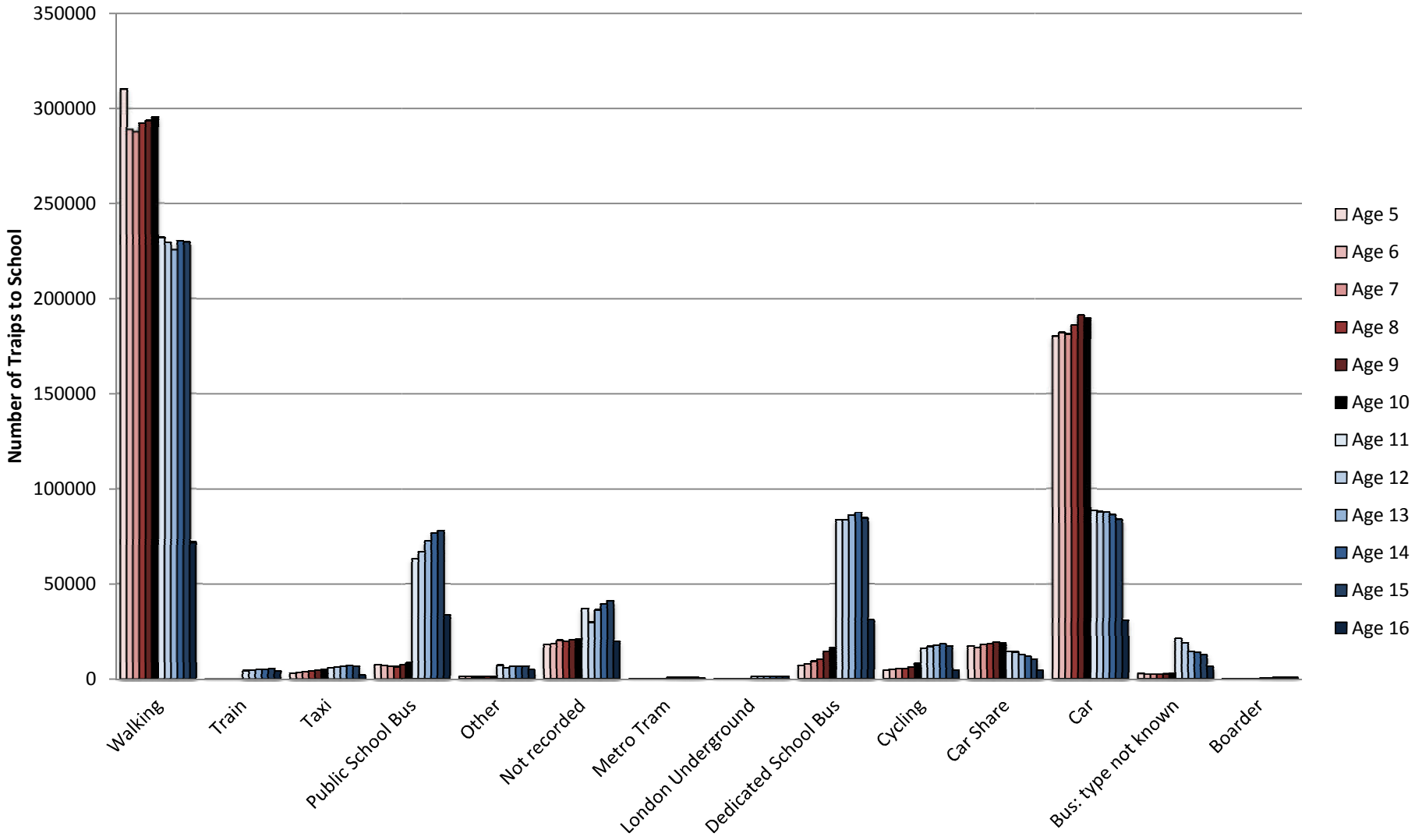


Figure 6.1 Mode of Transport to School for Primary and Secondary Pupils

As Figure 6.1 shows, the main mode of transport used by both primary pupils (aged 5-10 years) and secondary pupils (age 11-16 years) differs greatly between 10 and 11 years of age. Notably, there is a significant switch from walking and car up to the age of 10 to bus use and cycling to school for pupils aged 11 and over.

Figure 6.2 shows the distribution of travel by Post 16 pupils and there is even more varied choice within this age group.

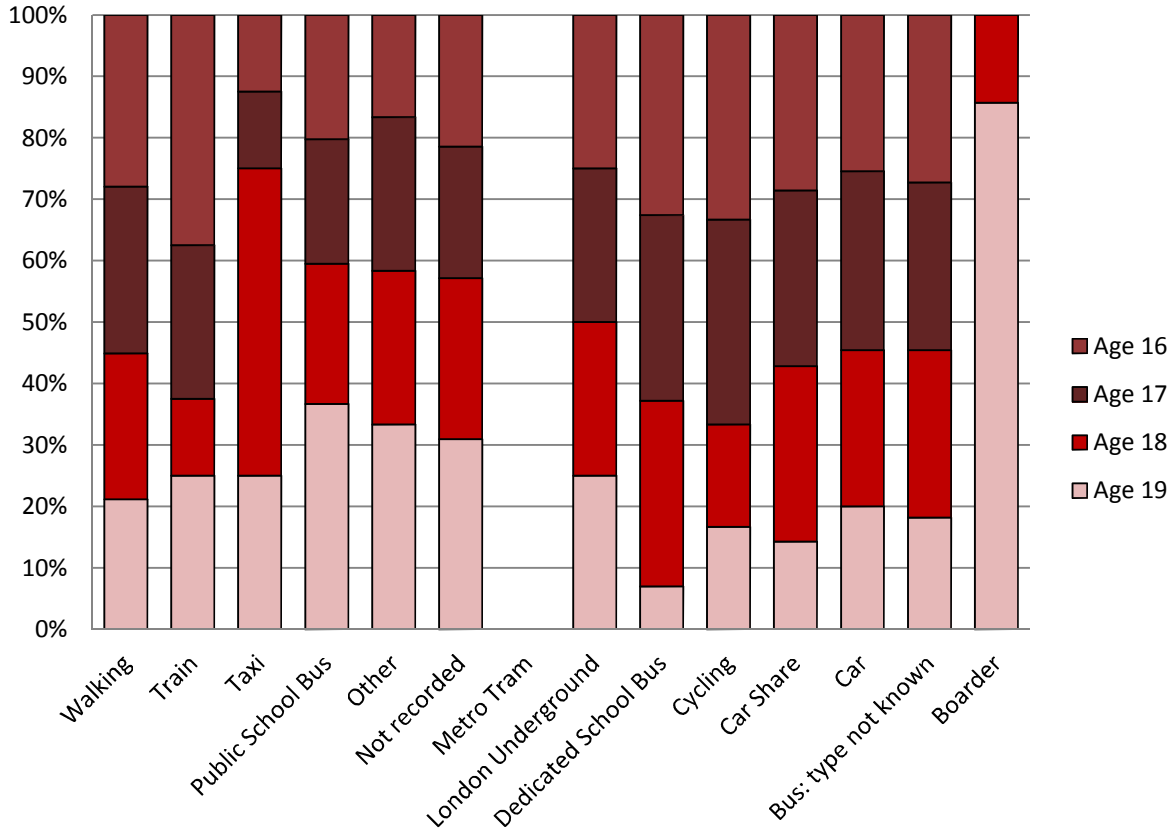


Figure 6.2 Modal Share of School Travel Mode for Post 16 Pupils

Post 16 pupils travelled more by walking, bus and car in 2009. The trends show that as pupils grow older, they are allowed to travel to school by more independent modes of transport. It also needs to be noted that in England 17-year-olds are legally old enough to drive.

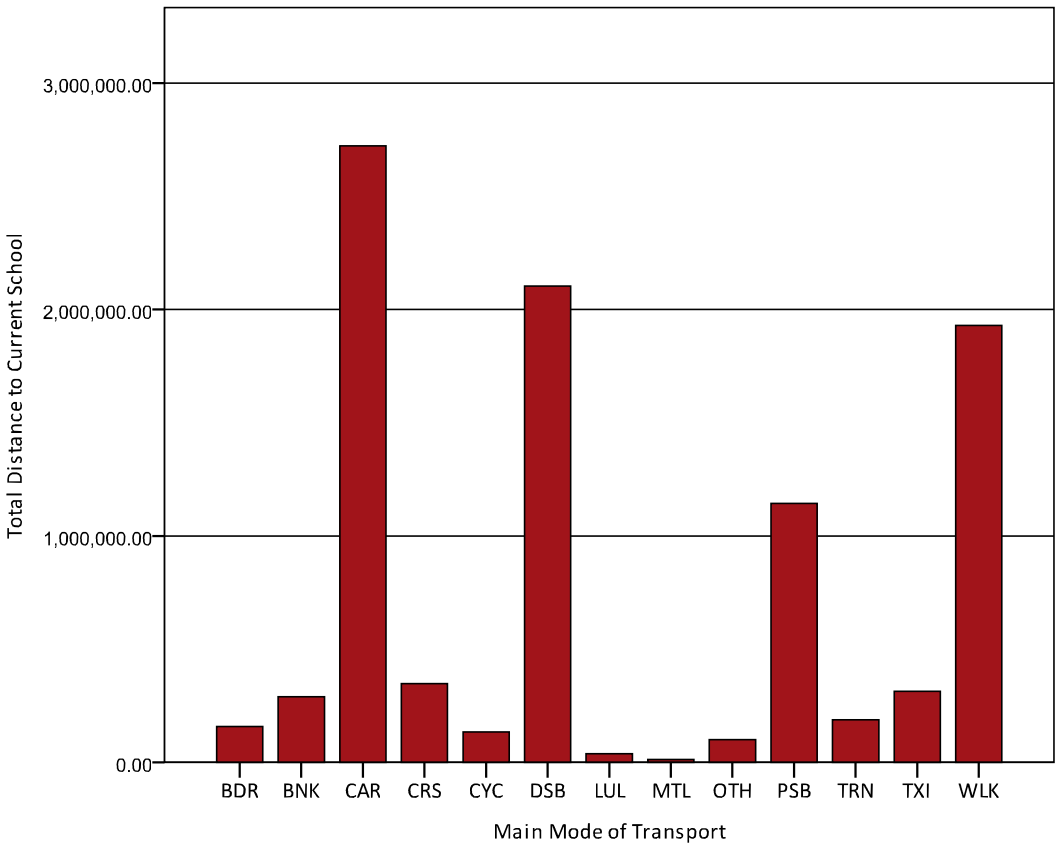


Figure 6.3 Distance (miles travelled) to School by Main Mode of Transport

Unsurprisingly, Figure 6.3 shows the furthest distances travelled to school are made by motorised transport. The pupils travelling the furthest distances to school made their journeys by car, whilst the dedicated and public school bus also account for over 3 million miles travelled per day combined.

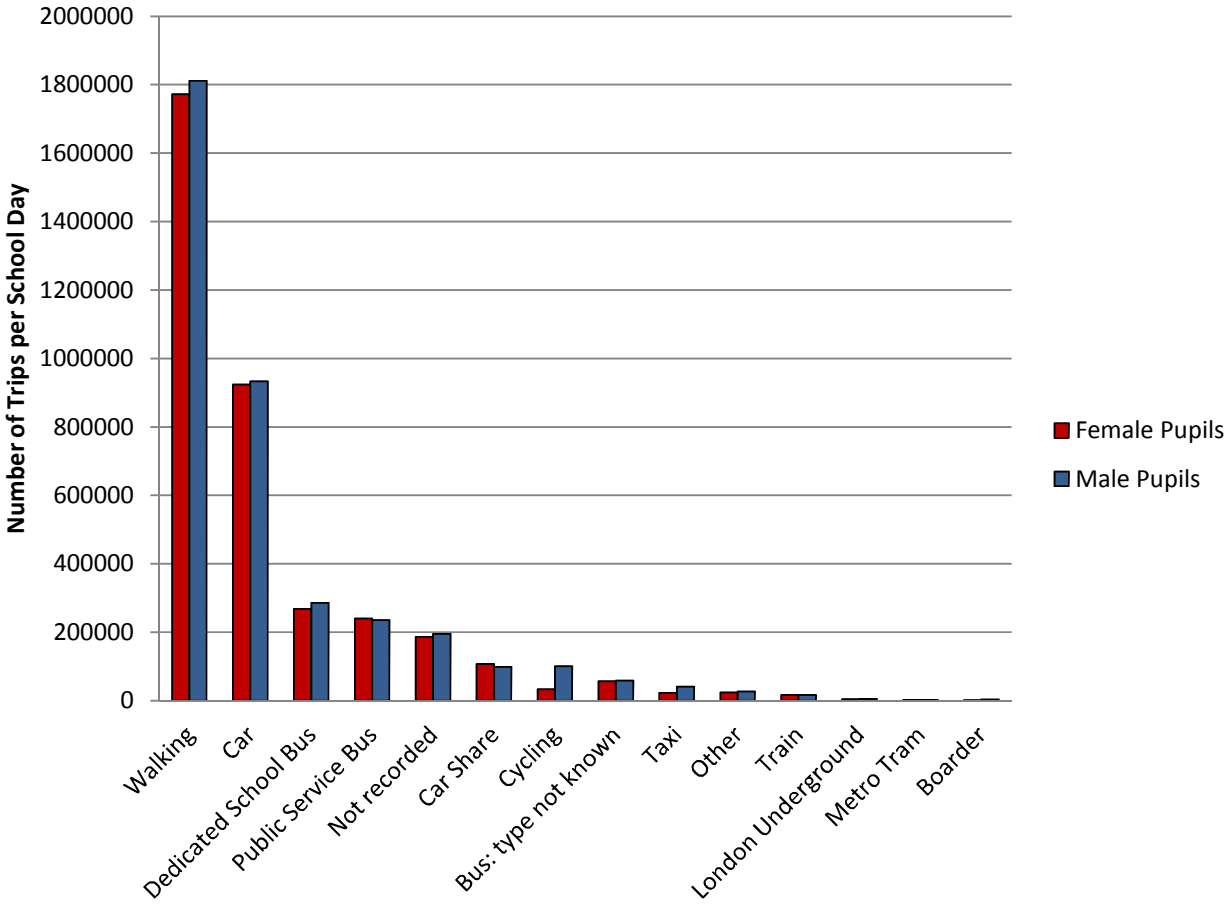


Figure 6.4 – Pupil's main mode of travel to school by gender 2009

Figure 6.4 shows that walking is clearly the most dominant mode of transport used in the journey to school (47.%); followed by the personal car being the second most popular form of transport (25%) for both male and female pupils.

The school bus (both dedicated and public) is the most used form of public transport in the journey to school (14% combined). Notably the number of pupils travelling to school by dedicated school bus is slightly higher than public service bus. Some pupils did not have their main mode of transport recorded in the census, but this only accounted for 5% of the population.

Figure 6.5 illustrates the changes mode of travel in the journey to school of pupils by their ethnic profile. White pupils have the highest level of ethnic background at 78% of the whole student population in England. Asian pupils make up 8%, followed by Black pupils at 5%.

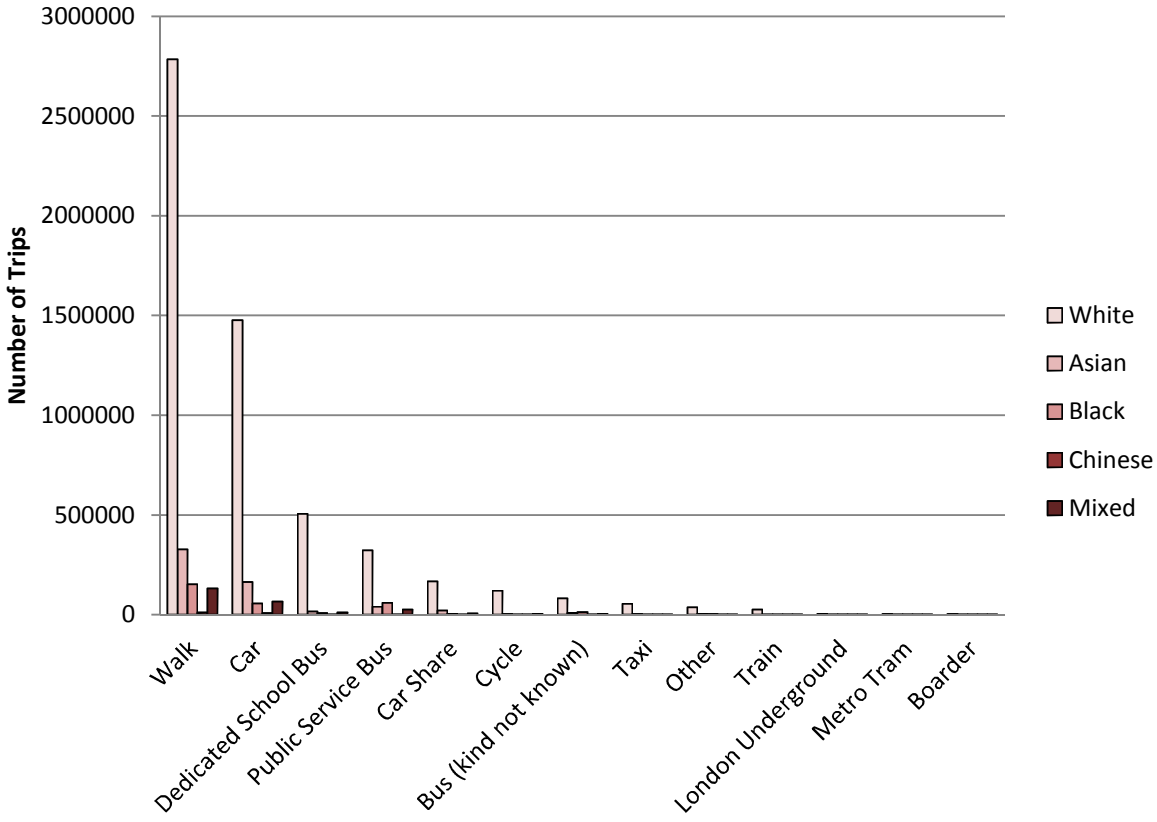


Figure 6.5 – Pupil's main mode of travel to school by ethnicity 2009

According to Figure 6.5 walking is the main mode of travel with 48% of pupils walking to school as their main of travel. The private car is used by 25% of pupils as their main mode of travel (79% of these are white pupils) and the dedicated school bus is used by 7% of pupils (91% are white pupils). Most ethnic groups follow the same travel patterns as their white peers with the except of public service bus travel in which Black pupils make up the second highest percentage share of users at 12.6%.

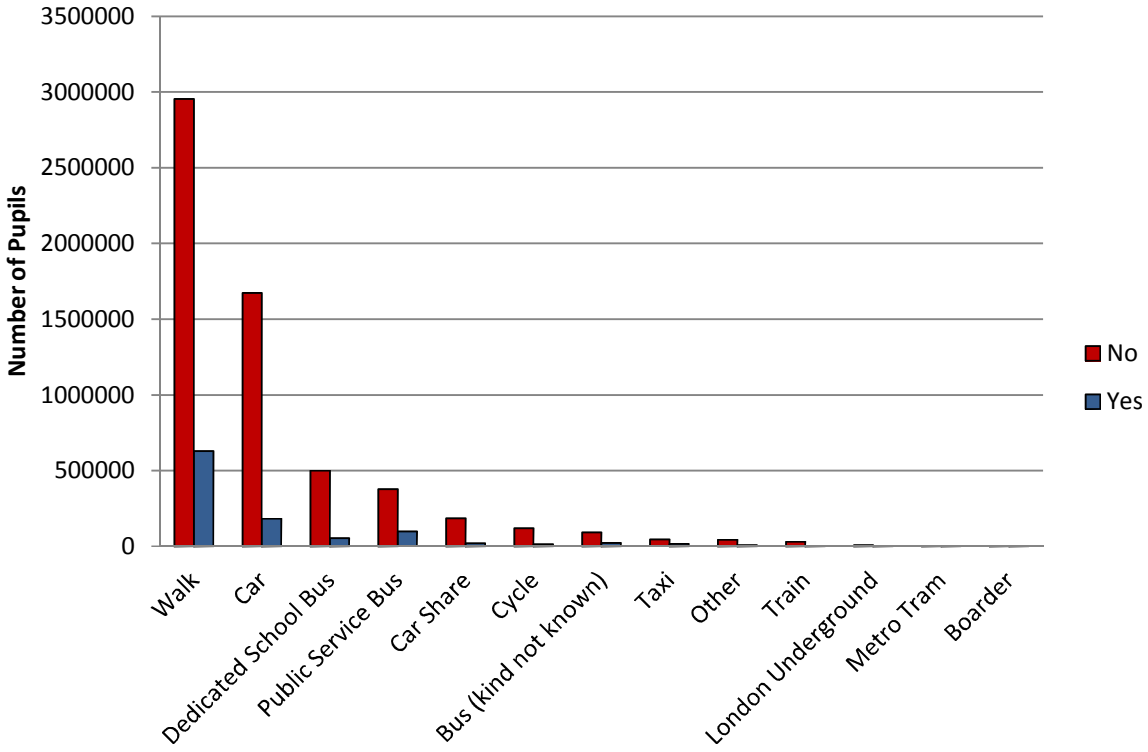


Figure 6.6 Mode of Transport to School by Pupils Eligible for Free School Meals

Figure 6.6 shows the distribution of pupils travelling to school who are eligible for free school meals. For the purpose of this research, being eligible for free school meals is a proxy for low income households (as household income was not available in the School Census dataset). Only 15% of the total student population was eligible for free school meals in 2009 (10% of White pupils, 2% of Asian, 2% of Black and 2% other) and the majority of this percentage travelled to school by walking, private car and dedicated and public bus services.

To summarise, the School Census offers a greater understanding into how pupils travel to school in England and an insight into the factors which could contribute to their travel behaviour. Overall, there is a fairly even split in the student population between male and female pupils. White pupils hold the majority of ethnic backgrounds and 15% of the pupil population was entitled to free school meals or comes from a low income family. With regards to transport, it is clear to see that almost half the student population travelled to school by walking to school, however the car is still a very popular mode of travel, particularly for younger pupils.

The next section will explore the financial data that has been used in this thesis to analyse school travel and policy.

6.3 Local Authority Spending and Policy in England

For the academic year 2009-2010 over £36 billion was spent on education by the Government in England. Of this, £1 billion was specifically spent on home-to-school transport. Special Educational Needs (SEN) travel requires specialist equipment, vehicles and staff and thus accounted for over £500 million of this figure. Yet, home-to-school transport provision still represents a large sum of the annual education budget and the DfE states that this figure is "spiralling above the rate of inflation".

To be able to fully understand LA policy and spending, data has been collected regarding annual LA budget and spending and the types of transport policies that are provided to pupils. This data has been collected directly from each LA, both through the DfE and as part of primary data collection. The first part of this section will explore the financial side of school transport, and the second part will explore the current policies offered to pupils in England to help them get to and from school.

6.3.1 LA Budget and Spending

Every year LAs must submit their annual spending, budget and outturn information on all education sectors to the DfE as required under Section 251 of the Apprenticeships, Skills, Children and Learning Act 2009 (DfE, 2010) and are published as the 'S251 Workbooks' which have been used in this thesis to deduce annual spending by LA.

Table 6.3 gives an overall view how much was spent annual by LAs on transport for the academic year 2009-2010 for pupils of compulsory school age (excluding pupils under 5 years of age).

Table 6.3 Total LA Spending on Transport 2009-2010

LA Spending on Transport 2009-2010	SEN Spending £000	Non-SEN Spending £000	Total Spending by School Type £000
Primary School	93,453	136,367	229,820
Secondary School	84,595	277,857	362,452
Post 16	21,609	44,468	66,077
Total Spending by School £000	199,657	458,692	--

In England over £4 billion is spent on 'special educational needs' (SEN) education (i.e. students with learning and/or physical disabilities) (Thornthwaite, 2009) and much of the LA annual budget is spent on SEN travel and hence is difficult to reduce yet according to the School Census in 2009 SEN only accounted for 12% of the student population (DfE, 2010). As a result, funds of over £450m were still spent by local authorities in England on subsidising home-to-school transport provision for the eligible pupils in the remaining 78% of non-SEN pupils.

Table 6.4 separates the annual LA spending on home-to-school transport by geographical region and lists the minimum and maximum spending for both SEN and non-SEN travel. Across all local authorities rural LAs had some of the highest spending.

The maximum annual spending on non-SEN travel was £9.6 million on primary pupils, £13m on secondary and £3.8m on Post 16. The spending of London boroughs was generally lower than other LAs.

Table 6.4 LA Spending on Transport 2009-2010

LA (Non-SEN) Spending £000	Primary		Secondary		Post 16	
	Min	Max	Min	Max	Min	Max
Rural	£6	£9,589	£12	£13,084	£0	£3,818
Urban	£0	£2,697	£0	£3,477	£0	£597
Metropolitan	£0	£1,192	£0	£3,770	£0	£874
Inner London	£0	£1,344	£0	£692	£0	£51
Outer London	£0	£985	£0	£163	£0	£52

LA (SEN) Spending £000	Primary		Secondary		Post 16	
	Min	Max	Min	Max	Min	Max
Rural	£0	£4,341	£0	£5,559	£0	£2,066
Urban	£0	£2,002	£0	£2,423	£0	£562
Metropolitan	£0	£1,759	£0	£2,304	£0	£665
Inner London	£0	£2,709	£0	£1,647	£0	£211
Outer London	£0	£4,267	£0	£1,914	£0	£393

For the purposes of this thesis, only non-SEN spending will be analysed and used because only policies and travel behaviour of non-SEN pupils will be investigated. Appendix 2 lists all the annual spending on both SEN and non-SEN travel by LA and also the average spending per non-SEN pupil travelling to school by bus. The key observations of LA spending will be discussed briefly by age group.

Primary school:

Most London LAs spend less than £0.01 per pupil on school transport. On average London LAs spend £137 per pupil on transport even though 39,000 primary school aged pupils attend schools in London.

West Sussex spends the most on primary school pupils by spending almost £6,000 per pupil. The 20 highest spending LAs are all from urban or rural locations and all only offer standard school transport policies.

Secondary School:

London based LAs spend even less per pupil on secondary school pupils averaging just £20 per pupil on school transport.

Northumberland LA spends the most per secondary school pupil spending around £1,400 on school transport. Similarly to primary school, the 20 highest spending LAs are in mostly rural locations and all only offer standard school transport policies.

Post 16:

London LAs spend around £18 per Post 16 pupil on school transport. Unusually, Thurrock LA spends the most per Post 16 pupil on school over £17,000 per pupil. However, Thurrock offers all post 16 pupils a generous school travel policy of a free return journey on weekdays for Post 16 pupils.

Unlike primary and secondary school, more of the 20 highest spending LAs offer generous school transport policies and are located in a combination of rural, urban and metropolitan locations around England. (Further details on individual LA spending can be found in Appendix 2). Table 6.5 outlines the average spending of LAs on bus travel in England per pupil in 2009-2010.

Table 6.5 Number of Pupils and Total Spending

	Number of Bus Users	Total Spending £000
Primary School	150,043	136,367
Secondary School	936,770	277,857
Post 16	60,684	44,468
Total	1,110,815	£458,692

On average, per primary school pupil LAs spent £909 on transport in 2009-2010. Average spending on transport is less for secondary school pupils (due to more pupils travelling to school by bus in this age group) at £297 per pupil on transport but spending was considerably higher at £732 per pupil for Post 16 pupils.

In order to determine the current status of the home-to-school transport provision policy, it was necessary to undertake, a national internet survey to gather information from all 152 LAs which have educational responsibilities in England.

The survey questions focused on the provision rules relating to the school transport of primary, secondary and Post 16 pupils and on 4 main criteria for compulsory school aged pupils by the LA:

- Walking Distance
- Safety
- Low Income Duty
- SEN

The survey also aimed to understand which LAs offer more than the standard statutory transport provision to pupils and what other policies are currently offered to pupils to ensure accessibility to education.

Each LA does not have just one policy for each pupil who lives within their jurisdiction. The review had to separate school travel policies by age (primary school, secondary school and Post 16) and look at the differences for each (particularly distance criteria for eligibility).

Table 6.6 National LA School Policy Review

Statutory provision 5-16 years old:				**Statutory provision 16+ years old:**
Walking Distance	**Safety**	**Low Income Duty**	**Special Needs**	
Free travel for child attending the nearest suitable school over the statutory walking distance	Free travel for young people where the route is not available/ Less than 3 miles but unsafe (accompanied as necessary)	Are aged 8 -11 and live over 2 miles from their nearest school	Children's statement of SN specifies the need for free transport and are eligible in line with the Pre16 policy	Ensure that learners of 6th form age are able to access the education and training of their choice; and
5 – 8 years old: 2 miles walking distance		Are age 11- 16 and want to attend one of three nearest qualifying schools between 2 and 6 miles	Children unable to walk to school by reason of their SEN, disability or mobility Problem	Ensure that, if support for access is required, this will be assessed and provided where necessary.
9 – 16 years old: 3 miles + walking distance		Area aged 11 – 16 the nearest school preferred by their parents on the grounds of religion or belief, and the school is between 2 and 15 miles away from their home address		

Once the details of each LA policy were collected into one full dataset, it was necessary to separate the policies into 2 types:

- Generous – more transport offered on top of the Education Act 1944 bus provision
- Standard – free travel based on the Education Act 1944 legislation, or additional transport offered at a cost to parents.

Table 6.7 Policy Categorisation for Thesis Analysis

1	**2**
Generous	**Standard**
Free Travel, no distance limit	Free travel after mile limit
Discounted / Half Fare	Bus Pass at cost (£100+ per annum)
Bus Pass at cost (<£100 per annum)	No discounted fares offered
Child Priced Fares	
Less than £1 per Journey	

Table 6.7 further illustrates the main findings of the criteria for each of these categories (please see Appendix 2)

Most London boroughs offer a 'generous' policy of free school travel to all pupils attending school. They must carry an 'Oyster photocard' smartcard which has their photograph and identification allowing them to travel for free on all London public transport as funded by TfL as oppose to the LA solely. The only exception to this is the London borough of Merton which only offers a rail card to primary and secondary pupils travelling over 2 miles from their home to their school. For Post 16 pupils, Merton offers the '16+ Oyster photocard' for 16-18 year olds allowing students free travel on bus, concessionary fares on the tube, DLR and London Overground services. For 19 year old students the 18+ student Oyster photocard allows a concessionary rate on 7 day, monthly and annual travelcards, and bus and tram passes.

Outside of London most LAs offer the statutory free bus travel to school provided to primary and secondary school pupils who live within the distance limit criteria, however there are some exceptions to this including:

- Spare seats on dedicated school buses can be purchased by parents (Calderdale, Kirklees, Stockton-on-Tees, Derbyshire, Portsmouth, Staffordshire, Reading, Cambridgeshire, Devon, Thurrock and Herefordshire) for costs between £63 and £140 per term or up to £410 per year.

- If transport is not available to pupils, some LAs reimburse parents for mileage costs transporting their own children to school (Kirklees, Staffordshire, Wiltshire, Bracknell Forest, Windsor and Maidenhead, and Cheshire).

- A cycling allowance is offered as an alternative to a bus pass on request (Kirklees, Staffordshire and Halton).

- West Berkshire will apply a graded fare charging system which is based on radial distances comprising of the following bands:
  - A up to 3 miles;
  - B up to 6 miles;
  - C over 6 miles

- Leeds Council state that in the case in which a parent requests that a child should attend a school other than the nearest appropriate school parent will have to pay any additional costs incurred by the Authority as a consequence of that request.

More differences are seen when investigating Post 16 travel. Because pupils are not required by law to continue their education after the age of 16 (when they have completed their GCSE exams) LAs are not required by the Education Act 1944 to provide free transport to pupils over this age.

The Newham Council (2011) website explains that:

> "*The Mayor of London has announced that free bus passes will be available to students up to the age of 18 and to a limited extent those who become 18 while they are completing a course of study. Therefore the Newham travel policy is only applicable to those students who can show that they are not eligible for support under the Mayor of London's travel scheme. The policies offered to pupils who choose to continue their education is varied*".

- In London all LAs offer free transport to pupils (aged between 16 and 18 years and in full time education) on all public transport services through the provision of a 'Oyster photocard' smartcard in which some LAs (i.e. Bromley) charge a £5 fee for the card itself.

- Birmingham Council does not provide travel assistance for those students who are 16 years and older. Pupils of Birmingham, Dudley, Walsall and Solihull can purchase a 'Centro 16-18 Photocard'. The card entitles pupils to pay child fares to and from school or college on buses, trains and Metro funded by Centro.

- Bolton, Bury, Manchester, Oldham, Rochdale, Salford, Stockport, Tameside, Trafford and Wigan allow pupils aged 16-19 attending a full-time course to obtain the "Scholars Permit" (at the cost of £5) entitling them to reduced fares from their home to their place of full-time study of 80p per single journey, and train or metrolink journeys are half fare

- SYPTE offer a concessionary fare pass for young learners aged 16 or 17 at the start of the academic year, which are in full-time education and resident in South Yorkshire. The 16-18 pass allows travel on buses and trams throughout South Yorkshire at 40p per journey. The pass may also entitle the holder to half-fare travel on Northern Trains.

- Finally, some LAs do not provide any free transport or subsidy to pupils over the age of 16 including Knowsley, Nottingham, Hampshire, Portsmouth, Blackpool, Bournemouth, North East Lincolnshire and Wirral.

Table 6.8 shows the distribution of policies across the LAs of England combined with the annual spending for each policy by type of LA (e.g. rural, urban, metropolitan, inner London and outer London).

Overall, England is made up of 152 LAs which offer a variety of school transport policies to suit pupils living in the area of England they are based in. Rural LAs have the highest spending on average, whilst London boroughs offer all pupils the most flexibility with free travel on all public transport. LAs spend the most per pupil on Post 16 pupils, however some LAs do not offer Post 16 pupils any form of school transport subsidy.

119 LAs offer the standard statutory policy to primary and secondary school pupils in England, whilst 33 offer a more generous policy. However, 86 LAs offer Post 16 pupils a more generous school transport policy even though they are not obliged by law to do so.

Table 6.8 - LA Policy and Spending Distribution

School (pupil age)	Type of LA	Number of 'Generous' LAs	Budget per year £000	Number of 'Standard' LAs	Budget per year £000	Total LAs	Total Budget £000
Primary (5-10)	1. Rural	0	-	37	112,850	37	112,850
	2. Urban	0	-	44	13,212	44	13,212
	3. Metropolitan	1	214	35	5,324	36	5,538
	4. Inner London	19	1,357	1	-	20	1,357
	5, Outer London	13	44,260	0	-	13	44,260
Secondary (11-16)	1. Rural	1	7,427	36	23,942	37	31,369
	2. Urban	0	-	44	28,945	44	28,945
	3. Metropolitan	0	-	36	16,225	36	16,225
	4. Inner London	19	571	1	-	20	571
	5, Outer London	13	2,929	0	-	13	2,929
Post 16 (over 16)	1. Rural	8	2,685	29	10,315	37	13,000
	2. Urban	13	398	31	1,187	44	1,585
	3. Metropolitan	32	748	4	114	36	862
	4. Inner London	20	53	0	-	20	53
	5, Outer London	13	253	0	-	13	253

This vast and varied data will be used in the analysis of school travel by school bus to determine the impacts of the statutory school bus provision policy. The results of this will be detailed in Chapter 8.

6.4 School academic achievement

In England school quality is considered an important aspect in education. English newspapers and media publish school and university league table results based on annual examination results. Many parents and pupils use this as a proxy for the quality of those schools. If a school receives better examination results, it is considered to be of high teaching, facilities and pupil quality. There has been a long debate of whether good quality pupils lead to a good quality school or whether the quality of the school influences the quality of the pupils. However, for the purposes of this thesis, as the exam results influence parental decision making, the higher the average examination result, the better quality the school is.

The DfE publishes the academic achievement of each Government maintained school in England. As explained in Chapter 1 children are generally educated on the basis of a national curriculum, and assessed as follows:

- Primary School — Key Stage 2
- Secondary School — Key Stage 4 (GCSE or GNVQ)
- Post 16 — GCE 'A' Level or NVQ

(DfE, 2010)

The DfE publishes the average achievement score of each school in the Key Stage Achievement and Attainment Tables.

For the purposes of this thesis, the average grade score of the Key Stage 2 exams, Key Stage 4 (or GCSE examinations) and Post 16 A-level results achieved in 2009 by school have been used as a proxy for school 'quality' making the assumption that the better the school's examination scores, the better quality the school is.

The Key Stage 2 exams test a pupil's academic progress (general knowledge, skills and understand of mathematics and English) set by the National Curriculum.

In 2009-2010 the number of pupils achieving level 4 or higher in their Key Stage 2 exams included:

- 73.5% of pupils in total in England
- 85% of girls achieve the expected level compared to 75.8 percent of boys.
- 55.8% of pupils known to be eligible for free school meals
- 72.7% in urban areas
- 77.2% in rural areas
- 75% in London areas

The DfE also noted that in this year, pupils residing in the least deprived areas, as defined by the Income Deprivation Affecting Children Index (IDACI), achieved higher results than pupils resident in the most deprived areas.

According to the DfE the Key Stage 2 tests are largely affected by the prior attainment of their pupils (how well they did at KS1). Therefore, in comparing the effectiveness of two or more primary schools, it is best to also look at the percentage of pupils making expected progress in English and in maths, and the contextual value added measure which adjusts for differences in prior attainment. This has been done in this study, and the average score for each school recorded and used as a proxy for school achievement within a LA.

The Key Stage 4 exams (also known as GCSEs) are usually taken at age 16 and are the first main qualifications achieved by English pupils and are required when applying for jobs, apprenticeships and further study.

In 2009-2010 the number of pupils achieving 5 or more GCSEs grade A*-C included:

- 53.4% of pupils in total in England
- 79.5% of female pupils and 71.4% of male pupils
- 54.8% of pupils in urban schools
- 58.6% of pupils in rural areas
- 54.2% in Inner London
- 59.8% in Outer London

Finally, A-level results usually taken at age 17-18 and are the second main qualifications achieved by English pupils after GCSEs and are required when applying for jobs, and university.

In 2009-2010 the number of pupils achieving passes in 2 or more A-Levels included:

- 94.8% of pupils, compared with 95.1% in 2008/09.
- 95.6% of female pupils and 93.9% male pupils
- 94.3% of pupils in urban areas
- 94.5% of pupils in rural areas
- 93.1% of pupils in inner London
- 95.5% in outer London.

These results show that pupils in rural areas and outer London achieved better academic results for all age groups in 2009-2010. On average, females achieve higher results than male pupils. The average Key Stage 2, GCSE and A-Level score of each Government maintained school has been collaborated and analysed in this thesis as a proxy for school quality.

6.5 Transport and environmental impact calculations

There are many other transport related factors to consider in school transport. To be able to model the vehicle and environmental impacts school travel has on the overall transport sector assumptions have been made to allow for analysis.

From a combination of Government sources including the DfT transport statistics, National Travel Survey, the AA, the Department for Environment Food and Rural Affairs (DEFRA), the Department for Energy and Climate Change (DECC), the International Review of Curriculum and Assessment (INCA) and the UKs National Atmospheric Emissions Inventory (NAEI).

Table 6.8 lists all the vehicle and environmental assumptions made to complete the analysis of impacts in this thesis. The data collected from these sources was produced in different measures, so therefore the average figures and totals have been converted into miles, tonnes and gram measurements.

The data does not contain the exact income of each child's household, however, if pupils are eligible for free school meals (represented as *FSM* in the data) then their household meets a Governmental criterion for being a 'low-income household' and so the model will indicate a low income household from free school meal eligibility.

The cost of car travel was estimated through average cost of fuel per mile figures from the AA website (AA, 2009). The cost for bus travel was obtained from the annual operating revenue per passenger journey (2009/10) on local bus services at £1.20 per vehicle mile (an average cost for London, English metropolitan and English non-metropolitan local bus services) which was sourced from Department for Transport Public Service Vehicle Survey (DfT, 2009) and will be used in this case as a proxy for value.

Table 6.9 Table of Transport and Environment Impact Calculations

Personal mobility (in England)		Source of Data
Person miles (individual by car) road transport per year	5,849 miles	DfT (2009b)
Person miles (total car) road transport per year	298 billion miles	
Person miles (individual by bus) road transport per year	277 miles	
Person miles (total bus) road transport per year	17 billion miles	
VMT (England)		
Average occupancy (car trips to school)	2.0 persons per vehicle	DfT (2009a; 2008c)
Average occupancy (bus, all trips)	11.0 persons per bus	
Number of School Days (UK)	190 a year	INCA (2010)
Fuel Used (England)		
Average mpg petrol (car)	37mpg	DEFRA (2008), Garner, C (2010) Personal Communication, School of Mechanical and Manufacturing Engineering, Loughborough University (20.11.2010)
Average mpg diesel (car)	44mpg	
Assumed car fleet characteristics	50% petrol, 50% diesel	
Average mpg diesel (bus)	7mpg	
Tonnes fuel car (petrol) from road transport	12,547 Kilo tonnes	DECC (2008)
Tonnes fuel car (diesel) from road transport	5,785 Kilo tonnes	
Tonnes fuel bus (diesel) from road transport	1,268 Kilo tonnes	
Tonnes fuel all road transport	34,661 Kilo tonnes	
CO2 Used (England)		
Tonnes CO2 from road transport	121.8 million tonnes	
Tonnes CO2 from all sectors	480.9 million tonnes	
CO2 from petrol car per mile	129.7g	NAEI (2007)
CO2 from diesel car per mile	125.4g	
CO2 from diesel bus per mile	506.0g	

6.6 Data Summary

This chapter has presented the data to be employed in the following chapters. This includes individual pupil, school and local authority variables – i.e. age and gender of pupils, size and academic achievement of schools and spending and policies of LAs.

The travel of individual pupils from the School Census (e.g. mode of travel to school and distance to nearest and current school) was employed to measure the impacts of the school choice policy in particular on vehicle miles travelled and the environment. The data obtained for English schools and local authorities was analysed to determine school bus passenger mileage in England for year 2009 and the impact of the statutory home-to-school transport provision policy which has been offered by LAs for nearly 70 years.

The model estimation results for the scenarios testing the school choice and statutory home to school policies are presented in the following chapters.

CHAPTER 7 MODELLING THE IMPACTS OF SCHOOL CHOICE

7.1 Introduction

This chapter will present the results of the impact of the school choice policy on school travel in England. The School Census 2009 data has been used to investigate the mode choice of school children travelling to their current school using discrete choice models, as presented in Chapter 4. The discrete choice models have been employed to estimate the modal share of school children if they travel to their nearest school. This chapter then discusses how mode choice changes (current vs nearest schools) give an insight into the personal car mileage accrued by the school choice policy. Other transport related impacts are also estimated and the implication of the school choice policy is discussed.

The chapter is organised as follows: first the mode choice results from the multinomial logit model (MNL) for a sample of school children in England are presented. This is followed by the discussion of the results from the more sophisticated mixed multinomial logit model (MMNL). In order to see whether the modal share of school children is affected by age, the pupils are divided into their two separate age groups i.e. primary school pupils (aged 10 years and younger) and secondary and Post 16 pupils (aged over 10 years). The same MMNL model is then developed for these two groups of pupils so as to examine the similarities and differences among the factors affecting modal share of school children. For each of the above models, various transport-related impacts (i.e. traffic level, fuel use and CO_2 emissions) are estimated and discussed. The chapter ends with a discussion on the implications of school choice policy in England.

7.2 Study 1: Multinomial logit model

The purpose of this modelling exercise was to develop a mode choice model to determine factors affecting the mode choice of pupils travelling to school and then to quantify the transport-related impacts of allowing parental choice of schools on personal travel behaviour, on traffic levels, fuel use and CO_2 emissions.

Due to the sheer size (7.484 million pupils), of the School Census data a sample of 1% (i.e. 69,910 pupils) has been used for the MNL analysis. A random sample is taken using a simple random sampling process in which the selection probability of each pupil is the same. In order to see the reliability of the sampling technique, a total of five random samples (with the same size) are selected and then the modal share for each of the five random samples are examined. The results are presented in Table 7.1. It is noticeable that there is no significant difference in modal shares of school children among the five random samples and all are in-line with the modal share related to the full dataset. This suggests that the random sampling technique is capable of producing a truly random sample and one can employ any of these samples to develop a mode choice model.

Table 7.1 Modal Share for Random Samples and Full Data

	Full Dataset	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5
	Percentage Share of Mode					
Boarder	0.1	0.1	0.1	0.1	0.04	0.0
Bus (type not known	1.6	1.6	1.7	1.7	1.8	0.0
Car	26.1	26.3	26.9	26.1	26.7	26.7
Car Share	2.9	3.1	2.8	2.8	2.8	3.1
Cycle	1.9	1.9	1.9	1.7	1.9	1.9
Dedicated School Bus	7.8	7.6	7.4	8.0	7.9	7.8
London Underground	0.1	0.2	0.1	0.2	0.1	0.1
Metro Tram	0.1	0.1	0.1	0.1	0.05	0.1
Other	0.7	0.7	0.7	0.8	0.9	0.8
Public Service Bus	6.7	7.3	6.7	6.9	6.6	6.7
Train	0.5	0.5	0.5	0.5	0.0	0.5
Taxi	0.9	0.9	1.0	0.7	0.0	1.0
Walk	50.5	49.8	50.2	50.5	51.3	51.3

Table 7.2 shows the final sample used in the analysis of the MNL model. The 13 mode choices were combined into four categories of Car, Bus, Non-Motorised Transport (NMT) and Other Public Transport (OPT). As explained in Marshall et al (2010) fewer categories and outcomes allow the MNL model to be most effective. A total of 69,910 pupils have been included in the sample, with modal share of Car=29.9%; Bus=14.7%; NMT=53.7% and other PT=1.7%.

Table 7.2 Final Sample Distribution

Mode of Travel		Full Data (%)	Sample (%)
Car	Car	26.1	26.7
Car Share		2.9	3.1
Dedicated School Bus	Bus	7.8	7.8
Public Service Bus		6.7	6.7
Bus (Type Not Known)		1.6	0.0
Walk	Non-Motorised Transport	50.5	51.3
Cycle		1.9	1.9
Train	Other Public Transport	0.5	0.5
Taxi		0.9	1.0
Underground		0.1	0.1
Metro Tram		0.1	0.1
Other		0.7	0.0
Boarder		0.1	0.0

Table 7.3 outlines the summary statistics of the MNL model. As expected, the highest modal share is for NMT at 53.7%. Motorised modal share includes 29.9% for car and 14.7% for bus use. The modal share for OPT is only 1.7%.

According to the summary statistics the average distance travelled of the pupil sample is 1.3 miles to their current school and only 0.6 miles to their nearest school. The maximum distance travelled to school recorded was 161 miles and the maximum distance to a nearest school was only 24 miles in comparison.

Table 7.3 Summary statistics of the variables used

Variable	Observations	Mean	Std. Dev.	Min	Max
Dependent variable					
Transport mode	69,345	Car=29.9%; Bus=14.7%; NMT=53.7% and other PT=1.7%			
Trip Characteristics					
Distance to current school (mile)	69910	1.296	2.091	0	161.2
Distance to nearest school	62783	0.5876	0.7728	0	24.12
Monetary cost of the trip					
Cost of car (£)	69910	1.296	2.091	0	161.2
Cost of bus (£)	68472	1.179	0.121	0	1.2
Cost of non-motorised transport	69910	0	0	0	0
Cost of other public transport (£)	69910	1.995	0.306	0	40.8
Personal characteristics					
Age (year)	69910	10.908	3.923	3	21
Gender (Female=1, Male=0)	69910	0.489	0.500	0	1
Free school meal (Yes=1, No=0)	69910	0.148	0.355	0	1
IDACI score (range 0 to 1)	69910	0.229	0.186	0.006	0.996
Ethnicity					
Asia (excluding Chinese)	69910	0.083	0.276	0	1
Black	69910	0.043	0.203	0	1
Chinese	69910	0.003	0.056	0	1
Mixed	69910	0.035	0.185	0	1
White	69910	0.791	0.407	0	1
Other	69910	0.044	0.206	0	1
Roadway density	69910	12.877	8.084	0	59.5

Already it can be seen that there is a big difference in distance from nearest school to current school. The data does not contain the exact income of each child's household. However, if pupils are eligible for free school meals then their household meets a Governmental criterion for being a 'low-income household' and so the model will indicate a low income household from free school meal eligibility. The Income Deprivation Affecting Children Index (IDACI) score also acts as a proxy for household income.

The cost of car travel was estimated through average cost of fuel per mile figures from the AA website (AA, 2009). The cost for bus travel was obtained from the annual operating revenue per passenger journey (2009/10) on local bus services at £1.20 per vehicle mile (an average cost for London, English metropolitan and English non-metropolitan local bus services) which was sourced from Department for Transport Public Service Vehicle Survey (DfT, 2009) and will be used in this case as a proxy for value.

The mean figure is a result of modelling two types of bus users. Pupils who travel by dedicated school bus (DSB) are generally assumed to not pay for their bus travel (as a result of the home-to-school transport policy) and therefore their journey would cost the users nothing, whilst other pupils who travel via public service buses (PSB) pay either full or subsidised fares and have been modelled as paying £1.20. Combined these pupils give an average cost of bus of £1.179.

The MNL model has been utilised to develop a mode choice model. As indicated, the dependent variable is mode choice of pupils travelling to school (car, bus, NMT and OPT). Results from the MNL model are presented in Table 7.4.

Table 7.4 Results of the MNL Model

	Multinomial Logit (MNL) Model					
Alternative specific variable	**Coefficient**			**t-statistics**		
Cost (generic)	-2.5660			-44.07		
	BUS		NMT		Other PT	
	Coefficient	t-stat	Coefficient	t-stat	Coefficient	t-stat
Alternative specific constants	-2.4240	-24.99	0.2037	5.76	-1.1880	-6.52
Pupil specific variables						
Distance	-2.4780	-41.94	-4.1431	-68.59	-2.3383	-39.35
Age	0.3077	66.52	0.1358	48.11	0.1912	18.62
Gender (Female=1, Male=0)	-0.0773	-2.6	-0.0898	-4.6	-0.1837	-2.54
Free school meal (Yes=1, No=0)	0.5679	12.72	0.4051	12.85	1.0031	10.41
IDACI Score	1.6391	17.22	0.8803	13.77	0.6001	2.54
Ethnicity						
Asia	-0.4383	-7.39	-0.4155	-11.7	-0.4482	-2.91
Black	0.9386	13.94	0.0710	1.3	0.7710	5.03
Chinese	-0.5289	-2.06	-0.4129	-2.48	0.0911	0.18
Mixed	0.2876	3.75	-0.0875	-1.65	0.4329	2.54
Other	0.6194	7.76	0.2381	4.93	0.8273	5.05
White (Reference)						
Roadway density (km/sq km)	0.0047	2.24	0.0098	7.12	0.0078	1.57
Statistics						
Pseudo R-squared	0.4470					
Log-likelihood at convergence	-51379					
Observations	67,014					

The MNL model is a non-linear model, therefore to better understand the impact of distance on pupils' mode choice, the predicted probabilities of different transport modes are plotted against distance in Figure 7.1 (for pupils age 8, white male, without free school meal, IDACI score=0.5, roadway density=30 miles per square mile of the area).

It is interesting to note that there is a notable inverted U-shaped relationship between the distance to current school and the probability of travelling by car.

As Figure 7.1 shows, the probability of travelling by car increases if the distance is within 3.5 miles, but decreases when distance is above 3.5 miles.

Age, on the other hand, shows a different result. As Table 7.4 shows, the coefficients are all significant and positive for bus, NMT and OPT, suggesting that with age increasing, pupils are less likely to travel by car. This may be because as a pupil's age increases, parents are more confident that their children can travel by public transport, walking or bicycle safely.

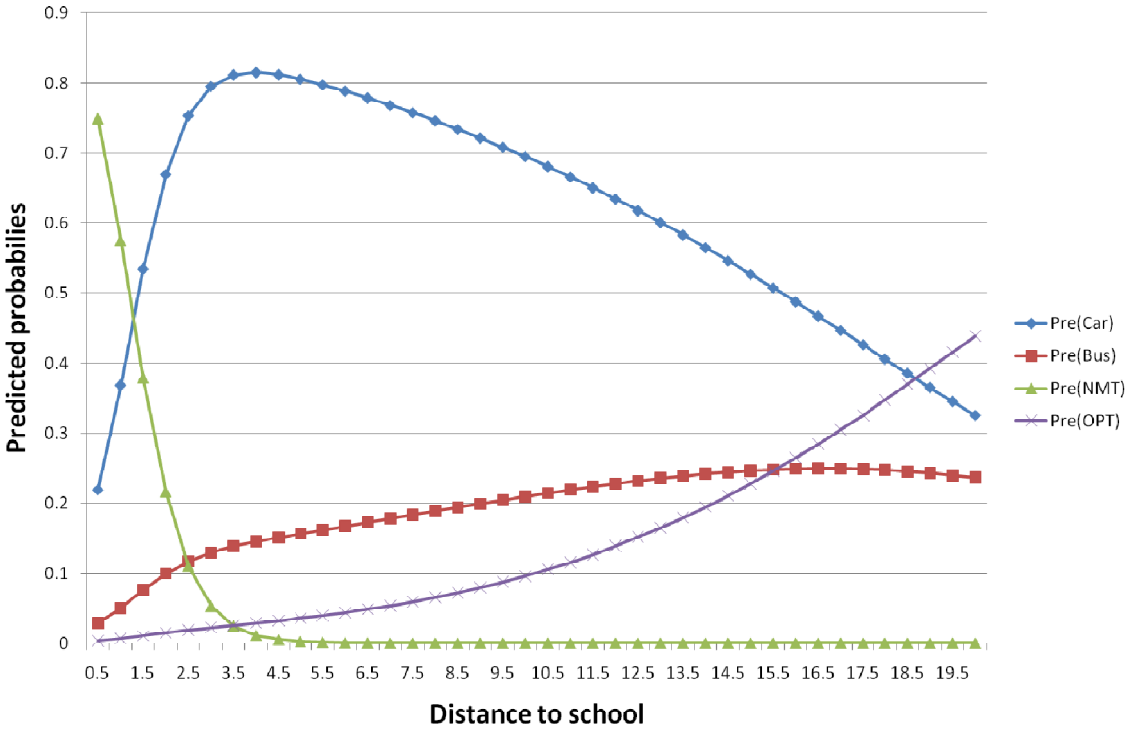


Figure 7.1 Predicted probabilities vs. Distance

The coefficients of *gender* are statistically significant and negative in all of the alternative mode of travel functions. This means that female pupils however are less likely to travel by Bus, NMT or OPT compared to male pupils.

Free school meal, which can be thought of as a good proxy for a low income family, also plays an important role in pupils' mode choice. As can be seen, those who receive free school meals are more likely use public transport or NMT relative to car. Similar effects can be found for *IDACI Score*. Increases in *IDACI Score* increase the probability of choosing public transport or NMT for travelling to schools.

As for ethnicity groups, the coefficients of *Asian* and *Chinese* pupils are all statistically significant and negative, except that the coefficient of *Chinese* for OPT is insignificant. This implies that, compared to *white*, Asian and Chinese pupils are more likely to travel by car relative to public transport and NMT. *Black*, *mixed* and *other* ethnicity groups, generally tend to use more public transport and NMT compared to white.

An exception is that the *mixed* appears less likely to travel by NMT relative to car, but this effect is only significant at 90% confidence level. The coefficient of *roadway density* is found to be statistically significant and positive for bus and NMT, meaning that pupils are more inclined to travel by bus and NMT compared to car at places where road density is high.

Higher roadway density may indicate better public transport and facilities (e.g. bicycle lanes), which may encourage pupils to use bus and NMT. Based on the model estimation results, it is possible to calculate the expected market share of different transport modes. The predicted market share of different transport modes for two scenarios are calculated: 1) pupils going to the current school; 2) pupils going to the nearest school. These results are further represented in Table 7.5.

The results presented Table 7.5, are obtained from the dataset of 7,484,001 pupils. From these results and assumptions, calculations can be made to determine the effect of school choice, and how travelling to a school other than the school closest to home, can lead to increases in VMT, CO_2 and fuel consumption as decreases in sustainable travel.

From the modelling results below if children travelled to their nearest school instead of the school of their choice the transport-related benefits would be dramatic. Table 7.5 shows the current modal share, average distance travelled, VMT, fuel use and CO_2 emissions of children travelled to their current school compared to the modelled scenario of what these figures would be if all children travelled to their nearest school.

There would be a significant difference in daily travel in England if all school children travelled to their nearest school as opposed to their current school. Mode choice changes in the modelled scenario to children travelling less by car and more by sustainable modes. The model shows that car use would fall from 33% modal share to 24%. Bus use would also fall from around 12% to 7%. However, NMT through walking and cycling would rise from around 54% to 68%.

Table 7.5: Quantification of the transport-related impacts MNL Results

Mode	Percentage of Mode Share (%)	Average one way distance (miles)	total pupil mileage per day (two way, millions)	Total education passenger mileage per year (millions)	Total passenger mileage per passenger per annum	Vehicle miles travelled for education based journeys per school day two way (millions)	Vehicle miles travelled for all trip purposes per day (millions)	Total vehicle miles travelled on a school day (%)
CURRENT SCHOOL								
Car	0.33	1.51	7.42	1,410	5,849	7.43	813.45	0.73
Bus	0.12	3.16	5.57	1,058	277	0.51	38.52	14.4
Walk/Cycle	0.54	0.55	4.43	842	242	-	-	
Other PT	0.02	4.70	1.50	285	768	0.75	27.68	5.42
Total	-	-	18.92	3,595.37	7,136	8.69	-	-
NEAREST SCHOOL								
Car	0.24	0.55	1.95	370	5,849	0.98	813.46	0.19
Bus	0.07	1.49	1.66	314	277	0.15	38.52	4.30
Walk/Cycle	0.68	0.37	3.77	716	242	-	-	
Other PT	0.01	0.91	0.12	22.46	768	0.02	27.68	0.21
Total	-	-	7.50	1,422.46	7,136	1.15	-	-
DIFFERENCE								
Car	-0.09	-0.96	-5.47	-1,040.37	-	-6.45	-	-0.54
Bus	-0.04	-1.67	-3.91	-744.30	-	-0.36	-	-10.1
Walk/Cycle	0.15	-0.18	-0.66	-125.70	-	-	-	-
Other PT	-0.01	-3.79	-1.38	-262.54	-	-0.73	-	-5.21
Total	-	-	-11.42	-2,172.91	-	-7.54	-	-

The model suggests that if all children travelled to the school nearest to their home, VMT by car could be reduced by 0.5% and VMT by bus could be reduced by 10% per school day.

As previously discussed, the MNL model assumes that all parameters are fixed, therefore there is no taste variation among pupils considered. This makes the above model somewhat unrealistic because as determined in Chapter 2, personal factors and preferences play a vital part on how children travel to school. For this reason the data has been re-modelled using the more advanced mixed multinomial logit model (MMNL) and the results will be explored in the following section.

7.3 Study 2: Mixed Multinomial logit modelling

The same dataset (as shown in Table 7.3) has been used to develop a mode choice model of school children again but this time using the more sophisticated mixed multinomial logit (MMNL) model to develop a mode choice model. Again, the dependent variable is mode choice of pupils travelling to school (car, bus, NMT and OPT).

Results from the MMNL models are presented in Table 7.6. While the MNL and MMNL models provide similar results in terms of values of coefficients and the corresponding t-statistics, the MMNL model outperforms the MNL model in terms of model goodness-of-fit. The pseudo R-square of the MMNL model (0.47) is larger than the pseudo R-square of the MNL model (0.45).

A likelihood ratio (LR) test has also been performed to compare the MNL and the MMNL models, and the result indicates that the inclusion of the random parameters (i.e. generic cost and distance related to NMT) in the MMNL model significantly improves the model fit. Therefore, the results from the MMNL model are used in this study for interpretation and calculating the transport related impacts of school choice.

The MMNL model is a non-linear model, therefore to better understand the impact of distance on pupils' mode choice, the predicted probabilities of different transport modes are plotted against *distance* in Figure 7.2 (for pupils age 8, white male, without free school meal, *IDACI score*=0.5, roadway density=15).

The coefficients of gender are statistically significant and negative in the bus, NMT and OPT functions. This means that female pupils however, are less likely to travel by public transport or NMT compared to male pupils.

Free school meal eligibility, which can be thought of as a good proxy for low income families, also plays an important role in pupils' mode choice. As can be seen, those who receive free school meals are more likely to use public transport or NMT relative to car. Similar effects can be found for *IDACI Score.* Increases in IDACI score increase the probability of choosing public transport or NMT for travelling to schools.

Table 7.6 MMNL results

	Mixed Multinomial Logit (MMNL) Model					
Alternative specific variable (vector z)	**Coefficient**			**t-statistics**		
Cost (generic)	-2.4996			-39.77		
	BUS		NMT		Other PT	
	Coefficient	t-stat	Coefficient	t-stat	Coefficient	t-stat
Alternative specific constants	-2.8370	-26.11	0.5846	12.91	-1.7878	-9.13
Pupil specific variables (*vector x)*						
Distance	-2.2743	-34.71	-5.8520	-73.32	-2.0669	-31.12
Age	0.3146	63.26	0.1949	49.97	0.1892	17.82
Gender (Female=1, Male=0)	-0.0892	-2.83	-0.0962	-3.86	-0.2048	-2.78
Free school meal (Yes=1, No=0)	0.5960	12.67	0.4076	10.37	1.0900	11.11
IDACI Score	1.6308	16.21	0.9815	12.18	0.6176	2.56
Ethnicity						
Asia	-0.4711	-7.55	-0.5602	-12.67	-0.5217	-3.27
Black	1.0091	14.17	-0.0392	-0.58	0.8024	5.16
Chinese	-0.6298	-2.27	-0.4992	-2.34	-0.1122	-0.21
Mixed	0.3192	3.93	-0.1405	-2.11	0.4413	2.54
Other	0.6384	7.43	0.2810	4.68	0.8181	4.9
White (Reference)						
Roadway density (km/sq km)	0.0052	2.38	0.0122	6.98	0.0129	2.57
Random parameters (S.D.)						
Cost (generic)	0.2619			11.99		
Distance			1.7129	43.42		
Statistics						
Pseudo R-square	0.4734					
Log-likelihood at convergence	-48,920					
Observations	67,014					

As for age, as Table 7.6 shows, the coefficients are all significant and positive for bus, NMT and OPT, suggesting that with age increasing, pupils are less likely to travel by car. This may be because as pupils' age increase, parents are more confident that their children can travel by public transport, walking or cycling safely.

It is interesting to note that there is a notable inverted U-shaped relationship between distance travelled and the probability of travelling to school by car. As the figure shows, the probability of travelling by car increases if the distance is within 3.5 miles, but decreases when distance is above 3.5 miles.

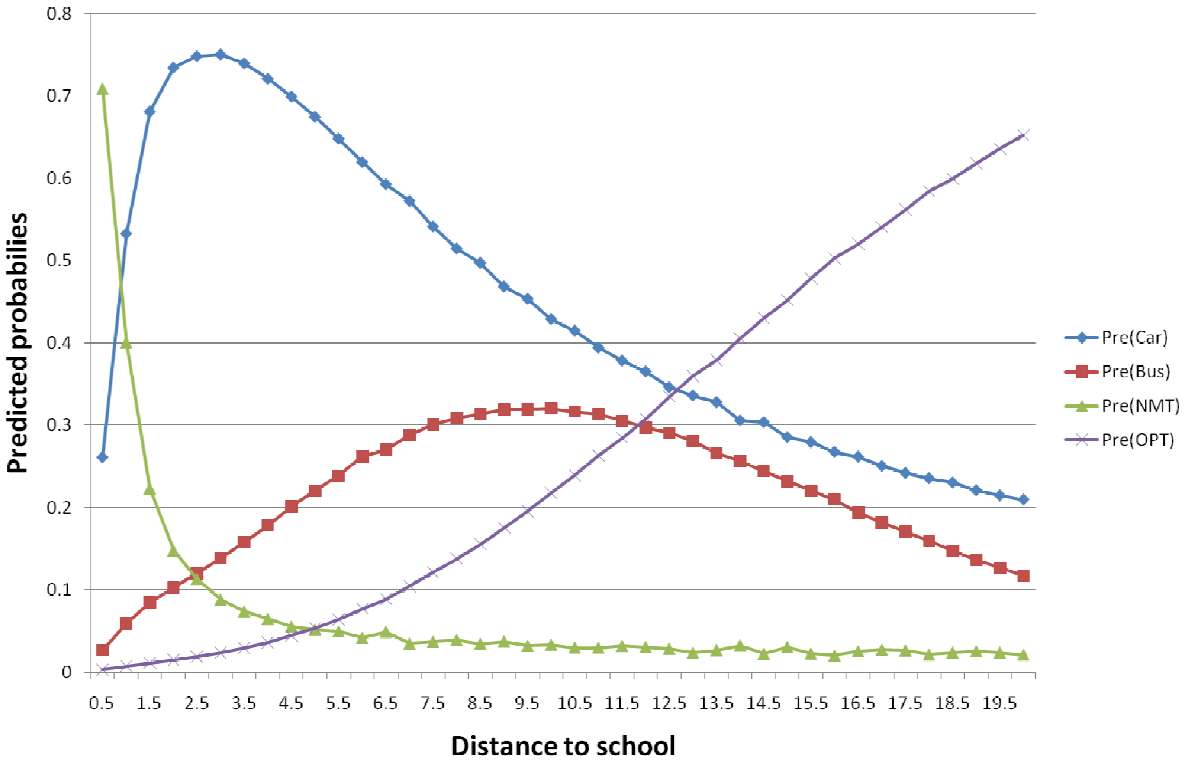


Figure 7.2 Distance to School for 'Typical Pupil'

As for ethnicity groups, the coefficients of *Asian* and *Chinese* pupils are all statistically significant and negative, apart from the coefficient of *Chinese* for OPT which is insignificant. This implies that, compared to white pupils, *Asian* and *Chinese* pupils are more likely to travel by car relative to public transport and NMT. *Black, Mixed* and *other ethnicity* groups generally tend to use more public transport and NMT compared to white pupils. An exception is that the mixed ethnic group appear less likely to travel by NMT relative to car.

The coefficient of roadway density is found to be statistically significant and positive for bus, NMT and OPT, meaning that pupils are more inclined to travel by public transport or NMT compared to car at places where road density is high. Higher roadway density may indicate better public transport and facilities (e.g. bicycle lanes), which may encourage pupils to use bus and NMT.

Based on the model estimation results, it is possible to calculate the expected market share of different transport modes. The predicted market share of different transport modes for two scenarios are calculated: 1) pupils going to the current school; 2) pupils going to the nearest school. These results are further represented in Table 7.7 and 7.8.

The results presented Tables 7.7 and 7.8 are obtained from the dataset of 7,484,001 pupils. From these results and assumptions (see Table 6.9 Data Chapter 6), calculations can be made to determine the effect of school choice, and how travelling to a school other than the school closest to home, can lead to changes in VMT, CO_2 and fuel consumption as decreases in sustainable travel.

The results suggest that if children travelled to their nearest school, instead of the school of their choice the transport-related benefits would be significant. Tables 7.7 and 7.8 show the current modal share, average distance travelled, VMT, fuel use and CO_2 emissions of children travelled to their current school compared to the modelled scenario of what these figures would be if all children travelled to their nearest school.

Mode choice changes in the modelled scenario to children travelling less by car and more by sustainable modes. The model shows that car use would fall from 32% modal share to 22%. The modal share for bus would also fall from around 12% to 7%. However, NMT through walking and cycling would rise from around 54% to 71%. The model suggests that if all children travelled to the school nearest to their home, total car miles travelled will fall by 1.08% and total bus miles travelled will reduce by 10.77%

Table 7.7 Quantification of the transport-related impacts

Mode	Percentage of Mode Share (%)	Average one way distance (miles)	Total pupil mileage per day (two ways, millions)	Total travel to school passenger mileage per year (millions)	Total passenger mileage per passenger per annum	Vehicle miles travelled to school per school day two ways (millions)	Vehicle miles travelled for all trip purposes per day (millions)	Total vehicle miles travelled on a school day (%)
CURRENT SCHOOL								
Car	0.32	1.51	7.280	1,383.27	5,849	7.28	508.41	1.43
Bus	0.12	3.16	5.648	1,073.18	277	0.513	3.50	14.66
Walk/Cycle	0.54	0.55	4.434	842.41	242	-	-	-
Other PT	0.03	4.70	1.777	337.65	768	0.889	53.41	1.66
Total	-	-	19.139	3,636.50	7,136	8.68	565.32	-
NEAREST SCHOOL								
Car	0.22	0.55	1.791	340.31	5,849	1.79	508.41	0.35
Bus	0.07	1.49	1.497	284.37	277	0.136	3.50	3.89
Walk/Cycle	0.71	0.37	3.919	744.53	242	-	-	-
Other PT	0.01	0.91	0.103	19.64	768	0.026	53.41	0.05
Total	-	-	7.310	1,388.86	7,136	1.95	565.32	
DIFFERENCE								
Car	-0.10	-0.96	-5.489	-1,042.96	-	-5.49	-	-1.08
Bus	-0.05	-1.67	-4.152	-788.81	-	-0.377	-	-10.77
Walk/Cycle	0.17	-0.18	-0.515	-97.87	-	-	-	-
Other PT	-0.02	-3.79	-1.674	-318.01	-	-0.863	-	-1.61
Total	-	-	-11.830	-2,247.65	-	-6.73	-	-

Table 7.8 Transport related energy impacts

Transport Related Impact Parameters	Current School	Nearest School	Difference
Petrol used - travel to school per school day (tonnes)	375.32	82.89	-290.66
Diesel used - travel to school per school day (tonnes)	615.94	114.27	-501.66
Petrol used in travel to school as a proportion of total petrol used in road transport (%)	1.09	0.24	-0.85
Diesel used in travel to school as a proportion of total diesel used in road transport (%)	3.19	0.59	-2.60
Energy used in travel to school per school day (TJ)	43.13	8.59	-34.54
Energy used in travel to school as a proportion of total energy used in road transport (%)	0.0297	0.0059	-0.0238
CO2 emitted by travel to school per school day (tonnes)	3363.03	776.57	-2586.46
CO2 emitted by travel to school as a proportion of total CO2 emitted by road transport (%)	1.01	0.23	-0.78
CO2 emitted by travel to school as a proportion of total CO2 emitted by all sectors (%)	0.26	0.06	-0.2

Table 7.8 outlines travel from a fuel consumption perspective, and shows that if all children travelled to their nearest school instead of their current school, England would save almost 300 tonnes of petrol per day or almost 1% of total petrol used by the road transport sector and just under 3% or 500 tonnes of diesel each day.

This work demonstrates that there are serious (presumably unintended) consequences on other areas of public policy, such as the impacts increased amounts of travel and longer journey distances have on the environment (as already noted).

Implications for the model include sample size of 1%. Further research would require larger datasets being modelled to identify more trends and changes in travel. In addition if similar data was available for other countries which allow school choice such as the US, international studies would allow for further comparisons to take place to see how much VMT and CO_2 could be reduced around the world.

Additional factors to enhance the current model would include school performance indicators as these may play a vital role in why parents choose certain schools over others. Ideally, knowing each pupil's postcode would allow mapping of travel and what public bus alternatives are available, however currently this data is sensitive and access is limited.

7.4 Study 3: Mixed Multinomial logit modelling for two age groups

As discussed in the methodology, the age of the pupil is a significant factor in how they travel to school based on safety and parental concerns. For this reason the previous model has been re-estimated for a sample of 69,910 pupils but instead of analysing the whole sample, the pupils will be divided into two age groups.

The whole sample (69,910 pupils) was divided into two parts: (1) all school children aged 10 or under (primary school) resulting in a sample size of 32,907 and (2) all pupils aged over 10 (secondary and Post 16) resulting in 37,003. The mixed multinomial logit (MMNL) model have been utilised to develop a mode choice model for these two separate age groups. The dependent variable is mode choice of pupils travelling to school (car, bus, NMT and other public transport). Results from the two MMNL models are presented in Table 7.10 and 7.14.

The modal share has been calculated by the model for pupils either aged either 10 years or younger and aged over 10 years. The results of these have been calculated using the Assumptions Table from Chapter 6 (Table 6.2) to quantify the impacts of changes on travel behaviour if all pupils travelled to their nearest school as oppose to their current school.

Table 7.9 outlines the summary statistics for pupils aged 10 years old and younger tested in the model. As expected very few primary school aged pupils travel to school via public transport. In the sample most pupils under the age of 10 travel to school via NMT or private car which combined account for 96% of primary school modal share. As found in other chapters, younger children are much less likely to travel by bus or OPT than older pupils.

Table 7.9 Summary statistics for pupils aged 10 and under

Variable	Observations	Mean	Std. Dev.	Min	Max
Transport mode	32,907	Car=37.5%; Bus=2.7%; NMT=58.9% and OPT=0.9%			
Trip Characteristics					
Distance to current school (mile)	32,907	0.79	1.53	0	161.2
Distance to nearest school (mile)	29,784	0.32	0.31	0	6.7
Monetary cost of the trip (£)					
Cost of car (£)	32,852	0.20	0.84	0	161.2
Cost of bus (£)	32,852	0.30	0.52	0	1.2
Cost of NMT (£)	32,852	0.00	0.00	0	0
Cost of other public transport (£)	32,852	0.50	0.88	0	7.8
Personal characteristics					
Age (year)	32,907	7.337	1.851	3	10
Gender (Female=1, Male=0)	32,907	0.514	0.500	0	1
Free school meal (Yes=1, No=0)	32,907	0.155	0.362	0	1
IDACIscore (% range 0 to 1)	32,907	0.240	0.191	0.006	0.996
Ethnicity					
Asia (excluding Chinese)	32,907	0.091	0.287	0	1
Black	32,907	0.045	0.207	0	1
Chinese	32,907	0.003	0.053	0	1
Mixed	32,907	0.039	0.194	0	1
White	32,907	0.754	0.430	0	1
Other	32,907	0.068	0.251	0	1
Roadway density km / sq km	32,907	13.081	8.196	0	59.49

The average distance travelled is much lower than the statistics obtained when testing the whole sample, however the maximum distance travelled to current school remains the same, but the maximum distance travelled to nearest school is much lower.

Table 7.10 MMNL Results for pupils aged 10 years and under

Age<=10	Mixed Multinomial Logit (MMNL) Model					
Alternative specific variable	**Coefficient**			**t-statistics**		
Cost (generic)	0.3442			-4.67		
	BUS		NMT		OPT	
	Coefficient	t-stat	Coefficient	t-stat	Coefficient	t-stat
Alternative specific constants	-3.8116	-16.9	2.6164	27.12	-3.6550	-9.33
Pupil specific variables						
Distance	-0.2660	-3.37	-4.7452	-37.4	0.0963	1.23
Age	0.0689	2.99	-0.0463	-4.66	-0.0814	-2.11
Gender (Female=1, Male=0)	0.0098	0.12	0.0040	0.11	-0.4514	-3.31
Free school meal (Yes=1, No=0)	0.7575	7.36	0.6054	10.64	2.1925	14.49
IDACI Score	2.1559	9.21	1.2644	11.03	1.2878	3.08
Ethnicity						
Asia	-0.2094	-1.24	-0.4087	-6.48	-0.0629	-0.23
Black	1.1850	8.79	0.0435	0.45	-0.0973	-0.29
Chinese	0.2239	0.31	-0.4119	-1.34	0.6591	0.61
Mixed	0.3531	1.92	-0.0566	-0.61	0.0599	0.19
Other	0.5815	3.77	0.0307	0.4	-0.3320	-1.05
White (Reference)						
Roadway density (km/sq km)	-0.0096	-1.69	0.0093	3.79	-0.0311	-3.11
Random parameters (S.D.)						
Cost (generic)	0.2393			7.75		
Distance			2.5669	25.97		
Statistics						
Pseudo R-square	0.5119					
Log-likelihood at convergence	-20030.997					
Observations	32,612					

Looking first at primary school pupils (32,907 pupils from the original sample aged 10 and under), the coefficient of roadway density is found to be statistically significant and positive for *NMT* and *OPT,* but not for *bus* meaning that pupils are more inclined to travel by public transport or NMT compared to car at places where road density is high but use usage is low.

As in the previous two models analysing the full pupil population, the expected market share of different transport modes has been calculated and presented in Tables 7.11 and 7.15 for pupils aged under 10 and over 10 respectively.

From a transport perspective, the results suggest that if primary school children under the age of 10 travelled to their nearest school, instead of the school of their choice the transport-related benefits would be quite significant. The model shows that if all primary school children travelled it their nearest school instead of a chosen school car use would fall from 38% modal share to 24%. Bus use is already very low for younger children, but would also fall from around 0.02% to 0.01%. However, NMT through walking and cycling would rise from around 59% to 75%. Overall, this change in policy would mean a reduction in VMT of 0.6% of VMT by car and 0.7% of VMT by bus to school per school day in England. From a transport perspective, the model suggests that if all children travelled to the school nearest to their home the average distance travelled by car could be reduced from 1.25 miles per school day to 0.41 miles per day.

From an environmental perspective, the amount of petrol used per day could be reduced significantly by over 150 tonnes a day. Diesel could also be dramatically reduced by over 150 tonnes a day. Finally, the amount of CO_2 generated per day could be reduced by over 1,000 tonnes per day.

To summarise, if primary school pupils in England travelled only to their nearest school instead of having the option of school choice allowing them to travel as far as they wish each day (usually via the personal car) both VMT and CO_2 emissions could be drastically reduced.

It needs to be noted that this information is only based on the travel of the individual pupils and does not include any journeys made before or after the child has been dropped off at school. The School Census provides details on the direct distance from a child's home postcode to school postcode in miles but does not account for any unobserved factors such as parent's trip chaining and dropping a child at school en-route to work or other activities. This information only addresses the travel made by the individual child.

Table 7.11: Quantification of the transport-related impacts for pupils aged under 10

Mode	Percentage of Mode Share (%)	Average one way distance (miles)	Total pupil mileage per day (two way, millions)	Total education passenger mileage per year (millions)	Total passenger mileage per passenger per annum	Vehicle miles travelled for education based journeys per school day two way (millions)	Vehicle miles travelled for all trip purposes per day (millions)	Total vehicle miles travelled on a school day (%)
CURRENT SCHOOL								
Car	0.38	1.25	3.99	757.78	5,849	3.99	813.43	0.78
Bus	0.02	1.99	0.35	66.71	277	0.32	38.52	0.91
Walk/Cycle	0.59	0.40	1.99	377.27	242	-	-	-
Other PT	0.01	3.81	0.32	60.30	768	0.79	27.68	0.19
Total	-	-	6.65	1,262.06	7,136	-	879.63	-
NEAREST SCHOOL								
Car	0.24	0.41	0.82	155.67	5,849	0.82	813.46	0.16
Bus	0.01	0.78	0.07	13.58	277	0.06	38.52	0.19
Walk/Cycle	0.75	0.25	1.54	292.58	242	-	-	-
Other PT	0.00	0.49	0.01	0.23	768	0.03	27.78	0.01
Total	-	-	2.44	462.06	7,136	-	879.76	-
DIFFERENCE								
Car	-0.14	-0.84	-3.17	-602.11	-	-3.17	-	-0.62
Bus	-0.01	-1.21	-0.28	-53.13	-	-0.03	-	-0.73
Walk/Cycle	0.16	-0.16	-0.45	-84.69	-	-	-	-
Other PT	-0.01	-3.31	-0.31	-60.07	-	-0.08	-	-0.14
Total	-	-	-4.21	-800	-	-	-	-

Table 7.12 Environmental impacts of the school choice policy for pupils aged under 10

Transport Related Impact Parameters for Primary Pupils	Current	Nearest	Difference
Petrol used - education based journeys per school day (tonnes)	190.54	37.71	-152.83
Diesel used - education based journeys per school day (tonnes)	191.59	37.14	-154.45
Petrol used in education based journeys as a proportion of total petrol used in road transport (%)	0.55	0.11	-0.44
Diesel used in education based journeys as a proportion of total diesel used in road transport (%)	0.99	0.19	-0.80
Energy used in education based journeys per school day (TJ)	16.71	3.28	-13.43
Energy used in education based journeys as a proportion of total energy used in road transport (%)	0.01	0.002	-0.008
Energy used in education based journeys as a proportion of total energy used in all sectors (%)	0.0003	0.00003	-0.0002
CO2 emitted by education based journeys per school day (tonnes)	1382.14	279.51	-1102.63
CO2 emitted by education based journeys as a proportion of total CO2 emitted by road transport (%)	0.41	0.08	-0.33
CO2 emitted by education based journeys as a proportion of total CO2 emitted by all sectors (%)	0.10	0.02	-0.08

The next stage of this research is to test the impacts of the school choice policy on secondary school pupils (aged over 10). It is expected that the results will be significantly different as Chapter 2 explained older pupils are less reliant on the personal car as younger children.

The MMNL summary statistics for pupils aged over 10 years are listed in table 7.13 and the results are presented in Table 7.14 and the quantifications of the transport impacts are presented in Table 7.15 and the environmental impacts are presented in Table 7.16.

Mode share for car and NMT is slightly lower than for the whole pupil population, but the share for bus and OPT is much higher than for younger pupils as expected. Similarly, the maximum distance travelled to current school is slightly less than for secondary school pupils, but again still suggests that pupils of both ages are willing to travel significant distances to attend a school of their choice as oppose to the school closest to their home.

Table 7.13: Summary statistics for pupils aged over 10 years

Variable	Observations	Mean	Std. Dev.	Min	Max
Transport mode	36,511	Car=23.3%; Bus=25.4%; NMT=49.0% and other PT=2.4%			
Trip Characteristics					
Distance to current school (mile)	37,003	1.742	2.40	0	106.35
Distance to nearest school (mile)	32,999	0.825	0.96	0	24.12
Monetary cost of the trip (£)					
Cost of car (£)	36,475	0.44	1.43	0	106.35
Cost of bus (£)	36,475	0.28	0.50	0	1.20
Cost of NMT (£)	36,475	0.00	0.00	0	0.00
Cost of other public transport (£)	36,475	0.50	0.88	0	40.77
Personal characteristics					
Age (year)	37,003	14.084	2.145	11	21
Gender (Female=1, Male=0)	37,003	0.508	0.500	0	1
Free school meal (Yes=1, No=0)	37,003	0.142	0.349	0	1
IDACIscore (% range 0 to 1)	37,003	0.220	0.181	0.01	0.996
Ethnicity					
Asia (excluding Chinese)	37,003	0.077	0.266	0	1
Black	37,003	0.041	0.199	0	1
Chinese	37,003	0.004	0.059	0	1
Mixed	37,003	0.032	0.176	0	1
White	37,003	0.823	0.382	0	1
Other	37,003	0.024	0.152	0	1
Roadway density km / sq km	37,003	12.696	7.979	0	59.49

Table 7.14 MMNL Results for pupils aged over 10 years

Age>10	Mixed Multinomial Logit (MMNL) Model					
Alternative specific variable	**Coefficient**			**t-statistics**		
Cost (generic)	-4.069			-33.61		
	BUS		NMT		Other PT	
	Coefficient	t-stat	Coefficient	t-stat	Coefficient	t-stat
Alternative specific constants	-0.2877	-1.44	-1.0861	-7.93	-0.5277	-1.28
Pupil specific variables						
Distance	-3.7325	-30.3	-7.1578	-52.3	-3.4978	-28.4
Age	0.2639	28.2	0.3297	31.05	0.2804	12.51
Gender (Female=1, Male=0)	-0.1409	-3.78	-0.2645	-6.76	-0.1098	-1.19
Free school meal (Yes=1, No=0)	0.4992	8.75	0.3912	6.44	0.2981	2.01
IDACI Score	1.3950	11.66	0.4116	3.23	0.3153	1.03
Ethnicity						
Asia	-0.5882	-8.4	-0.9274	-13.6	-0.6856	-3.41
Black	1.0204	11.01	-0.1496	-1.38	1.1652	6.27
Chinese	-0.8395	-2.69	-0.7621	-2.38	-0.2277	-0.4
Mixed	0.3448	3.47	-0.2437	-2.21	0.6554	3.04
Other	0.5056	4.43	-0.2987	-2.18	1.0915	5.24
White (Reference)						
Roadway density (km/sq km)	0.0121	4.64	0.0118	4.24	0.0366	6.04
Random parameters (S.D.)						
Cost (generic)	0.468			12.45		
Distance			1.478	34.08		
Statistics						
Pseudo R-square	0.38					
Log-likelihood at convergence	-27,538					
Observations	34,402					

Table 7.15: Quantification of the transport-related impacts for pupils aged over 10

Mode	Percentage of Mode Share (%)	Average one way distance (miles)	Total pupil mileage per day (two way, millions)	Total education passenger mileage per year (millions)	Total passenger mileage per passenger per annum	Vehicle miles travelled for education based journeys per school day two way (millions)	Vehicle miles travelled for all trip purposes per day (millions)	Total vehicle miles travelled on a school day (%)
CURRENT SCHOOL								
Car	0.27	1.89	3.30	627.92	5,849	3.30	813.43	0.65
Bus	0.21	3.27	4.55	864.15	277	0.41	38.52	11.81
Walk/Cycle	0.49	0.71	2.31	438.68	242	-	-	-
Other PT	0.04	4.99	1.41	267.21	768	0.35	27.68	0.66
Total	-	-	11.57	2,197.96	7,136	-	879.63	-
NEAREST SCHOOL								
Car	0.20	0.76	0.99	188.31	5,849	0.99	813.43	0.19
Bus	0.12	1.55	1.25	236.65	277	0.11	38.52	3.23
Walk/Cycle	0.67	0.50	2.21	420.45	242	-	-	-
Other PT	0.01	1.08	0.09	16.64	768	0.02	27.68	0.04
Total	-	-	4.54	862.05	7,136	-	879.63	-
DIFFERENCE								
Car	-0.07	-1.13	-2.31	-439.61	-	-2.31	-	-0.46
Bus	-0.09	-1.72	-3.30	-627.50	-	-0.30	-	-8.58
Walk/Cycle	0.18	-0.21	-0.10	-18.23	-	-	-	-
Other PT	-0.03	-3.92	-1.32	-250.57	-	-0.33	-	-0.62
Total	-	-	-7.03	-1,335.91	-	-	-	-

Table 7.16 Environmental impacts of the school choice policy for pupils aged over 10

Transport Related Impact Parameters	Current	Nearest	Difference
Petrol used - education based journeys per school day (tonnes)	184.15	46.04	-138.11
Diesel used - education based journeys per school day (tonnes)	376.19	73.53	-302.66
Petrol used in education based journeys as a proportion of total petrol used in road transport (%)	0.54	0.13	-0.41
Diesel used in education based journeys as a proportion of total diesel used in road transport (%)	1.95	0.38	-3.53
Energy used in education based journeys per school day (TJ)	24.72	3.27	-21.45
Energy used in education based journeys as a proportion of total energy used in road transport (%)	0.017	0.004	-0.013
Energy used in education based journeys as a proportion of total energy used in all sectors (%)	0.0004	0.0001	-0.0003
CO2 emitted by education based journeys per school day (tonnes)	1745.34	481.74	-993.87
CO2 emitted by education based journeys as a proportion of total CO2 emitted by road transport (%)	0.52	0.14	-0.38
CO2 emitted by education based journeys as a proportion of total CO2 emitted by all sectors (%)	0.13	0.04	-0.09

Pupils aged over 10 years (37,003 pupils from the original sample) show fairly similar trends to primary school pupils in so much as motorised transport falls if the school choice policy is removed, however the extent of these changes is quite different. The coefficient of roadway density is found to be statistically significant and positive for all modes of transport (but is not for primary) meaning that secondary school pupils are less likely to travel to school by car.

Similarly, as distance increases, secondary school pupils are more likely to use the personal car in their journey to school. As pupils get older, they are more likely to use the *Bus, NMT* or *OPT* than the personal car. A significant difference between the two age groups is the likelihood of travelling via *NMT* as oppose to the car which is positive for primary school pupils but negative for secondary school pupils.

From a transport perspective, the results suggest that if secondary school children over the age of 10 travelled to their nearest school, instead of the school of their choice the transport-related benefits would quite significant especially as older pupils are more likely to travel further as they have more independence than younger pupils.

The model shows that if all secondary pupils travelled it their nearest school instead of a chosen school car use would fall from 27% modal share to 20%, although still a drop it is not as dramatic as the decrease shown in the primary pupil results, however as stated, car use in primary pupil travel to school is much higher than for secondary pupils.

Bus use on the other hand is much higher for older pupils but if the policy was changed, would decrease from around 20% to 12%. NMT through walking and cycling would still rise from around 49% to 67%. Overall, this change in policy would mean a reduction in VMT by car of 0.5% and of 9% by bus per day.

From an environmental perspective, the amount of petrol used per day could be reduced from over 184 tonnes to just over 46 tonnes. A greater reduction in bus travel could result in a reduction in the amount of diesel used daily by over 300 tonnes a day. The amount of CO_2 generated per day could be reduced by over 990 tonnes per day as a result of less car and bus usage.

Table 7.17 compares the findings of the 2 mixed multinomial logit models of this study. Most of the findings were statistically significant (**) showing that the variables included in the model do have an impact of school travel behaviour. When testing the pupils in 2 separate age groups, some of the findings of primary school aged pupils were found to be statistically insignificant particularly ethnicity variables. However, this is still reasonable, as younger pupils are more likely to have their travel behaviour influenced by their age as opposed to other factors.

Table 7.17 Significance of Results

	Total			Pupils Aged 10 and Under			Pupils Aged Over 10		
Alternative specific variable (vector z)	**Coefficient**			**Coefficient**			**Coefficient**		
Cost (generic)	-2.4996 **			0.3442 **			-4.069 **		
Mode of Travel Car Reference	BUS	NMT	OPT	BUS	NMT	OPT	BUS	NMT	OPT
	Coeff	Coeff	Coeff	Coeff	Coeff	Coeff	Coeff	Coeff	Coeff
Alternative specific constants	-2.837 **	0.5846 **	-1.7878 **	-3.8116 **	2.6164 **	-3.655 **	-0.2877	-1.0861 **	-0.5277
Pupil specific variables (*vector x)*									
Distance	-2.2743 **	-5.852 **	-2.0669 **	-0.2660 **	-4.7452 **	0.0963	-3.7325 **	-7.1578 **	-3.4978 **
Age	0.3146 **	0.1949 **	0.1892 **	0.0689 **	-0.0463 **	-0.0814 **	0.2639 **	0.3297 **	0.2804 **
Gender (Female=1, Male=0)	-0.0892 **	-0.0962 **	-0.2048 **	0.0098	0.004	-0.4514 **	-0.1409 **	-0.2645 **	-0.1098
Free school meal (Yes=1, No=0)	0.5960 **	0.4076 **	1.0900 **	0.7575 **	0.6054 **	2.1925 **	0.4992 **	0.3912 **	0.2981 **
IDACI Score	1.6308 **	0.9815 **	0.6176 **	2.1559 **	1.2644 **	1.2878 **	1.395 **	0.4116 **	0.3153
Asia	-0.4711 **	-0.5602 **	-0.5217 **	-0.2094	-0.4087 **	-0.0629	-0.5882 **	-0.9274 **	-0.6856 **
Black	1.0091 **	-0.0392	0.8024 **	1.185 **	0.0435	-0.0973	1.0204 **	-0.1496	1.1652
Chinese	-0.6298 **	-0.4992 **	-0.1122	0.2239	-0.4119	0.6591	-0.8395 **	-0.7621 **	-0.2277
Mixed	0.3192 **	-0.1405 **	0.4413 **	0.3531 *	-0.0566	0.0599	0.3448 **	-0.2437 **	0.6554 **
Other	0.6384 **	0.2810 **	0.8181 **	0.5815 **	0.0307	-0.332	0.5056 **	-0.2987 **	1.0915 **
White (Reference)									
Roadway density (km/sq km)	0.0052 **	0.0122 **	0.0129 **	-0.0096 *	0.0093 **	-0.0311 **	0.0121 **	0.0118 **	0.0366 **
Random Cost (generic)	0.2619 **			0.2393 **			0.468 **		
Random Distance		1.7129 **			2.5669 **			1.478 **	

** Statistically Significant to a 95% confidence interval

* Statistically Significant to a 90% confidence interval

Statistically Insignificant

Table 7.18 shows the differences experienced if both primary and secondary pupils travelled to their nearest school instead of their current school.

Table 7.18 Quantification of the transport-related impacts for different age groups

Mode	Whole sample	Pupils aged 10 years and under	Pupils aged over 10 years
Percentage change in Mode Share (%)			
Car	-0.10	-0.14	-0.07
Bus	-0.05	-0.01	-0.09
Walk / Cycle	0.17	0.16	0.18
Other Public Transport	-0.02	-0.01	-0.03
Total pupil mileage per day (two way; millions)			
Car	-5.489	-3.17	-2.31
Bus	-4.152	-0.28	-3.3
Walk / Cycle	-0.515	-0.45	-0.1
Other Public Transport	-1.674	-0.31	-1.32
Total vehicle miles travelled on a school day (%)			
Car	-1.08	-0.62	-0.46
Bus	-10.77	-0.73	-8.58
Walk / Cycle	-	-	-
Other Public Transport	-1.61	-0.14	-0.62
Petrol used - education based journeys per school day (tonnes)	-290.66	-152.83	-138.11
Diesel used - education based journeys per school day (tonnes)	-501.66	-154.45	-302.66
CO2 emitted by education based journeys per school day (tonnes)	-2586.46	-1102.63	-993.87
CO2 emitted by education based journeys as a proportion of total CO2 emitted by road transport (%)	-0.78	-0.33	-0.38
CO2 emitted by education based journeys as a proportion of total CO2 emitted by all sectors (%)	-0.2	-0.08	-0.09

It can be seen from Table 7.18 that the changes in model share for car for younger pupils is double that for older pupils. It is also evident in the summary statistics that younger children travel by car more than older pupils. As a result, miles travelled by bus and other public transport and changes in modal share are much higher for older pupils than for the younger pupils.

To summarise, if primary and secondary school pupils in England travelled only to their nearest school instead of having the option of school choice allowing them to travel as far as they wish each day (usually via the personal car) both VMT and CO_2 emissions could be drastically reduced. Overall, this analysis has shown the dramatic reduction in daily vehicle miles travelled and CO_2 emissions just by changing the school choice policy in England. If this study were to be applied to other developed countries the results could be fairly significant.

CHAPTER 8 MODELLING THE IMPACTS OF HOME-TO-SCHOOL TRANSPORT

8.1 Introduction

This chapter presents the results of a series of multilevel (ML) linear regression models analysing the impacts of the home to school statutory bus provision policy in England.

This first part of this chapter will explore how the ML modelling was developed with summary statistics from the initial findings, followed by the results of school bus passenger mileage for three age groups of pupils (with and without London schools) followed by a simulation sensitivity study of the impacts on travel behaviour if budget / funding were removed for this policy.

The ML has been developed for three different age groups:

- Primary school pupils (aged less than 11)
- Secondary school pupils (aged from 11 to 16)
- Post 16 pupils (aged 17 years and above).

As discussed in Chapter 5, the statutory home-to-school transport provision (HTS) policy has been in place in England since 1944 and has remained relatively unchanged for the last 67 years. However, during the current time of financial uncertainty, the English Government as ordered a review of this policy. The purpose of this study is to investigate the current use of the HTS policy and to conduct a sensitivity test to determine the impacts on travel if this policy was removed.

The HTS policy will be investigated using two sets of data: (1) modelling all Government maintained schools in England and (2) modelling all Government maintained schools in England excluding all schools based in London.

The first section of this chapter will present a summary of the multilevel linear regression model used in this analysis and how the key variables have been calculated, next it will present the findings the results of the ML regression models for the data with and without London schools. Finally, the results of the sensitivity testing of the models will be presented and discussed.

8.2 ML modelling and the Variables

A multilevel linear regression model (ML) has been used (as discussed in Section 4.6) to analyse the impacts of the home-to-school transport provision (HTS) policy on bus passenger mileage by schools employing data from the two levels: the school level factors and the local authority (LA) factors. Since schools from a local authority (LA) experience the same HTS policy, it is considered that the impact of this policy on the school-level bus passenger mileage would be correlated across schools that are located in the same LA. Therefore, a multilevel model is more appropriate as the data are hierarchically nested. Figure 8.1 outlines the variables used in the ML models for each of the two levels (i.e. school and LA).

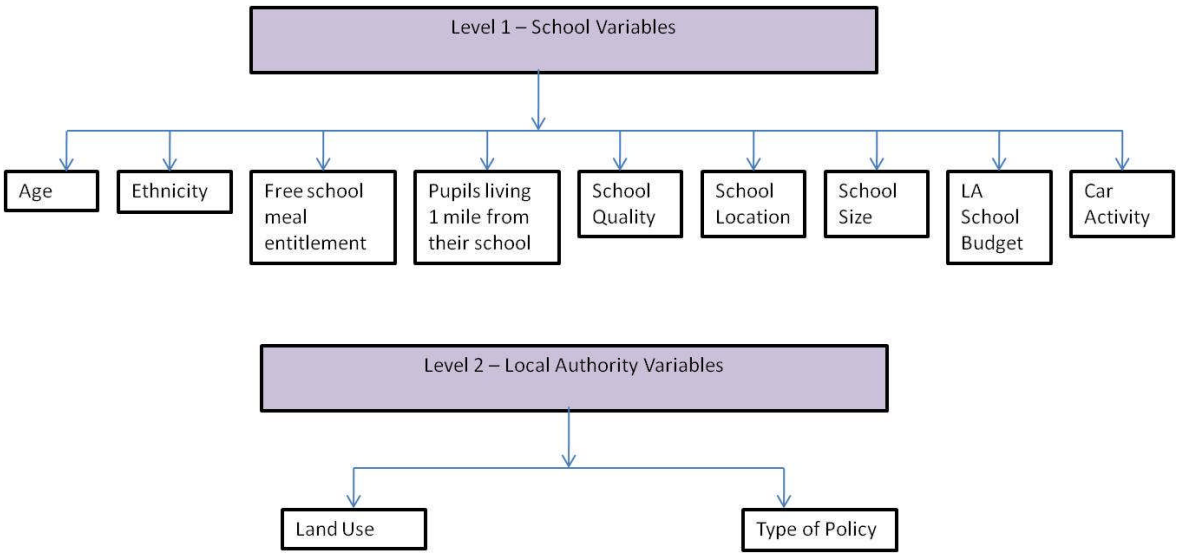


Figure 8.1 Multilevel Variables

Level 1 focuses on the school level variables obtained from the School Census 2009 including both school and pupil characteristics. Level 2 focuses on local authority related variables such as the area characteristics and policies offered and the relevant data were obtained from a number of sources such as the Census 2001 and an internet survey (see Chapter 6 for details).

School related variables include the factors relating to the pupils which attend the school. These include age, proportion of pupils from a white ethnic background, proportion of pupils entitled to free school meals (from low income families) proportion of pupils living within one mile of the school), school factors (such as average academic achievement scores i.e. Key Stage 2 for primary school, GCSE grades for secondary pupils and A-level grades for Post 16), how many pupils attend each school (i.e. school size), the total LA budget per school and average car activity which occurs around the school area.

Level 2 includes the main LA factors such as land use (e.g. where the LA is located including rural, urban, metropolitan, inner London and outer London) and the type of policy offered to school with the LA (i.e. generous or standard). The dependent variable in each of the groups is the total school-level bus passenger mileage that is calculated as follows:

$$Total\ bus\ mileage\ for\ a\ school = \sum_{k=1}^{K} BusDistance_k$$

in which *K* refers to the number of pupils of the school who use 'buses' for home-to-school trips; *BusDistance* is the trip distance by bus for pupil *k* in that school. Data for *K* and *BusDistance* are obtained from School Census 2009.

Using the postcode of a school and the trip distances related to the school (i.e. trips made by the pupils of that school), it is possible to calculate the percentage of pupils who live within a 1-mile distance (i.e. trip distances<1 mile) from their current school. It is hypothesised that if this percentage is high for a school then the total bus passenger mileage for the school would be low as more pupils would travel by foot.

The number of passenger cars registered within a school's neighbourhood (i.e. car activity around a school) may also affect the level of pupil-miles travelled by bus. This can be achieved by summing up the registered cars within the Lower Layer Super Output Area (LLSOA) where the school is located and all other cars registered in the neighbouring LLSOAs weighted by the inverse of the centre-to-centre distance. A gravity model can therefore be employed to obtain the total number of registered cars that may travel in a LLSOA (where the school is located) from its neighbouring LLSOAs:

$$Registered\ cars\ from\ the\ \ neighbouring\ LLSOAs = \sum_{m=1}^{M} \frac{Car_m}{D_{lm}} \qquad l \neq m$$

in which Car_m is the total number of cars registered in LLSOA *m* which is neighbour to LLSOA *l* where a school is locatedD_{lm} is the Euclidean distance (miles) between LLSOA *l* and *m*; *M* is the total number of neighbouring LLSOAs. It is anticipated that if car activity around a school is high then pupils from that school are more likely to make trips by car rather than bus and therefore, total pupil-miles travelled by bus would be less.

One of the primary variables in the analysis is the LA budget that is allocated for home-to-school public transport provision and subsidies. Therefore, a variable – *LA budget by school* is calculated as follows:

$$LA\ Budget\ for\ a\ school\ = The\ average\ spending\ by\ a\ LA\ for\ a\ bus\ user\ per\ year * total\ bus\ users\ of\ the\ school$$

Therefore, LA budget for each of the schools is calculated and on an average per school, this is £11,467 for primary schools, £68,332 for secondary schools and £21,326 for post 16 schools.

As stated in the introduction, the model will be tested using two sets of data: (1) all state schools in England and (2) all state schools excluding the schools within London. This is because there was a concern that the inclusion of the schools from London could affect the final results as (as seen in Chapter 6) all London LAs (with the exception of Merton) offer a 'generous' policy through allowing all pupils to travel for free on all modes of public transport in central London. In the model London has 2,646 schools in total (see Table 8.1)

Table 8.1 Schools in London

School Type	Inner London	Outer London	Total
Primary	1158	633	1791
Secondary	385	166	551
Post 16	224	80	304

Also, the majority of budget / spending for London LAs is very low because Transport for London (TfL) funds the majority of travel subsidy.

An example of this is Lambeth Council. Lambeth Council (in 2009-2010) had 1.3 million primary school pupils, 168,000 secondary school pupils and 51,000 Post 16 pupils attending schools in the LA. However, both the SEN and Non-SEN spending for Lambeth was £0 for all age groups. Therefore, to include London based examples such as Lambeth in the analysis could result in unrealistic results. For this reason the ML model has been run with and without London schools.

8.3 Summary Statistics of the Variables

Tables 8.2 – 8.4 illustrate the summary statistics of the variables to be included in the models for each of the 3 age groups. These will be discussed in turn.

Table 8.2 Summary Statistics of the Variables Associated with the Primary Schools

Primary Schools					
Variable	**Observations**	**Mean**	**Std. Dev.**	**Min**	**Max**
Bus passenger mileage (by school for single home to school trip)	11803	25.1551	57.5410	0	1861.08
% of pupils entitled to free school meals	11819	17.2328	14.4203	0	100
% of white pupils	11819	75.8263	27.5755	0	100
% of pupils living within 1 mile of school	11819	72.4539	23.9187	0	100
All car activity around school	9845	934.588	246.4843	343.0274	2309.482
Number of pupils at school	11819	248.6218	138.137	1	972
Average KS2 Grades	9107	27.7146	2.2054	15	32.7
LA Budget by school (000)	11819	11.4670	30.0821	0	905.8733
LA fare policy (Standard=1, Generous=0)	11819	0.8263	0.37887	0	1
Rural Schools	11819	0.4475	0.4973	0	1
Urban Schools	11819	0.1472	0.3543	0	1
Metro Schools	11819	0.2537	0.4352	0	1
Inner London Schools	11819	0.0980	0.2973	0	1
Outer London Schools	11819	0.0536	0.2252	0	1

The primary school analysis has the most observations due to there being more primary schools in England. Primary schools generate the least school bus passenger mileage of all the age groups as expected.

As a result primary schools also generate the highest levels of car activity around the schools, even though the average LA spending on school transport per primary school is just over £11,400.

On average, 17% of primary school pupils are entitled to free school meals within a school and there is a significantly high proportion of white pupils attending primary school, although this is the lowest mean value of all the three age groups.

Primary schools have the highest proportion of pupils living within one mile of their current school. This supports previous findings of primary school age pupils having the highest levels of walking to school than older pupils.

Table 8.3 Summary Statistics of the Variables Associated with the Secondary Schools

Secondary					
Variable	**Observations**	**Mean**	**Std. Dev.**	**Min**	**Max**
Bus passenger mileage (by school for single home to school trip)	4000	755.3125	996.6127	0.26	8846.09
% of pupils entitled to free school meals	4001	17.7833	15.6659	0	100
% of white pupils	4001	82.1023	23.2581	0	100
% of pupils living within 1 mile of school	4001	41.1439	24.6193	0	100
All car activity around school	3935	942.4066	210.4412	344.5559	1871.117
Number of pupils at school	4001	755.4501	462.5329	1	2404
Average GCSE results	3243	0.4682	0.2309	0	1
LA Budget by school (£000)	4001	68.3329	108.4076	0	851.8569
LA fare policy (Standard=1, Generous=0)	4001	0.8555	0.3516	0	1
Rural Schools	1951	0.4876	0.4999	0	1
Urban Schools	4001	0.1567	0.3636	0	1
Metro Schools	4001	0.2179	0.4129	0	1
Inner London Schools	4001	0.0962	0.2949	0	1
Outer London Schools	4001	0.04149	0.1994	0	1

Secondary schools generate the most school bus passenger mileage of all the age groups. This could be due to two key reasons: Firstly, on average, just under half of secondary school pupils live within 1 mile of their school. Secondly, an average of 18% of secondary school pupils are entitled to free school meals, as with primary school pupils. As free school meal entitlement is usually associated with low household income, this could lead to pupils travelling to school more by school bus. As expected, as secondary schools generate the most school bus passenger mileage, the average LA spending per school on school transport provision is the highest for secondary schools at £68,000 per school.

Table 8.4 Summary statistics of the variables associated with Post 16 schools

Post 16					
Variable	**Observations**	**Mean**	**Std. Dev.**	**Min**	**Max**
Bus passenger mileage (by school for single home to school trip)	2008	115.7528	161.1366	0.33	2432.62
% of pupils entitled to free school meals	2008	9.0705	14.4111	0	100
% of white pupils	2008	79.5394	24.6311	0	100
% of pupils living within 1 mile of school	2008	33.2749	21.2902	0	100
All car activity around school	2007	961.0058	204.7189	400.8833	1803.596
Number of pupils at school	2008	87.0757	62.7913	1	685
Average A-Level results	1541	197.9694	21.5181	50.2	256.3
LA Budget by school (£000)	1979	21.3258	51.1606	0	693.4854
LA fare policy (Standard=1, Generous=0)	2008	0.5049	0.5000	0	1
Rural Schools	2008	0.4975	0.50012	0	1
Urban Schools	2008	0.1404	0.3475	0	1
Metro Schools	2008	0.2107	0.4079	0	1
Inner London Schools	2008	0.1116	0.3149	0	1
Outer London Schools	2008	0.0398	0.1956	0	1

Finally, Post 16 schools generate around 115 miles of bus travel per school, which is much higher than primary school pupils, but much lower than secondary school pupils.

As expected, Post 16 pupils have the lowest average number of pupils entitled to free school meals per school, and the lowest average number of pupils attending a school. In England, pupils are not required to stay in education after the age of 16. For this reason, Post 16 schools have fewer pupils in attendance than primary and secondary schools. However, Post 16 schools receive on average £21,000 per school for school transport provision even though according to the Education Act 1944, LAs are not required to provide free transport to pupils over the age of 16.

One key fact of the summary statistics tables is that the average bus passenger mileage by school (i.e. the dependent variable of the ML model) is found to be 25 miles for primary schools, 755 miles for secondary schools and 115 miles for Post 16 schools. This suggests that bus passenger mileage is the highest for secondary schools due to the high numbers of bus users within this age group. On average secondary schools have 234 bus users per school compared to 30 per Post 16 school and 13 bus users per primary school (as recorded in the School Census).

The next section will explain how these variables have been analysed in the multilevel (ML) model.

8.4 ML Modelling Results for All Schools

The objective of this modelling exercise is to investigate whether the HTS policy (in particular, LA policy and budget) has an impact on the school bus travel while controlling for other factors related to both school and LA. The estimation models are then employed to test the impacts on school bus travel if both these variables are removed from the models.

In order to achieve this, ML linear regression models have developed using two data sets: with all schools and with all London school excluded. The variable *percentage of pupils eligible for free school meals* is excluded from the secondary schools model as this variable has found to be highly correlated with the *school quality* variable. This is however not the case for the other two models.

The random intercept ML linear regression models (as discussed in Chapter 4, section 4.6) that were developed as a starting point for the analysis indicated that over 86% of the variation in total bus passenger mileage is explained by the school-level factors only (see Table 8.5 below). This suggests that more complex models such as random coefficients ML models could be avoided (Heck and Thomas, 2009).

The dependent variable *school-level bus passenger mileage* was transformed into a logarithmic scale as this variable should be non-negative and hence this transformation would avoid the potential problem of obtaining a negative predicted value of bus passenger mileage. In order to reduce the variance among the variables, *school size* was also transformed into a logarithmic scale and *LA budget by school* was divided by 1,000.

Due to correlation, car ownership rate at the area where the school is located has been excluded from the model as this is highly correlated with the variable *car activities around a school* (a correlation coefficient of 0.91). All other variables are uncorrelated with each other.

Since the dependent variable (*bus passenger mileage*) was transformed into a logarithmic scale, the effect of explanatory variables on school-level bus usage from the estimated models needs to be quantified carefully. Since school size was also transformed into a logarithmic scale, its coefficient represents 'elasticity' suggesting that 1% increase in school size (i.e. number of pupils) the total bus passenger mileage would increase by 0.73% for the case of secondary schools (see Table 8.5).

For all other variables, the following formula is used to estimate the percentage change in bus passenger mileage for a δ unit change in an explanatory variable:

$$100 \times \{\exp(\beta_j \delta) - 1\}$$

In which β_j is the estimated coefficient of the *j*-th explanatory variable as shown Table 8.5.

Table 8.5 ML Including London

	Multi-Level (ML) Modelling Results					
	Primary		**Secondary**		**Post 16**	
	Coefficient	t-stat	Coefficient	t-stat	Coefficient	t-stat
Dependent variable: ln(Bus Passenger Mileage)						
School-level Variables						
% of pupils entitled to free school meals	0.0116	10.3	-	-	0.003	0.8
% of white pupils	-0.0008	-1.4	0.0033	3.32	0.0027	2
% of pupils living within 1 mile of school	-0.0347	-48.8	-0.0344	-39.84	-0.0343	-28.5
All car activity around school	-0.0001	-1.5	-0.0001	-1.31	-0.0001	-0.6
ln(school size)	0.3958	15.9	0.7284	23.72	0.957	19.9
School achievement	-0.0356	-5.9	0.4506	5	0.0028	2.2
LA budget by school in thousand	0.015	40.3	0.0041	21.07	0.0044	9.2
Local Authority-level Variables						
LA fare policy (Standard=1, Generous=0)	-0.2171	-0.8	0.0752	0.35	0.1266	1.4
Urban area	-0.043	-0.5	-0.0740	-1.06	-0.2714	-2.9
Metropolitan Area	0.0115	0.1	0.2545	3.56	-0.0103	-0.1
Inner London Area	0.6151	2.3	0.7180	3.19	0.1712	1.3
Outer London Area	0.8202	2.9	0.7221	2.96	0.1522	0.9
Rural (Reference)						
Intercept	3.5620	10.37	1.7749	6.27	0.2756	0.8
Intercept S.D. (u_0)	0.3416	14.27	0.2259	9.09	0.2597	7.51
Error S.D. (ε)	0.8634	127.81	0.8200	78.48	0.8085	53.16
Statistics						
Pseudo R-square	0.4		0.32		0.43	
Log-likelihood at convergence	-10791.17		-4058.52		-1941.53	
Number of Observations	8,325		3,241		1,537	
Number of groups (i.e. LAs)	147		146		136	
Intraclass Coeff	0.135		0.071		0.094	

The signs of the coefficients are consistent across the three models except the variable - *school achievement*. When modelling all schools including London most of the school level variables are found to be statistically significant for all three age groups, particularly secondary school pupils with the exception of two variables – *all car activity around school* and *LA fare policy*. As expected, *LA budget by school* is found to be statistically significant and positive across all three age groups. The result indicates the likelihood of bus passenger mileage increasing when LA spending by school increases.

The results show that distance is a significant factor in school bus travel as the variable *percentage of pupils living within 1 mile* is found to be statistically significant and negative suggesting that bus passenger mileage reduces when more pupils attending a school live within 1 mile. *School size* is also found to be statistically significant but positive for all three age groups implying that when schools have more pupils, bus passenger mileage increases. This variable acts as the primary controlling factor of bus passenger mileage in the models.

The elasticity of bus passenger mileage with respect to school size is high (0.96%) for the case of post 16 schools relative to that of for the secondary (i.e. 0.73%) and primary (0.4) schools.

Surprisingly, the variable of policy (in this case *standard* with reference to a *generous* policy) is found to be statistically insignificant for all schools. This result implies that school level factors have more of an influence on school bus travel than local authority factors.

It is noticeable from Table 8.5 that the variable – *school achievement* has a mixed effect on the school-level bus passenger mileage. For instance, it shows a negative sign in the case of primary schools but exhibits a positive sign for the secondary and post 16 schools. The value of the coefficient is very high for the case of secondary schools suggesting that pupils from the secondary schools tend to travel more distances by bus if the quality of the school is good.

In terms of geographical variations, the results suggest that school-level bus passenger mileage for schools (primary and secondary) within London is higher relative to schools from rural LAs. There is no difference in bus passenger mileage among Post 16 schools from Inner, Outer and metropolitan areas although urban schools shows less bus passenger mileage compared with rural schools. Overall, this shows an expected result.

8.5 Modelling Results: Excluding London Schools

Even though the above results do provide reasonable results, it would be logical to re-estimate the models without London based schools. As discussed above, pupils in London receive free school travel as funded by TfL and therefore LA spending by school is very low. Bus passenger mileage is however likely to be high when it is free to all pupils.

For this reason, the models have been re-estimated (with the same set of explanatory variables) without the inclusion of London schools and the results are presented in Table 8.6.

Table 8.6 Multilevel Modelling Results EXCLUDING London schools

All Schools	Multi-Level (ML) Modelling Results					
	Primary		**Secondary**		**Post 16**	
	Coefficient	t-stat	Coefficient	t-stat	Coefficient	t-stat
Dependent variable: ln(Bus Passenger Mileage)						
School-level Variables						
% of pupils entitled to free school meals	0.009	7.07	-	-	0.0047	1.02
% of white pupils	0.0004	0.65	0.0059	5.33	0.0051	3.11
% of pupils living within 1 mile of school	-0.0326	-42.08	-0.0352	-38.02	-0.0347	-26.46
All car activity around school	-0.0001	-1.18	-0.0001	-0.69	0.00002	0.19
Log(school size)	0.3218	11.68	0.6928	21.14	0.9200	17.05
School achievement	-0.0355	-5.34	0.5822	6.11	0.0049	3.56
LA budget by school in thousand	0.0153	39.79	0.004	20.22	0.0044	8.92
Local Authority-level Variables						
LA fare policy (Standard=1, Generous=0)	-0.4539	-1.22	0.1443	0.54	0.0819	0.89
Urban area	-0.0163	-0.18	-0.0534	-0.77	-0.2575	-2.74
Metropolitan area	0.0373	0.41	0.2851	3.97	0.0039	0.04
Rural (Reference)						
Intercept	3.9425	8.81	1.6345	4.94	-0.2664	-0.69
Intercept S.D. (u_0)	0.3606	12.75	0.237	8.47	0.2594	6.88
Error S.D. (ε)	0.8731	116.43	0.7948	73.18	0.8082	49.24
Statistics						
Pseudo R-square	0.19		0.31		0.27	
Log-likelihood at convergence	-9,024.80		-3,447.80		-1,662.40	
Number of Observations	6,901		2,808		1,309	
Number of groups (i.e. LAs)	114		114		106	
Intraclass Coeff	0.0941		0.0759		0.096	

The results of the two separate models present very similar findings in terms of the sets of statistically significant variables and the values of the coefficients. However, for the sensitivity tests, London schools will still be excluded because it is more logical to test the bus passenger mileage and budget of the LAs which do not offer such a generous policy to pupils and therefore offer a more realistic view of how travel behaviour would change.

Due to missing values in some of the explanatory variables (e.g. school quality), the actual number of observations employed in the models has reduced by 30-40% compared with the available observations (see Tables 8.5 and 8.6).

The models goodness-of-fit (GOF) is found to be very good (ranging from 0.19 to 0.31), especially for the models related to secondary and post 16 schools where LAs are currently spending the majority of their budget. The estimation of the random intercept models is justified as the standard deviation (S.D) of the intercept term is statistically significant in all of the models.

As shown in Table 8.6, the intraclass correlations estimated in different models ranges from 0.07 to 0.09 suggesting that only school-level factors explain over 90% variation in total bus passenger mileage. This means that the differences in characteristics between higher level groups (i.e. local authorities) are relatively small (i.e. less than 10%) and they (local authorities) do not differ each other significantly.

As expected, factors affecting school-level bus passenger mileage are varied for different school types. For instance, the percentage of *white pupils* has found to be statistically and positively significant in the secondary and post 16 but insignificant in the primary schools models. Although *school achievement* is found to be statistically significant in all three models, this variable is negatively associated with the total bus passenger mileage for the case of primary schools, but is positively associated with the total bus passenger mileage in the other two models. LA-level land-use variables also show a mixed-effect on bus passenger mileage.

Some of the controlling variables such as *school size* and *pupils living within 1 mile from the school* have shown the expected effect on the total bus passenger mileage. Across all age groups, the pupils that live within 1 mile of their school increases then total bus passenger mileage decreases and this is likely due to alternate modes of travel being available (such as walking and cycling).

At primary school age, pupils who receive free school meals from the Government are more likely to use the bus in their journey to school. The average grade achievement of a school is only positive for secondary school and Post 16 pupils. However, this could be the result of these grades having more impact on later life and therefore pupils are more willing to travel further to reach the schools with higher exam achievement. Geographical factors seem to have less impact on bus usage for primary school pupils; however, as parents can have safety concerns regarding young children travelling alone to school this is not unusual. Older children however, are more likely to use the bus in their journey to school when living in a rural area as oppose to more dense urban and metropolitan areas.

One of the key findings of this study is that LA budget is very statistically significant across all three age groups and that the model suggests that the higher an LA budget, the more bus passenger mileage expected from a school. More specifically, for a 1 unit decrease in LA budget by school (i.e. £1,000 for a school per year) the percentage decrease in bus passenger mileage would be 1.5% for primary schools, 0.4% for secondary schools and 0.43% for Post 16 schools, holding all other variables constant.

Only two land use variables were statistically significant in this model: *Metropolitan area* was significant and positive for secondary school bus travel and *Urban area* was significant and negative for Post 16 bus travel when compared to the reference variable of *Rural area*. These findings suggest that in the case of secondary schools, bus passenger mileage is higher in metropolitan areas compared to rural areas. This is likely to be due to pupils of secondary school age travelling more independently than younger pupils and having more transport options available to them than in rural areas. However, in the case of Post 16, the results are negative, suggesting pupils living in rural areas generate more bus passenger mileage than those living in urban areas. This could be due to pupils being more reliant on public transport in rural areas as generally schools are less accessible.

The next stage of this study is to estimate the changes in bus passenger mileage that would occur if LAs removed their bus provision policy and thus saving millions in their budget.

8.6 LA Budget Sensitivity Test

Now the model results have been presented, the next stage of this study is to test how much budget and spending affects school bus travel. As discussed in Chapter 2 and 5, during the current economic climate national and local Government are reviewing school transport provision to determine if the current £1 billion annual budget (for both SEN and non-SEN transport) is still key to encouraging pupils to travel to school by bus. Therefore, if removing the statutory school transport provision policy and £400 million funding (for non-SEN transport) makes little difference to how pupils travel to school, the Government could possibly consider reducing this annual spending and redistribute the sending to other areas of the educations sector.

To achieve this, the models (without the inclusion of London schools) have been re-estimated but this time with the policy variable removed as this is statistically insignificant in all models presented in Tables 8.7- 8.9.

8.6.1 Primary Schools

Looking first at the primary school results, Table 8.7 shows the differences which have occurred when the fare policy dummy variable (i.e. standard vs generous) has been removed from the model.

Table 8.7 Primary School ML Results

Primary Schools	Multi-Level (ML) Modelling Results			
	Model A: With the policy variable		Model B: Without the policy variable	
	Coefficient	t-stat	Coefficient	t-stat
Dependent variable: ln(Bus Passenger Mileage)				
School-level Variables				
% of pupils entitled to free school meals	0.009	7.07	0.009	7.12
% of white pupils	0.0004	0.65	0.0004	0.56
% of pupils living within 1 mile of school	-0.0326	-42.08	-0.0327	-42.11
All car activity around school	-0.0001	-1.18	-0.0001	-1.16
Log(school size)	0.3218	11.68	0.3223	11.70
School achievement	-0.0355	-5.34	-0.0353	-5.32
LA budget by school in thousand	0.0153	39.79	0.0153	39.78
Local Authority-level Variables				
LA fare policy (Standard=1, Generous=0)	-0.4539	-1.22	-	-
Urban area	-0.0163	-0.18	-0.0169	-0.19
Metropolitan Area	0.0373	0.41	0.0502	0.55
Rural (Reference)				
Intercept S.D. (u_0)	0.3606	12.75	0.3616	12.85
Error S.D. (ε)	0.8731	116.43	0.8731	116.43
Statistics				
Pseudo R-square	0.19		0.20	
Log-likelihood at convergence	-9,024.80		-9025.5019	
Number of Observations	6,901		6901	
Number of groups (i.e. LAs)	114		106	
Intraclass Coeff	0.0941		0.146	

The results have remained very similar and no dramatic changes can be seen in terms of the values of coefficients and their signs (i.e. *ln(school size* and *Urban area)*. This suggests that either of the models (i.e. Model A or Model B) could be used to estimate bus passenger mileage when LA budget by school is assumed to zero (i.e. no budget for school transport). Since the policy variable and LA budget variable are somewhat related (as a policy usually cannot exist without some form of budget or funding), it is more logical to employ Model B to predict bus passenger mileage when LA budget is taken as zero. Therefore, Model B has been used to predict the total bus passenger mileage in England with and without the variable - *LA budget by school*.

To test the validity of this prediction model Figure 8.2 shows the comparison of the observed bus passenger mileage with the predicted bus passenger mileage using Model B. The scatter plot shows that the model predicts bus passenger mileage well with the exception of a few outliers.

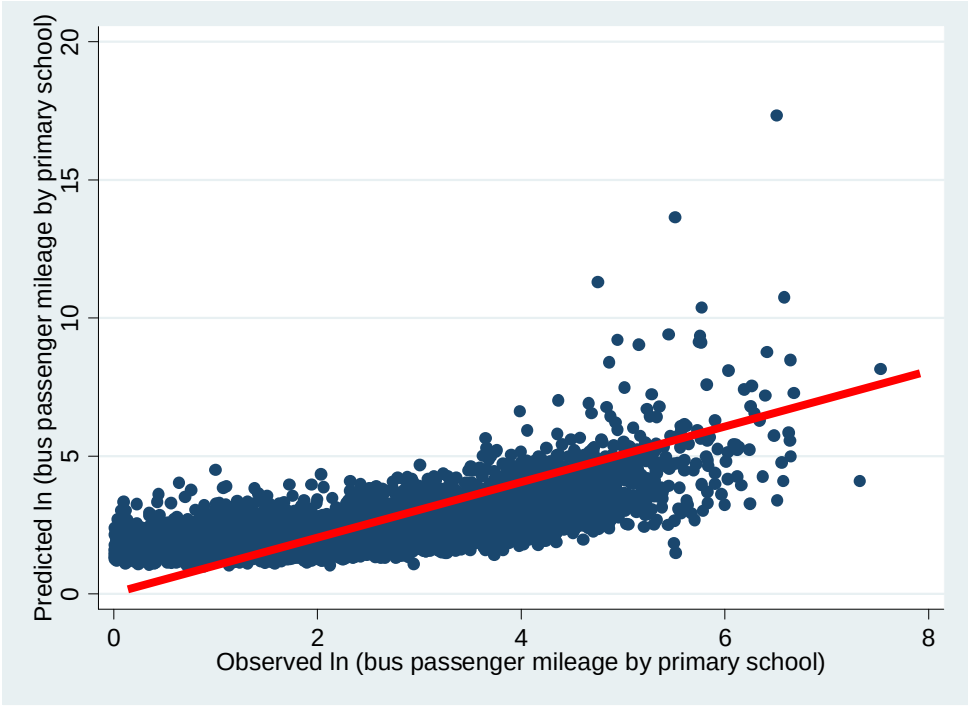


Figure 8.2 Bus Passenger Mileage for Primary Schools ML and Prediction

Figure 8.2 illustrates the scatter plot between the residuals squared (predicted using model B) and the observed bus passenger mileage. Since no clear pattern is observed it can be said that Model B can be used to predict bus passenger mileage (Gujarati, 2003).

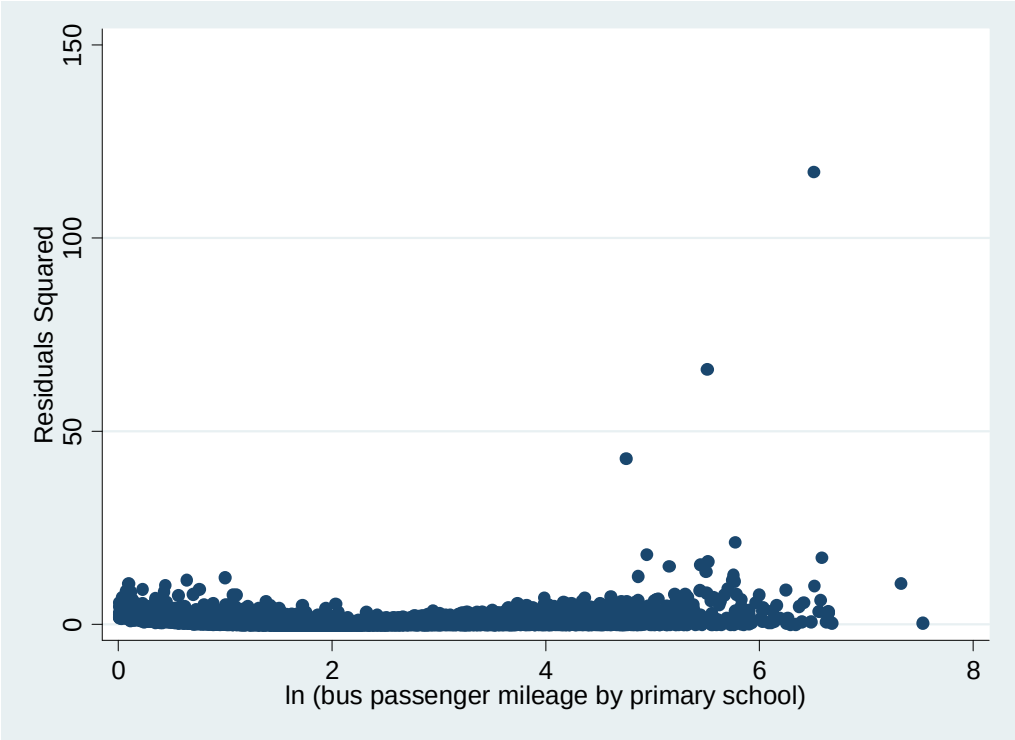


Figure 8.3 Residuals Squared for Primary School Analysis

8.6.2 Secondary Schools

Similar to the primary schools model, the ML linear regression model for the secondary schools also shows that there is no significant different between model A and model B (i.e. models with and without the policy variable). The results are presented in Table 8.8.

Table 8.8 Secondary School Results

Secondary Schools	Multi-Level (ML) Modelling Results			
	Model A: Models with the policy variable		Model B: without the policy variable	
	Coefficient	t-stat	Coefficient	t-stat
Dependent variable :ln Bus Passenger Mileage				
School-level Variables				
% of pupils entitled to free school meals	-	-	-	-
% of white pupils	0.0059	5.33	0.0059	5.32
% of pupils living within 1 mile of school	-0.0352	-38.02	-0.0352	-38.07
All car activity around school	-0.0001	-0.69	-0.0001	-0.67
Log(school size)	0.6928	21.14	0.6934	21.17
School achievement	0.5822	6.11	0.5819	6.11
LA budget by school in thousand	0.004	20.22	0.004	20.23
Local Authority-level Variables				
LA fare policy (Standard=1, Generous=0)	0.1443	0.54	-	-
Urban area	-0.0534	-0.77	-0.0498	-0.72
Metropolitan Area	0.2851	3.97	0.2887	4.05
Rural (Reference)				
Intercept S.D. (u_0)	0.237	8.47	0.227	8.47
Error S.D. (ε)	0.7948	73.18	0.7995	73.17
Statistics				
Pseudo R-square	0.31		0.30	
Log-likelihood at convergence	-3,447.80		-3447.56	
Number of Observations	2,808		2,808	
Number of groups (i.e. LAs)	114		106	
Intraclass Coeff	0.076		0.075	

Again, the plot between the observed vs predicted bus passenger mileage shows that the prediction from model B is in-line with the observed value (see Figure 8.4).

In addition, the plot between the residuals squared and the observed bus passenger mileage also do not exhibit any clear pattern suggesting that Model B can also be used to reliably predict bus passenger mileage for the case of secondary schools (see Figure 8.5).

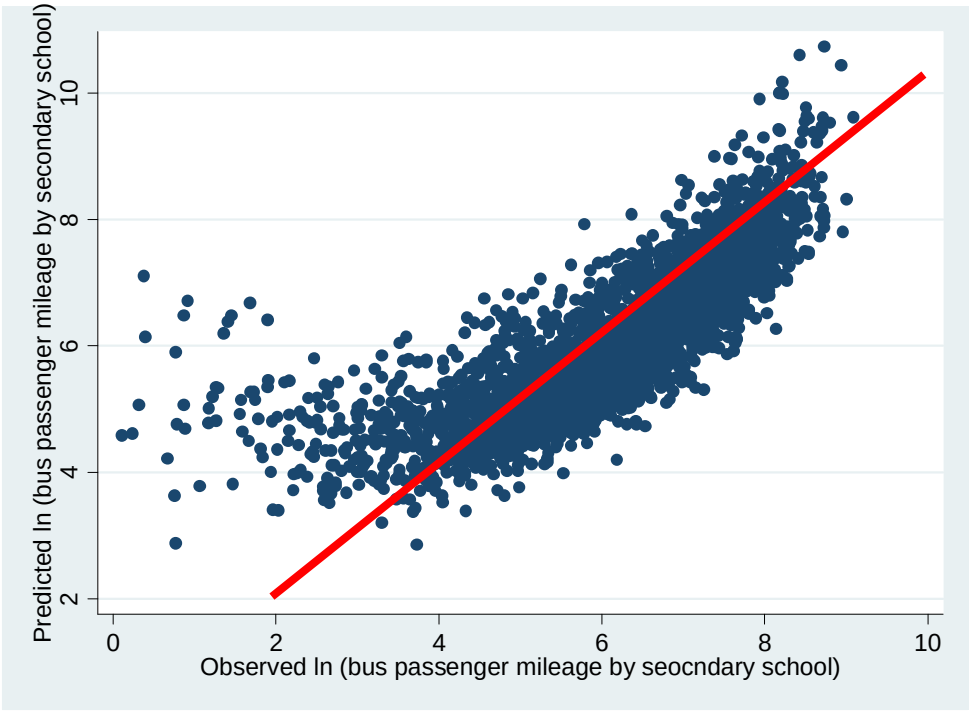


Figure 8.4 Bus Passenger Mileage for Secondary Schools ML and Prediction

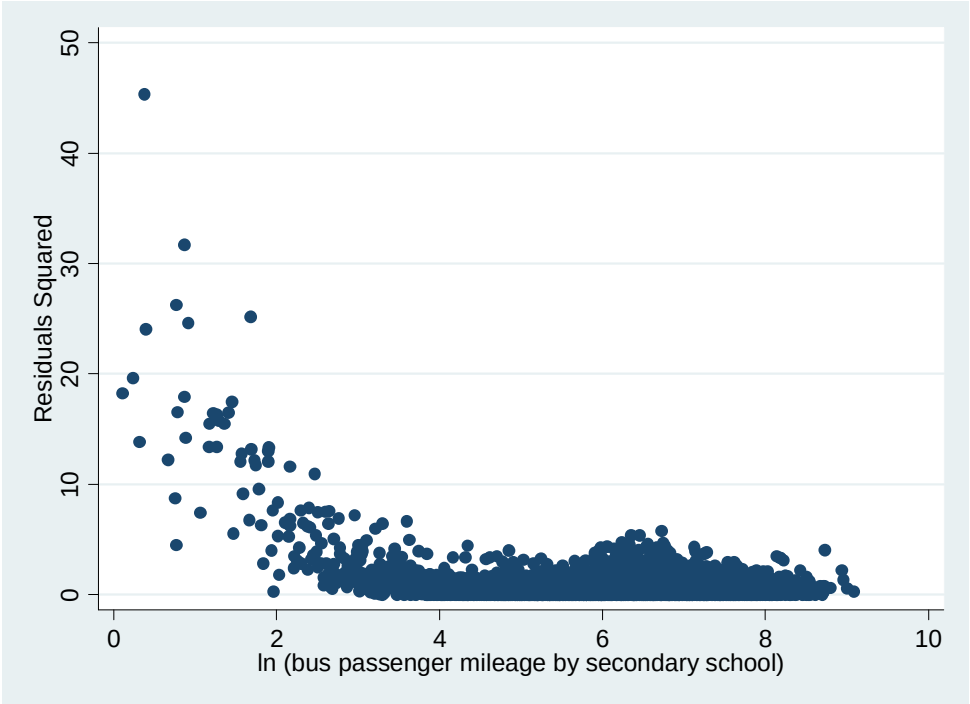


Figure 8.5 Residuals Squared for Secondary School Analysis

8.6.3 Post 16 Schools

Finally, examining the results of the Post 16 model, again, the statistical findings have remained fairly similar for both model A and model B for the case of post 16 schools (see Table 8.9).

Table 8.9 Post 16 ML Results

Post 16	Multi-Level (ML) Modelling Results			
	Model A: Models with the policy variable		Model B: Models without the policy variable	
	Coefficient	t-stat	Coefficient	t-stat
Dependent variable: ln Bus Passenger Mileage				
School-level Variables				
% of pupils entitled to free school meals	0.0049	1.06	0.0049	1.07
% of white pupils	0.0051	3.13	0.0053	3.27
% of pupils living within 1 mile of school	-0.0347	-26.46	-0.0347	-26.5
All car activity around school	0	0.19	0.0000	0.14
Log(school size)	0.9215	17.08	0.9202	17.05
School achievement	0.005	3.59	0.0049	3.53
LA budget by school in thousand	0.0043	8.86	0.0000	8.99
Local Authority-level Variables				
LA fare policy (Standard=1, Generous=0)	0.1202	1.32	-	-
Urban area	-0.2542	-2.72	-0.25432	-2.71
Metropolitan Area	0.0292	0.27	-0.04266	-0.45
Rural (Reference)				
Intercept S.D. (u_0)	0.2562	6.78	0.259204	6.95484
Error S.D. (ε)	0.8083	49.23	0.808167	49.25566
Statistics				
Pseudo R-square	0.27		0.264398	
Log-likelihood at convergence	-1,655.20		-1,661.47	
Number of Observations	1,309		1,309	
Number of groups (i.e. LAs)	106		106	
Intraclass Coeff	0.096		0.094	

Again, the scatter plot between the observed vs predicted (using model B) bus passenger mileage indicates that the prediction bus passenger mileages are very well in-line with the observed bus passenger mileages (see Figure 8.6). The residuals squared plot also do not exhibit any clear pattern suggesting that Model B can also reliably be used to predict bus passenger mileage for the case of post 16 schools (see Figure 8.7).

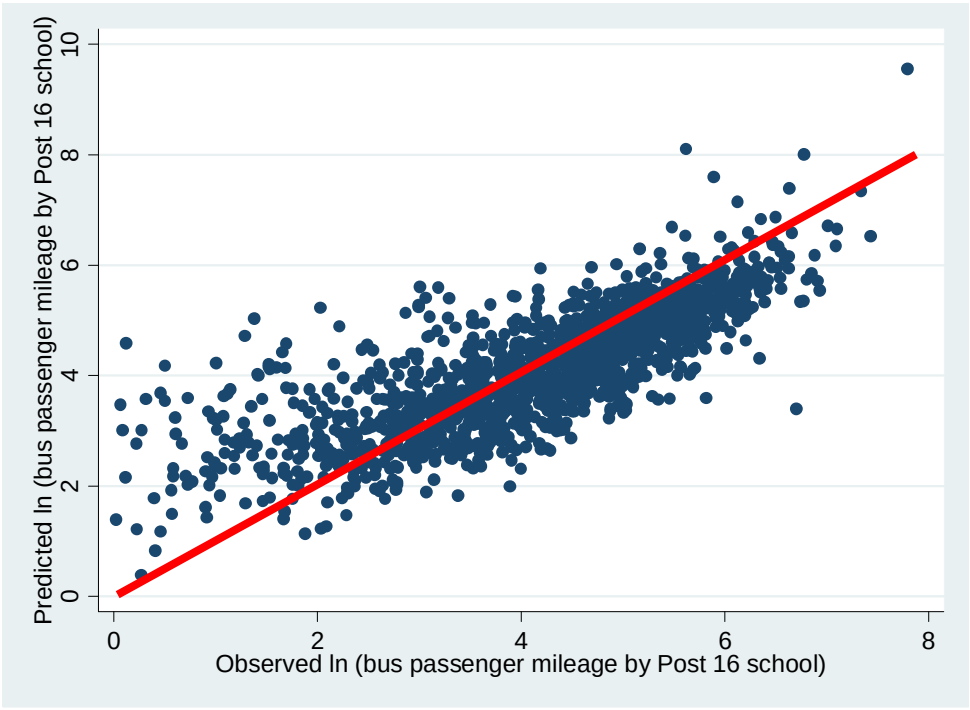


Figure 8.6 Bus Passenger Mileage for Post 16 ML and Prediction

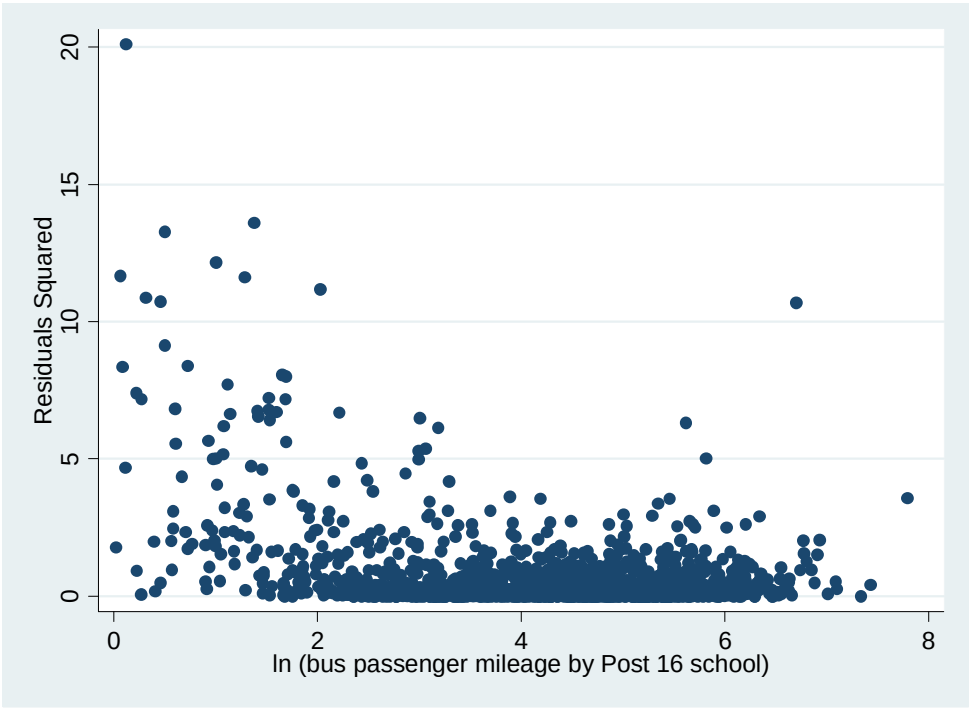


Figure 8.7 Residuals Squared for Post 16 Analysis

Therefore, the ML linear regression models without the policy variable (i.e. Model B in Tables 8.6, 8.7 and 8.8) have used to predict bus passenger mileages with and without the variable – *LA budget by school*. The results are presented in Table 8.9.

Table 8.9 Changes in school bus passenger mileage for all ages

	Primary schools	Secondary schools	Post 16 Schools
Total bus passenger mileage with LA budget	61,467	1,022,627	99,793
Total bus passenger mileage when LA budget = 0	51,654	750,143	89,329
Difference in total bus passenger mileage	-16%	-27%	-10%
Total bus users (from the school census)	125,842	936,770	60,782
Number of pupils that may move away from bus to other modes such as car	20,135	252,928	6,078
Average distance travel by bus per pupil	1.83	3.12	5.73

Table 8.9 shows that there could be a 16% reduction in bus passenger mileage for primary school pupils, 27% for secondary school pupils and 10% for Post 16 pupils travelling to school by bus if the Government decide to remove the LA budget.

Since the average bus passenger mileage for the primary, secondary and post 16 pupils are 1.83, 3.12 and 5.73 respectively; this decrease in bus passenger mileage may result in the reduction of bus trips as some of the pupils would change their mode of travel (e.g. bus to car or other modes). In other words, 20,135 primary school pupils (from the total 125,842 based on the School Census), 252,928 secondary school pupils (from the total 936,770) and 6,078 Post 16 pupils (from the total 60,782) may look to travel in other ways which may result in more congestion during peak travel times if the home-to-school provision was refused.

For pupils to change from using the bus this could lead to 279,141 pupils travelling twice a day (190 school days per year) resulting in over 327 million miles a year potentially being made by less sustainable modes of travel and thus leading to further congestion and environmental issues around England.

8.7 Summary

To summarise, the aim of this section was to examine the statutory school transport provision policy and model the impacts of the removal of both this policy and the budget that funds it.

The bus provision currently provided by LAs across England are very successful in ensuring children are able to access their chosen school. However, this comes at a very high cost, particularly in the current economic climate where LAs are looking to save money wherever possible. Previous research shows that there are many underlying costs to concessionary and subsidised bus travel and school travel is no different.

However, it is difficult to model exactly how many children would change from using the bus to school if all pupils were required to pay for the service. As school attendance is compulsory between the ages of 5-16 many of these children would have no others option but for their parents to pay for a bus service. There is a percentage of children that would change to other modes and this could lead to other costs for the LA in the long run.

As the ML models show, the budget financing bus travel to school is quite fundamental in allowing pupils to travel to school by bus. If this funding was to be removed, LAs across England face a 10%-27% change in travel for pupils. This change in travel could lead to more costs in the long term such as infrastructure in the form of cycle lanes and road crossings and the possibility of increased congestion in and around schools (particularly those with high car activity).

The results suggest that if the LA budget becomes zero, school-level bus passenger mileage in England would decrease by 16%, 27% and 10% for primary, secondary and Post 16 schools respectively. This decrease in bus passenger mileage may result in the reduction of bus trips as some of the pupils would change their mode of travel (e.g. bus to car).

In other words, 20,135 primary school pupils (from the total 125,842 based on the School Census), 252,928 secondary school pupils (from the total 936,770) and 6,078 Post 16 pupils (from the total 60,782) may look to travel in other ways which may result in more congestion during peak travel times if the home-to-school provision was refused.

The current provision of school bus accessibility is a high cost to English LAs but as this study shows, it is well used and the removal of such a policy is likely to have detrimental impacts on the community and those living within it.

CHAPTER 9 DISCUSSION AND IMPLICATIONS

9.1 Introduction

This thesis explores the relationship between school travel in England and two of the main school transport policies in place. This has been achieved by firstly examining the views and opinions of experts in the school travel field (Chapter 3), and secondly by estimating the effects of changes in travel behaviour as a result of the school choice policy (Chapter 7), and then analysing the impacts on school bus passenger mileage as a result of the statutory home-to-school transport provision policy (Chapter 8). Appropriate econometric models were employed for the analysis of both policies.

This chapter examines the results and findings of the interview scoping study and then econometric model exercises employed. Section 9.2 will explore the results of the interview scoping study whilst section 9.3 will discuss the findings of the multinomial logit (MNL) and mixed multinomial logit (MMNL) models used for calculating the impacts of the school choice policy. Section 9.4 will discuss the findings of the multilevel (ML) model used for calculating bus passenger mileage as a result of the statutory home-to-school transport policy. Section 9.5 will revisit the research propositions which emerged in Chapter 2 and the final section 9.6 of this chapter will then summarise the overall findings of the thesis.

9.2 Expert Views of School Travel in England

The interviewees partaking in the interview scoping study listed 6 key stakeholder groups in school travel:

- Parents
- Local Authorities
- Schools
- Bus Operators
- Local Communities
- School Pupils / Children

Each of these stakeholders hold some control over how children travel to school, yet unusually, the main user (school pupils / children) in this case actually have the least control over their own travel behaviour. This is also found in studies conducted by McDonald et al (2008, 2010 and 2011) in which parents are found to be the main stakeholders and key influences in how children travel to school (i.e. due to work schedules, their own travel behaviour and safety concerns). The study explained that economics, policy and legislation played vital roles in how children travel to school.

Thornthwaite (2009) and White (2009) have also found that LAs have key responsibilities for providing school transport to pupils in England as a result of the Education Act 1944 and therefore set most of the criteria for pupils wishing to use these services. If LAs only offer free transport to those who meet the very basic criteria of the Education Act, many pupils may end up travelling by other means if LAs do not make services available for all.

The key issues that emerged from this study, is that cost, the school choice policy and the current statutory home-to-school transport provision eligibility limits are currently some of the main barriers to children travelling to school by transport modes other than the private car.

It was stated by some of the interviewees that the school choice policy encourages more car travel to school and restricts pupils from accessing LA-provided transport. They also stated that as more choice becomes available to pupils, the likelihood of LAs being able to cater for all transport needs will reduce. Interviewees stated that funding was already stretched to its limit regarding the statutory transport provision and therefore it is unlikely that the services can be offered to more pupils, yet other interviewees stated although many pupils are offered free transport services they still choose to travel by car suggesting that this policy is no longer relevant or useful in school travel. This supports the findings of Hine (2009, p.38) who states "*Increased parental choice under the post-primary review will also place more pressure on this system and may even contribute to further increases in car use on the home to school journey*".

Overall, this study provided a fresh insight into the views of current experts in the school travel field and highlighted some of the key issues facing policy makers today and thus highlighting the research gap and research propositions of this project.

9.3 Impacts of the School Choice Policy

Chapter 7 presented two types of model estimation results using a MNL and MMNL model for the whole school population and then a separate MMNL study for two age groups to measure the vehicle and environmental impacts of the school choice policy.

As Burgess et al (2006) have noted the school choice policy has greatly benefitted the English education system and created more social mobility and accessibility to better education regardless of Income Deprivation Affecting Children Index. Data from the School Census data shows that only 42.5% of children attended their nearest school in 2009, meaning that over half the pupil population was attending a school other than the one closest to their home.

Nevertheless, there are serious (presumably unintended) consequences on other areas of public policy, such as increased amounts of travel and longer journey distances have on the environment (as already noted). In addition, there are wider implications such as longer distances impacting on mode choice. This could threaten the health of children due to the reduction in so-called 'active travel'. In addition, poorer parents are less able to exploit the available opportunities because they are less likely to own a car and/or have less money to send their children longer distances by public transport. There needs to be more research undertaken to examine potential ways of keeping good quality schools accessible to all children, but also not promoting a policy which encourages children to have to travel further each day and usually in an unsustainable way.

There are implications for other sectors too – the location for health care facilities for example. Thus, trends in the UK towards offering patients the choice of where they can be treated within a health 'marketplace' may deliver more comprehensive and cost effective medical treatments, but once again impact on the ability of (often the most vulnerable) patients and visitors to access them.

Similar issues may also apply to other facilities where user choices are broadened (either as a result of policy or market decisions) such as supermarkets, airports, universities, and employment centres generally.

The model showed that when school choice was replaced by a policy where each child only travelled to their 'nearest school' several changes occurred in English school travel. VMT fell by over 3.9 million miles per day. The reduction in VMT could lead to less congestion on the roads during the morning rush hour and less cars driving near school gates. Mode choice changed in the modelled scenario. Car use fell from 32% to 22%. Bus use fell from 12% to 7%, whilst NMT (walking and cycling) saw a rise of 17%. With more children travelling to school by walking or cycling the current epidemic of childhood obesity could also be reduced through active travel.

When analysing the two age groups separately in Chapter 8, it could be seen that 96% of primary school pupils travelled mainly by car and non-motorised transport (walking and cycling), but older pupils did have higher levels of bus travel.

As a result, when testing the impacts of school choice policy, if this policy were removed, a 14% fall in car use occurred in primary school travel almost double the reduction of car use in secondary school pupils. However, the levels of travel by non-motorised transport rose for both age groups between 16-18% (17% when testing the whole student population) leading to a reduction VMT for both car and bus use per school day by car for both age groups.

As well as being a healthier option for children, the reduction in car use could also mean CO_2 emissions would fall by 0.78% or the equivalent of 2,586 tonnes per day in England alone.

This supports the US findings of Marshall et al (2010), that a change in the school choice policy can have significant benefits from a transport and environment perspective, as walking increases whilst travel by car and bus decrease on a small scale. The findings of this paper build on this to show the results at a national scale and with a larger population.

This investigation illustrated some of the impacts the school choice policy has in England. It needs to be noted that not all behaviour would change if the policy was changed and all children travelled to their nearest school. The main limitation of this research is the inability to fully predict travel behaviour by taking into account personal preference as well as personal factors which influence choice. Some children would still choose to travel by car, yet the impacts are still very significant.

This supports the findings of Müller et al (2008) and also Wilson et al (2007, p.516) who states "*altering children's travel patterns for school choice carries significant transportation and cost implications for school districts, inconvenience implications for households, and societal implications in terms of traffic congestion, criteria pollutant emissions, and overall greenhouse gas emissions*".

Marshall et al (2010, p.1542) add that "*school choice can dramatically reduce active travel*". This has certainly been the case in this thesis which found that the modal share of car use could fall by 7-14% and non-motorised transport rise by 16-18% each day resulting in reductions of 800 tonnes of fuel could be made per school day leading to almost 2,500 tonnes less of CO_2 emitted in England.

The wider implications for policy are that whilst diversity is encouraged through school choice, it brings many negative side effects through transport, health and the environment. If parents continue to allow their children to travel to school by car, these figures are only likely to rise as the population grows. The school choice policy is not the only factor affecting children's travel, but as this study shows it does have a strong influence.

9.4 Quantifying the Impacts of the Statutory Home-to-School Bus Provision Policy

There are strong reasons why local authority bus provision exists but it is also a high expense to LAs and a large part of their annual budget (e.g. Thornthwaite, 2009; YBC, 2008) and it could be reasoned that the percentage change in behaviour is not high enough to justify the current costs being spent on bus provision in England. However, as the prediction model found in Section 8.6 in Chapter 8, over 279,000 pupils could change their travel from the school bus to other modes.

The first multilevel model illustrated that the amount spent on bus travel plays a vital role in getting children to school by bus. However, it needs to be noted that school based factors in this case have resulted in being more influential as local authority factors. The size of a school, or whether a school is deemed of 'good quality' because of high exam results also impact upon bus passenger mileage. Particularly in rural areas this will lead to further distances travelled to school.

It is understandable that during this economic climate, local authorities are trying to make as many cuts to budget as possible, yet as the ML shows, there would be thousands of pupils that would have to travel to school by others means if their bus travel was not provided by their local Government. This travel could lead to further costs having to be made by construction of more walking paths, cycling paths, infrastructure or lead to more road congestion during the peak morning rush. This research compliments the findings of Baker and White (2010) and Bristow et al (2008) in showing how much this concessionary scheme is affected by cost and how patronage would be directly impacted by a removal of funding to school travel. Inevitably, there are unobserved factors that cannot be analysed in this model. For example, children are not the main decision makers in their travel and that their travel behaviour is greatly influenced by parental lifestyles (i.e. work schedules). However, this research still gives an overall understanding on what affects school bus use from the child's travel behaviour point of view.

The bus transport provision currently provided by LAs across England is successful in ensuring children are able to access their chosen school. However, this comes at a high cost, particularly in the current economic climate where LAs are looking to save money wherever possible. Previous research shows that there are many underlying costs to concessionary and subsidised bus travel and school travel generally is no different.

However, it is difficult to model exactly how many children would change from using the bus to school if all pupils were required to pay for the service. As school attendance is compulsory between the ages of 5-16, many of these children would have no others options but for their parents to pay for a bus service, although there is a percentage (ranging from 10-27%) of children who would change to other modes and this could lead to other costs for the LA in the long run.

As the multilevel models show, the budget financing bus travel to school is vital in allowing pupils to travel to school by bus. If this funding was to be removed, LAs across England face a 10%-27% change in travel for pupils. This change in travel could lead to more costs in the long term such as infrastructure in the form of cycle lanes and road crossings, and the possibility of increased congestion in and around schools (particularly those who already have high car activity).

Travel to school accounts for 15% of all bus journeys and 16% of bus passenger mileage in Great Britain per year (DfT, 2011). 20,135 primary school pupils (from the total 125,842 based on the School Census), 252,928 secondary school pupils (from the total 936,770) and 6,078 Post 16 pupils (from the total 60,782) may look to travel and thus leading to further congestion and environmental issues around England. The current provision of school bus accessibility is a high cost to English LAs but as this study shows, it is well used and the removal of such a policy is likely to have detrimental impacts on the community and those living within it.

The finding of Cooper et al (2003) "*as children get older they become less active, raising the possibility that active commuting may be a more-important contributor to daily physical activity in older children and adolescents*" (p.276) is also evident in these trends. Figure 5.1, 5.2 and 5.3 show that the number of pupils walking or cycling to school significantly falls the older the children are, but the levels of bus use rises.

In summary, this study showed that if LA school bus provision was removed, up to 279,414 of pupils are likely to change their mode of travel to school from bus to other modes. Due to the age of the children and national trends there is a strong likelihood these would travel to school by car. The final section of this chapter will explore the original research propositions from Chapter 2 and how the analysis conducted throughout this project has aimed to address each of these.

9.5 Addressing the Research Propositions

Proposition 1

Younger (primary) pupils are more likely to travel by motorised modes of transport in their daily journey to school than older (secondary / Post 16) pupils.

Rosenbaum (1993), Hillman (1993), Fyhri and Hjorthol (2009), Cooper et al (2003), Mackett et al (2005) and McDonald et al (2011) all find that pupil mobility usually increases with age. According to the literature available, the main reason for this is parental concern for safety.

Although in many studies parents listed a number of concerns regarding safety, the most notable was high levels of traffic and the risk of injury as a result.

Age was considered by many of the interviewees in the scoping study as a barrier to children travelling to school by a mode of transport other than the car. The interviewees stated that it was unlikely that young children would be allowed to walk, cycle or travel on the bus to school without an adult escort and that parents would prefer to drive younger children to school themselves.

The scoping study highlighted the fact that experts in the field are aware of this issue. Interviewee M stated that "we need to get parents to see that sustainable travel *is* safe ... we need to try and change the mindsets of people". Interviewee C suggests that the bus is more appropriate for children around the secondary school age group because of parental concerns regarding safety and adds that "children are now being escorted to a greater degree than in previous generations".

When analysing how the school choice policy affects the travel of the English school population as a whole, the mixed multinomial logit model showed that for the *Age* variable, the coefficients were significant and positive for bus, non-motorised travel and other public transport, suggesting that as age increases, pupils are less likely to travel by car. However, when the primary school pupils were modelled separately, as age increased (up to the age of 10) pupils were more likely to travel bus than by private car. Primary school travel by non-motorised transport and other public transport were significant but negative suggesting that as pupils got older, there are more likely to travel to school by car.

When analysing secondary school pupils the *Age* coefficient was significant and positive for bus, non-motorised transport and other public transport suggesting that older pupils are much less likely to travel by car to school than younger pupils. The multilevel analysis of the statutory school bus policy shows that both school level and LA level factors are less significant for primary school pupils than secondary and Post 16. These differences are explored individually in the following propositions.

In summary, age has a significant impact on pupil travel behaviour. With regards to motorised transport via private car, the literature review assessed that many studies (i.e. Hillman, 1993; Malone, 2007; Carver et al, 2008) have concluded that younger pupils are more likely to travel by car to school than other transport modes usually as a result of parental concerns regarding their safety as pedestrians.

This was also the account of many of the interviewees who found that more policies for non-motorised travel and school bus use was usually aimed at secondary and post 16 pupils because parents have such a strong influence and concern about how younger children travelling unescorted. The impact of age was tested in both the models presented in this thesis and found to be a significant factor in how children travel.

The results support the previous findings in which younger pupils travelled more by car than by other modes. However, with regards to bus travel, older pupils travelled by bus more than pupils of primary school age (under the age of 10). The models found that secondary and post 16 pupils generated more bus passenger mileage than primary which actually generated higher levels of walking.

Overall, younger pupils did travel more by motorised modes in general, but this was mostly by private car. Younger / primary school pupils travel more by motorised modes, but really to be specific this should refer to car use only, as older pupils actually account for more bus passenger mileage than younger pupils.

Proposition 2

Female pupils travel less actively than male pupils.

In a range of studies from different countries, Hillman (1993), Fyhri and Hjorthol (2009), Loucaides and Jago (2008) Leslie et al (2010) McDonald (2011) all find that male pupils tend to travel on average more actively to school than female pupils.

Whilst analysing the school choice policy, the mixed multinomial logit model showed that the *Gender* coefficients were significant and for bus, non-motorised transport and other public transport. As Male=0 and Female=1 this suggests that female pupils are more likely to travel by car than by other modes of transport.

The results of the mixed multinomial logit model for female primary pupil travel were found to be insignificant compared to male primary pupil travel for bus and non-motorised transport. Only the coefficient for other public transport was found to be significant but (as expected) was negative suggesting female pupils are more likely to travel by car instead of other public transport than male primary school pupils.

However, when testing secondary school pupils, the coefficients for all three modes of transport were found to be both significant and negative suggesting that older female pupils were less likely to travel to school by bus, non-motorised transport and other public transport compared to male secondary pupils.

Overall, gender has been found to have a less significant affect on school travel than other variables such as age. Findings in the literature review argued that female pupils were less active and more reliant on motorised travel than male pupils. Gender was not highlighted as an issue to the participants in the interview scoping study and was not listed as one of the main issues / barriers of sustainable school travel. In the mixed multinomial modelling analysis, gender has less of an impact on school travel as a result of school choice, however, when split by age, the model did highlight gender to be more significant for the travel behaviour of female secondary pupils. From this finding, it may be that gender does affect travel behaviour and (according to the literature review findings) female pupils travel less actively than male pupils, but from the multinomial results, this is only evident when age is less of a factor.

Proposition 3

The ethnic background of a pupil will have a significant effect on their travel behaviour.

Results from McDonald (2008) and Pont et al (2009) determine that children from an ethnic minority background are more likely to travel actively to school than their white peers.

When analysing the school choice policy, the mixed multinomial logit model showed that for the *Age* variable, the coefficients were significant and positive for bus, NMT and OPT, suggesting that as pupil age increases, pupils are less likely to travel to school by car. The mixed multinomial logit model tested five types of pupil ethnicity (based on the School Census tested categories): White, Asian, Black, Chinese, Mixed and Other ethnic backgrounds.

When testing the travel behaviour of pupils from ethnic minority backgrounds against the reference case of *White* pupils the following results were observed:

- Asian pupils were more likely to travel by car than by bus, non-motorised transport and other public transport than white pupils
- Black pupils were more likely to travel by bus and other public transport than white pupils but results for non-motorised transport were insignificant
- Chinese pupils were more likely to travel by car than by bus and non-motorised transport than white pupils but results for other public transport were insignificant.
- Mixed pupils were more likely to travel by bus and other public transport than white pupils but were less likely to travel by non-motorised transport than white pupils
- Other ethnic pupils were more likely to travel by bus, non-motorised transport and other public transport than white pupils.

When modelling primary school pupil ethnicity, most of the coefficients were found to be insignificant suggesting that ethnicity has little effect on travel behaviour of very young children. However, when modelling the impacts of ethnicity on school travel for secondary school pupils most of the coefficients were found to be significant, and almost identical to the results of the whole pupil population:

- Asian pupils were more likely to travel by car than by bus, non-motorised transport and other public transport than white pupils
- Black pupils were more likely to travel by bus and other public transport than white pupils but results for non-motorised transport were insignificant
- Chinese pupils were more likely to travel by car than by bus and non-motorised transport than white pupils but results for other public transport were insignificant.
- Mixed pupils were more likely to travel by bus and other public transport than white pupils but were less likely to travel by non-motorised transport than white pupils
- Other ethnic pupils were more likely to travel by bus and other public transport than white pupils, but less likely to travel by non-motorised transport.

In the multilevel analysis conducted in Section 8.6 states that the percentage of *white pupils* was found to be statistically and positively significant for secondary and post 16 pupils but insignificant in the primary schools models. This suggests that ethnicity plays little part in the travel behaviour of younger pupils, but as pupils get older and begin attending school in which the examinations have more of an impact on their future careers, those from ethnic minorities use the bus in their journey to school more than their white peers.

In summary, the findings of the modelling analysis support those of the literature review to a point. The studies in the literature found that pupils from an ethnic minority background were more likely to travel to school via walking and cycling than motorised transport. However, when testing school transport policies, the models presented mixed results. While the multilevel model found that ethnic minority pupils travelled more by bus than White pupils, the mixed multinomial results found that in some cases Asian and Chinese pupils travelled more by car than White pupils. This suggests that ethnicity can have a strong influence over travel behaviour (particularly if comparing pupils from Black or Mixed backgrounds to White pupils).

Proposition 4

Pupils from low income households do not travel as far to school as their higher income peers.

Giuliano and Dargay (2006, p.18) state that income and employment notably increases daily travel, but note that travel per person decreases as the number of people living in a household increases "*presumably because household maintenance activities are shared*".

Srinivasan and Ferreira (2002) find that families with children have higher levels of "non-work" travel than those without children and find that single parent and families in which both parents work usually have shorter non-work related journeys. This suggests that when a family has a parent that works trip journeys may be shorter as a result of time limitations but are also spread out more throughout the week and weekend than those of households with non-working parents.

Chen and McKnight (2007) find those who are unemployed generate less travel to school because the majority of their activities take place within the home unlike those who are employed and therefore have to leave home and commute to work.

The influence of income on distance travelled was not directly considered in the econometric modelling analysis. Free school meal eligibility, which can be thought of as a good proxy for low income families, also plays an important role in pupils' mode choice. As can be seen from the mixed multinomial logit model results in Chapter 7, those who receive free school meals are more likely to use public transport or non-motorised transport relative to car. From previous findings relating to distance, this suggests that pupils are travelling further than the 'feasible' walking and cycling distance of 1-2 miles.

In Chapter 8, when testing school bus passenger mileage, free school meal eligibility was a statically significant and positive factor for primary school pupils travelling to school by bus suggesting that as free school meal eligibility rises, as does school bus passenger mileage. This factor however, was not found to be statistically significant for older secondary and Post 16 pupils suggesting that income has less of an impact on travel distance as pupils get older.

This has been a difficult factor to test, as details on household income are not readily available on such a large scale as the School Census. However, by using free school meal eligibility as a proxy for income this can be measured. When testing free school meal eligibility in the multilevel model, this variable was only found to be significant for primary school pupils. This suggests that as pupils get older, income has less of an influence on school travel.

This could possibly be due to parents having less influence on school travel as pupils get older or that because secondary and Post 16 pupils are taking more specific examinations (GCSEs and A-Levels) they take advantage of the school choice policy and thus make themselves exempt of the statutory bus provision policy.

Proposition 5

Pupils living in less densely populated areas are likely to travel further to school than those residing in more urbanised locations.

In Chapter 2, Table 2.3 illustrated how in Great Britain in 2008-2009 the average trip length of pupils travelling to school in rural areas was 4.4 miles, but in metropolitan and urban areas the average trip to school was only 1.9-2.3 miles respectively. As the overall average trip distance was 2.4 for all of England, pupils living in rural areas travelled double the national average.

Boarnet and Crane (2001) state that urban form and travel behaviour are key to trying to reduce car use in travel behaviour. It is expected that pupils who live in more rural areas are less likely to travel to school actively by walking and cycling, but would resort to motorised modes of transport that can carry them further distances. The findings of Srinivasan and Ferreiraland (2002) suggest that rural areas which have less accessible roads, less lighting, and are more isolated than densely populated areas lead to further distances travelled.

Some of the experts interviewed in the scoping study worked for rural LAs and stated that in rural pupils were very reliant on public transport because of the distances they were required to travel few alternatives were available to them. Interviewee N notes “in a rural area, it is some children’s only way to independence”.

The influence of population density was not directly considered in the econometric modelling analysis. However, the coefficient of roadway density in Chapter 7 is found to be statistically significant in the mixed multinomial logit model and positive for bus non-motorised transport and other public transport, meaning that pupils are more inclined to travel by public transport or NMT compared to car at places where road density is high. Higher roadway density may indicate better public transport and facilities (e.g. bicycle lanes), which may encourage pupils to use bus and NMT.

The multilevel model in Section 8.6.3 shows that the coefficient for urban areas was found to be statistically significant and negative for post 16 pupils suggesting that the more densely populated an area is for older pupils the less bus passenger mileage is generated. However, this could be due to other school level factors having more of an influence on Post 16 bus passenger mileage than location and population density. Most results for primary and secondary pupils were found to be statistically insignificant.

Overall, the findings of the econometric models support the findings of the literature. The multilevel model found that when compared to rural areas, most of the results were fairly insignificant. It can be seen that bus passenger mileage usually increases for pupils in more densely populated areas, but this could also be a result of age increasing. It is likely that population density and the availability of bus services and active travel facilities influence behaviour, but not to the extent of the impact of pupil age.

Proposition 6

Distance to school significantly affects mode choice.

As per the findings of Müller et al (2008), van Sluijs et al (2009), Marshall et al (2010), Davison et al (2008) and Emond and Handy (2011), pupils are more likely to travel using motorised transport if their school is located more than 1 mile (if walking) and 2.5 miles (if cycling) from their home.

According to the interviewees, the further children have to travel, the more difficult it is to encourage sustainable travel for children. Moreover, this is the exacerbated when parents are choosing to send them to schools even further away from home and do not want them to travel without an adult escort.

When analysing the school choice policy, the MMNL results obtained in Chapter 7 showed that for the *Distance* variable, the coefficients were significant and negative for bus, NMT and OPT, suggesting that as distance to school increases, pupils are more likely to travel by car than by other modes. However, when this was tested for the 'average pupil' the MMNL found that the probability of pupils travelling to school by car increases if the distance to school lay between 3.5 miles, but decreased when distance was above 3.5 miles (see Figure 9.1).

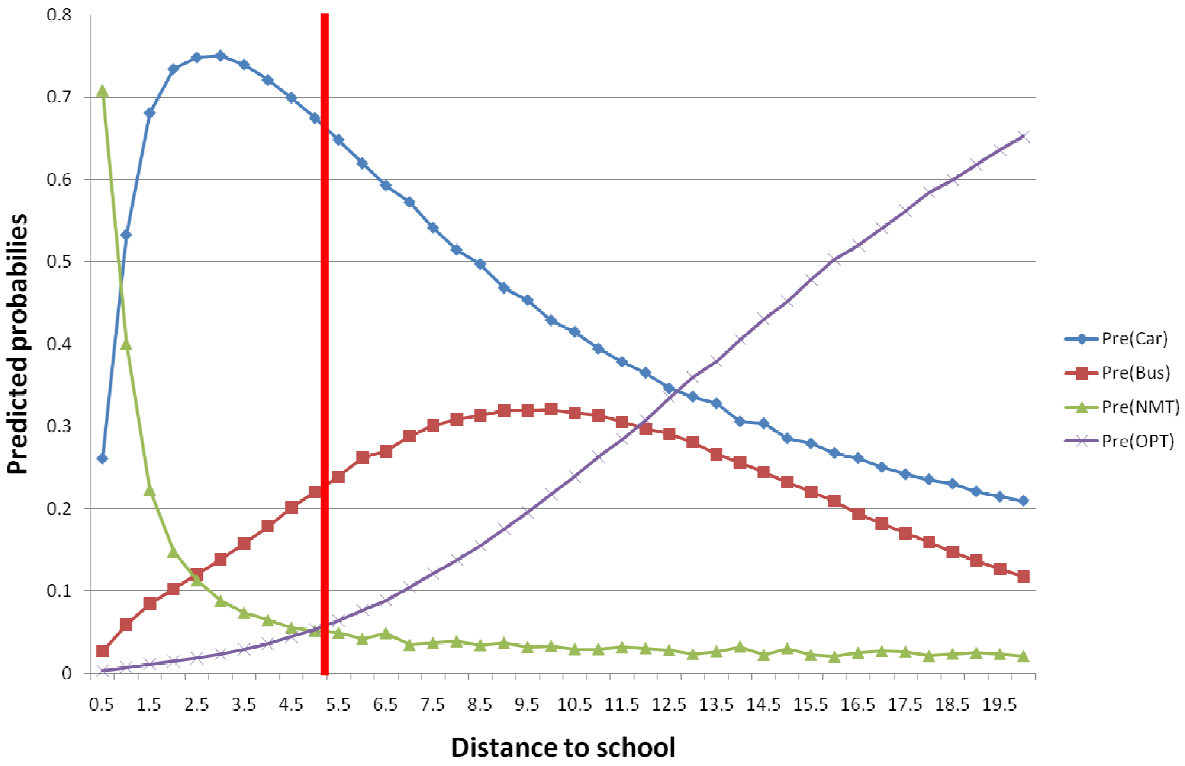


Fig 9.1 Predicted probabilities vs. Distance to school

Figure 9.1 illustrates how the key changes in travel behaviour occur around 1 mile in which the likelihood of travelling via non-motorised travel falls significantly, in direct contrast to the likelihood of travelling by car which rises just as significantly. Travel by other public transport rises gradually, and this is likely to be due to the train becoming more popular for longer journeys.

Finally, travel by bus gradually rises to between 8-10 miles and gradually falls as other public transport becomes used more. However, based on the School Census data, the majority of school travel takes place up to 5 miles so for this reason, the most realistic travel trends in Figure 9.1 occur before the red line.

When modelling *Distance* for primary school pupils, the coefficients for non-motorised transport and other public transport were found to be random and insignificant respectively, but for bus it was found to be significant and negative suggesting that as distance increases to school for primary school pupils they are more likely to travel to school by car as opposed to the bus. When modelling *Distance* for secondary school pupils, the coefficients for bus and OPT were found to be significant and negative suggesting that older pupils were still more likely to travel to school by car than by other modes when the distance to school increases. However the coefficient for NMT was found to be random, meaning that there is no clear pattern in walking distances (i.e. some pupils walked very long distances whilst others used other means of travel for very short distances).

In the multilevel model, across all age groups, the trend shows that when pupils live within 1 mile of their school increases then total bus passenger mileage decreases and this is likely due to alternate modes of travel being available (such as walking and cycling).

The factor of distance clearly has a huge impact on pupil travel behaviour. This is evident in all of the studies featured in this thesis. Interestingly, the studies explored in the literature review based in different developed countries found travel behaviour to drastically change when pupils were required to travel further than 1-2 miles. This is also apparent in the multinomial and multilevel modelling. Even though there is evidence that travel behaviour changes around 1 mile from active walking and cycling to motorised travel; the statutory school transport provision policy is only applicable to pupils living 2-3 miles from their nearest school.

There is a significant gap between pupils actively travelling up to 1 mile to school and those eligible for free travel. Pupils living between 1-2 miles of their school appear to have fewer choice alternatives available to them. This could be an area for further research to determine the impact of the travel behaviour of pupils living within this distance limit of their current school.

Proposition 7

The policy allowing parental choice of schools leads to a considerable increase in vehicle miles travelled by car and associated wider impacts.

The findings of Wilson et al (2007), Müller et al (2008), Marshall et al (2010), Cui et al (2011) suggest that the freedom the school choice policy gives results in many children travelling further to school and thus travelling more by motorised transport than by other modes.

Many of the interviewees from a mixture of consulting, academic and planning backgrounds stated that school choice greatly reduces sustainable travel as children are travelling further to attend school and this is likely to result in an increase in car use and dependence. From the interviews, parental choice appears to be the biggest barrier in reducing car travel to and from school. Fewer parents appear to want to send their children to their local school.

According to Interviewee A “The average length of a journey to school is increasing as a result of being encouraged to send your children to a school other than the closest to your house. What we have now is an education policy that is encouraging people to travel further and further”. Interviewee D warns that “the more choice [of school] that is offered; the more difficult it will be to offer services for so many different choices”.

The results of the mixed multinomial logit model when testing the whole pupil population suggest that if children travelled to their nearest school, instead of the school of their choice car use would fall from 32% modal share to 22%. Bus use would also fall from around 12% to 7%. However, NMT through walking and cycling would rise from around 54% to 71%. The mixed multinomial logit model also suggests that if all children travelled to the school nearest to their home, total car miles travelled would fall by 1.08% and total bus miles travelled will reduce by 10.77% and that England would save over 290 tonnes or almost 1% of petrol and just under 3% or 500 tonnes of diesel each day.

Primary school pupils (aged 10 years and younger) the MMNL shows that if all children travelled it their nearest school instead of a chosen school car use would fall from 38% modal share to 24%. Bus use is already very low for younger children, but would also fall from around 0.02% to 0.01%. However, NMT through walking and cycling would rise from around 59% to 75%. From a broader transport perspective, this change in policy would mean a reduction in VMT by car of 0.62% and a reduction in VMT by bus of 0.73% for primary school pupils. From an environmental perspective, the amount of petrol used per day to transport primary school aged pupils to school could be reduced from over 190 tonnes to just over 37 tonnes per school day. Diesel as well could be dramatically reduced by over 150 tonnes a day. The amount of CO_2 generated per day could be reduced by over 1100 tonnes per day.

The mixed multinomial logit model also shows that if all secondary pupils travelled to their nearest school instead of a chosen school car use would fall from 27% modal share to 20%. Although still a reduction, it is not as dramatic as the decrease shown in the primary pupil results. However, as stated, car use in primary pupil travel to school is much higher than for secondary pupils. Bus use on the other hand is much higher for older pupils but if the policy was changed, would decrease from around 20% to 12%. NMT through walking and cycling would still rise from around 49% to 67%. This change in policy would mean a reduction in VMT by car of 0.46% and a reduction in VMT by bus of 8.68% for secondary school pupils. The amount of petrol used per day could be reduced from over 180 tonnes to just over 46 tonnes. A greater reduction in bus and car travel could result in a reduction in the amount of diesel used daily by over 300 tonnes a day. The amount of CO_2 generated per day could be reduced by over 990 tonnes per day.

The findings of the mixed multinomial modelling analysis supports the findings from the literature review and the statements made by the interviewees in the scoping study. There is clear evidence that the school choice policy has an impact on car use. This is due to pupils travelling further than 1-2 miles to school (normal ‘walking distances’) and by not travelling to their nearest school pupils are not eligible for the statutory school bus transport provision of the LA. Burgess et al (2006, 2010) explain that the school choice policy has benefitted English pupils through social mobility, but the traffic, transport and environmental impacts of this policy are inescapable and it is likely this policy may need further reviewing.

Proposition 8

Local authorities that offer only the statutory level of school transport provision experience lower levels of bus mileage per pupil on average than those with more generous policy guidelines.

In the interview scoping study Interviewee A states the statutory 2-3 mile limit is restricting a lot of pupils travelling to school by bus who would otherwise travel to school by car and adds "if you reduced the [provision of free school transport] limit, blanket across the board within one and two miles, it isn't that expensive [to local authorities/provide school bus services] when you take into account parental time savings, congestion savings, the environmental savings and safety benefits you are not looking at a substantial cost".

Similarly Interviewee F stated "where bicycling or walking is not feasible due to most students living further than a ½ mile from school, bussing should be offered, and walking to bus stops encouraged". Interviewee N also added "I think if you have a free pass to travel on the bus, you use it ... and as a parent that's how you send your children to school" suggesting that when the service is offered to pupils they usually take advantage and therefore are much less likely to travel to school by car.

Surprisingly, the types of policy (Generous or Standard) offered by LAs had less effect on how pupils of all age groups travelled than the school-level factors. As explained in Chapter 8, the school-level factors accounted for over 90% variation in total bus passenger mileage and the differences in characteristics between the local authority level was actually relatively small (i.e. less than 10%).

It needs to be noted that this study took place at a national level incorporating many different types of policies in comparison with the statutory home-to-school transport provision policy. To gain a more in-depth view on the effectiveness of individual policies in LAs and case studies on each LA would need to take place to have a stronger view on how effective more 'generous' policies are. However, there is still evidence from the analysis that when free or subsidised travel is offered to pupils, bus passenger mileage increases. This is particularly evident when observing travel in London LAs. Yet it is also evident that it takes a great deal of funding to be able to provide more generous school transport policies and in the current economic climate this is difficult to offer.

Proposition 9

The higher the level of bus subsidy provided by a local authority per pupil, the greater the average bus mileage generated.

Thornthwaite (2009) and Hine (2009) state that although many students use the statutory transport provision as their main means of travel to school, the cost of this policy is very high for local authorities. Interviewee A states that "local authorities are spending about a billion pounds a year on home to school travel". Local authorities realise this and so do their best to minimise costs wherever possible. Interviewee K stated that the funding to local authorities is already stretched with free transport offered at this limit.

However interviewees agreed that making changes to reduce the current statutory limit and making free transport more available would surely encourage more people to use the bus, just as free bus travel encouraged more elderly passenger to travel by bus instead of car when the concessionary fares were introduced.

The ML model found that for a 1 unit decrease in LA budget by school (i.e. £1,000 for a school per year) the percentage decrease in bus passenger mileage would be 1.5% for primary schools, 0.4% for secondary schools and 0.43% for Post 16 schools, holding all other variables constant. A secondary school from a Metropolitan-type local authority would have 33% more bus passenger mileage relative to a school from a rural local authority, holding all other variables constant.

As stated in Chapter 5, over £400 million was spent on school transport in 2009. When tested in the multilevel model, the *LA Budget* coefficient was found to be both significant and positive suggesting it is highly influential on school travel by bus. As the LA Budget increases, school travel by bus is also likely to increase. However, the results suggest that if the LA budget becomes zero, school-level bus passenger mileage in England would decrease by 16%, 27% and 10% for primary, secondary and Post 16 schools respectively.

This decrease in bus passenger mileage may result in the reduction of bus trips as some of the pupils would change their mode of travel (e.g. bus to car). could lead to 279,141 pupils travelling twice a day (190 school days per year) resulting in over 327 million miles a year potentially being made by less sustainable modes of travel and thus leading to further congestion and environmental issues around England.

To summarise, there is evidence that if an LA offers more school transport subsidy to pupils, bus passenger mileage does increase. However this comes at a cost and is sometimes not feasible particularly for LAs with less funding from the Government to spend on school transport and those with high SEN transport spending.

9.6 Discussion Summary

Table 9.1 summarises the propositions and the evidence used to test them. From this it can be seen that only proposition 8 did not match the results found in the analysis.

Overall, this chapter has drawn conclusions on the modes of transport which offer pupils of all ages maximum utility based on the school transport polices offered to them by their LA. It found that although the school choice policy offers benefits from an academic point of view, from a traffic and environmental perspective it is responsible for an increase in VMT and CO_2 daily. It also found that although millions are invested in providing the statutory home-to-school transport provision policy, this is still a relevant and well-used policy in England. Although other transport schemes are offered around the country, the removal of this particular policy could indeed result in thousands of pupils changing their travel behaviour. This change in behaviour could lead to increased congestion and traffic around schools.

In addition, this chapter reviewed the propositions set out in the literature review and methodology and discussed them in light of the original research. The next chapter will provide the final conclusions, limitations and thoughts regarding this thesis.

Table 9.1 Addressing the Research Propositions

Research Proposition	Evidence					
	Literature Review	Interview Scoping Study	Data	Mixed Multinomial Results	Multilevel Results	Summary
1	The studies reviewed find that younger children are more reliant on private car.	Impact of age on child travel behaviour specifically stated by Interviewees C and M	Significant change from walking and driving up to the age of 10 to bus use and cycling to school for pupils aged over 10.	Modal share for car for primary school pupils is double that for secondary school pupils.	Older pupils are much less likely to travel by car to school than younger pupils.	Younger pupils travel more by motorised modes, in particular by private car. Older pupils tend to travel more by bus.
2	All find that male pupils travel to school more actively than female.	Gender was not mentioned as being a significant factor in school travel	Male and female mode of travel is very similar. Walking is the main mode of transport used in school travel followed by the private car.	Female primary pupils were more likely to travel by car instead of OPT than male pupils, but other findings were statistically insignificant.	Secondary female pupils were less likely to travel by bus, non-motorised transport and other public transport compared to secondary male pupils.	Female pupils, particularly at secondary school, are less likely to travel actively than male pupils.
3	Studies find that children from an ethnic minority background are more likely to travel actively to school than their white peers.	Ethnicity was not mentioned as being a significant factor in school travel	Most ethnic groups follow the same travel patterns as their white peers (highest % walk, 2nd highest travel by private car, followed by bus)	Asian and Chinese pupils travel more by car than White pupils. White pupils travel by car more than Black and Mixed ethnicity pupils.	Pupils from an ethnic minority background travelled more by bus than White pupils	Ethnicity can have a significant influence over travel behaviour.
4	Pupils with employed parents travel further due to time and schedule issues but higher incomes are also linked to higher levels of active travel.	Income was not mentioned as being a significant factor in school travel.	The effect of income on distance travelled was not considered in this analysis.	The effect of income on distance travelled was not considered in this analysis.	For primary school pupils as proportion of free school meal eligibility rises, school bus passenger mileage also rises	Pupils from wealthier backgrounds travel further than those from poorer backgrounds.

5	Pupils from areas of low population density (i.e. rural areas) are likely to travel further than those from highly populated areas	In rural locations many pupils are far more likely to travel by motorised transport due to distance.	Population density was not found to be significant in the Data	Pupils travelled less by car in denser areas suggesting that they didn't travel as far as pupils in less densely populated areas	The effect of population density on distance travelled was not directly considered in this analysis.	Pupils generate high levels of travel in rural areas as a result of longer distances travelled to school.
6	Pupils are more likely to travel using motorised transport if their school is located more than 1 mile (if walking) and 2.5 miles (if cycling) from their home.	The interviewees state that the further children have to travel, the more difficult it is to encourage sustainable travel	The furthest distances travelled to school are made by motorised transport. The pupils travelling the furthest distances to school made their journeys by car followed by bus	The results suggest that as distance to school increases, pupils are more likely to travel by car than by other modes	If pupils live within 1 mile of their school bus passenger mileage decreases	The factor of distance clearly has a huge impact on pupil travel behaviour.
7	The freedom the school choice policy gives results in many children travelling further to school and thus travelling more by motorised transport.	School choice reduces sustainable travel as children are travelling further to attend school resulting in increased car use	There was no significant evidence that school choice influenced travel behaviour	If children travelled to the nearest school, car use would fall from 32% modal share to 22%. Bus use would also fall but NMT would rise.	The school choice policy was not tested in this analysis	The school choice policy results in higher levels of car, bus and public transport use.
8	The literature finds that when concessionary fares are offered, public transport use is likely to increase	When school transport is provided, pupils travel via modes other than the car	When LAs in England offered a generous school transport policy car travel was reduced (i.e. London)	This was not tested in the MMNL model	Policy has a lower impact on travel behaviour than school related factors.	When LAs offer more generous policies it is likely that pupils will travel to school by bus.
9	Many students use the statutory transport provision as their main means of travel to school; the cost of this policy is very high for LAs.	Changes to reduce the current statutory limit and free transport available would encourage more bus use.	There is no evidence for this in the Data chapter.	This was not tested in the MMNL model	When the LA budget decreases, bus passenger mileage also decreases.	Higher subsidy leads to higher bus use by pupils.

CHAPTER 10 CONCLUSIONS

10.1 Introduction

This chapter draws together the research conducted in this thesis together and provides conclusions and recommendations. It will first examine the ways in which the research has achieved its aim. It will then look at the contribution to knowledge that this research has made, before discussing the limitations of this research. Finally, this chapter will suggest further research which will be undertaken as part of a step change into the school travel field.

10.2 Achieving the aim of the research

This section will consider the findings of the research in context with the project aim and objectives. The aim of this research thesis was to investigate the transport related impacts of policy on school travel. As such, the research set out to understand and analyse the current school travel issues in England and the traffic and environmental impacts of the school choice policy and the statutory home-to-school transport provision policy.

Five objectives were defined that would guide the research and help fulfil this aim. In addition, a number of research propositions were identified from of the literature review. These propositions identified particular areas where there was a lack of knowledge or a particular issue arose that would be important to the context of the evaluation. The findings with regard to the propositions were discussed and summarised in Chapter 9 and the policy implications arising from this will be noted later in this chapter.

1. *To identify the current issues and factors affecting school travel.*

The results of a literature review in Chapter 2 reported the published literature currently available regarding the issues of school travel. The literature revealed that parents were central to child travel behaviour and that mode choice was usually based on parental factors such as attitudes and concerns, perceived views of safety and traffic levels employment, working hours and income. The literature review also highlighted the key child related factors which influences their travel behaviour, namely their age, gender and ethnicity.

The literature review also highlighted how school factors and policy decisions significantly influence how children travel to school in developed countries. In particular, the school choice policy and the statutory home-to-school transport provision policy were highlighted as being relatively under researched , whilst being high profile and topical.

2. *To determine the opinions of academics, consultants and travel planners in the transport sector, regarding school travel.*

The literature review also noted a lack of research pertaining to school travel in the UK context. For this reason an in-depth semi-structured interview based study was carried out to gather the views and opinions of current school travel in England from experts in the school travel field.

Concerns regarding funding to the education sector were expressed. Experts also articulated the issues created as a result of the freedom the school choice policy offered parents, namely increased car use, and also spoke of the limitations faced by local authorities as a result of the dated rules of the statutory transport policy. A clear review of these two policies emerged from this study as to the extent of the impacts of the school travel policy and the costs generated by the statutory home-to-school transport provision policy.

From the scoping study conclusions, a concern over the two key policies of school choice and home-to-school transport provision emerged as key barriers to children travelling to school by modes other than the private car.

3. *To quantify the transport related impacts of the school choice policy across England.*

This objective was addressed by conducting a series of econometric multinomial and mixed multinomial logit modelling exercises coupled with a specifically developed impact inventory to estimate the change in behaviour generated by the school choice policy. These exercises were first undertaken for pupils of all ages, and then were conducted for primary and secondary pupils separately to determine which age groups travel this policy influenced the most.

The econometric models found that car use and VMT greatly increased when the school choice policy was allowed resulting in negative environmental impacts. When all pupils travelled only to the school closest to their home, these impacts reduced significantly.

If pupils over the age of 10 travelled to the nearest school 0.5% vehicle miles travelled by car per day could be removed from the roads, as well as 990 tonnes of CO_2. If younger pupils aged under 10 travelled to their nearest around 0.6% car miles travelled could be reduced resulting in a reduction of over 1,100 tonnes of petrol per day.

4. *To evaluate the impacts of the statutory home-to-school transport provision policy and determine the effectiveness of this policy in school travel.*

This objective was achieved through the use of a multilevel modelling technique. This analysis required 2 levels of factors to be observed as both school level and local authority levels factors where stated to be key influences on school travel in previous studies.

The multilevel model found the school level factors to be much more significant on child travel behaviour than some local authority level factors (i.e. proportion of pupils living within 1 mile of school, eligibility for free school meals). However, when conducting a sensitivity test in a scenario in which the local authority budget for the statutory home-to-school transport policy was removed, bus passenger mileage fell considerably for all age groups suggesting that this policy, although very dated, still has a role to play in England today.

The results suggest that if the LA budget becomes zero, school-level bus passenger mileage in England would decrease by 16%, 27% and 10% for primary, secondary and Post 16 schools respectively. This decrease in bus passenger mileage may result in the reduction of bus trips as some of the pupils would change their mode of travel (e.g. bus to car). In other words, 20,135 primary school pupils (from the total 125,842 based on the School Census), 252,928 secondary school pupils (from the total 936,770) and 6,078 Post 16 pupils (from the total 60,782) may look to travel in other ways which may result in more congestion during peak travel times if the home-to-school provision was removed.

5. *To provide recommendations for policy makers and practitioners relating to school travel in England.*

Objective 5 provides the final stage of this research project by linking the previous four objectives back to the ultimate aim of the research. It allows a summary to be generated from all of the findings made throughout the previous objectives to be used for future reviews or evaluation of the policies investigated in this project.

In an attempt to help improve current school travel in England, the research has allowed for the development of recommendations and advice to those in the policy sector who wish to incorporate these findings into their reviews of policy.

10.3 Recommendations for Policy

This thesis has served to highlight a number of issues pertaining to the school choice policy and to support the provision of statutory home-to-school transport.

This section will seek to provide the recommendations to policy makers and practitioners on how policy could be changed to improve the way children currently travel to school.

In deriving recommendations for policy makers and practitioners, it is helpful for these to emerge directly from the 'answers' to each of the research propositions. Thus, the recommendations address the issues of school transport which have emerged from the findings in this thesis. Throughout the analysis of this thesis the influence of the national and local Government on school travel has become clear.

Proposition 1 - Younger (primary) pupils are more likely to travel by motorised modes of transport in their daily journey to school than older (secondary / Post 16) pupils.

Thesis Findings: age has a significant effect on pupil travel behaviour motorised transport via private car. It is fair to say that younger / primary school pupils travel more by motorised modes, but really to be specific this should refer to car use only, as older pupils actually account for more bus passenger mileage than younger pupils.

Across all the studies, it has been evident that younger pupils are more car reliant and travel less independently than older pupils. This suggests that it may be sensible to focus resources (for example through school travel plans) on changing the travel behaviour of older children who have been shown to be less car reliant and hence may well be more responsive to policy interventions. More generally, policy makers need to focus travel behaviour policies to be more age specific.

Proposition 2 - Female pupils travel less actively than male pupils.

Thesis findings: Gender has been found to have a less significant affect on school travel than other variables such as age. Nevertheless, female pupils tend to travel less actively than male pupils.

Given that male pupils tend to travel more actively than female the implication here is that more research is needed to understand why girls walk and cycle less than boys, thus ultimately enabling policy makers to encourage more active travel from female pupils.

Proposition 3 - The ethnic background of a pupil will have a significant effect on their travel behaviour.

Thesis findings: Ethnicity can have a strong influence over travel behaviour. Pupils from an ethnic minority background were more likely to travel to school via walking and cycling than motorised transport. The exception here is that in some cases Asian and Chinese pupils travelled more by car than White pupils.

Similarly, this finding implies targeting resources at pupils from Black, Mixed and White ethnic groups which already walk, cycle and use the bus more frequently whilst attempting to understand the reasons why Asian and Chinese pupils for example travel more by car.

Proposition 4 - Pupils from low income households do not travel as far to school as their higher income peers.

Thesis findings: Household income was found to be significant for primary school pupils, which suggests that as pupils get older, income has less of an influence on school travel.

As pupils from wealthier backgrounds tend to travel further than pupils from poorer backgrounds, it may be beneficial to look more broadly at education policies. For example, the Government might look to invest in poorer performing schools so as to raise their quality and hence make them more likely to attract pupils living locally from higher income backgrounds, rather than in seeking to introduce greater choice (with the implications of widening standards between schools).

Proposition 5 - Pupils living in less densely populated areas are likely to travel further to school than those residing in more urbanised locations.

Thesis findings: population density and the availability of bus services and active travel facilities do influence behaviour, but not to the extent of other factors such as pupil age.

When schools are located in densely populated areas it could be useful for LAs to consider introducing policies which integrate education transport services with other non-commercial operations to enhance their cost effectiveness.

LAs may also consider developing lift sharing schemes, (in a similar way to walking bus schemes) in which parents take their children to and from an agreed location near to their homes.

Proposition 6 - Distance to school significantly affects mode choice.

Thesis findings: Pupils living within 1 mile of their school tend to actively travel far more than those living further away.

It could therefore be advantageous to reconsider the location of schools (particularly in the planning of new schools) to ensure schools are located near residential areas (if possible within a 1 radius) to encourage more active travel. When schools are located just over 1 mile from homes it would be useful for LAs to consider introducing policies which integrate transport.

When designing and building new schools it would be useful for LAs to consider locating these schools closer to residential areas. It would also aid pupils if schools were located close to bus routes, road crossings and pedestrianised areas. In the case of established schools, LAs could work together with bus operators to reconsider some of the current bus routes and stops to see if schools could be better served by current public service buses.

As congestion around the school gate in residential areas can cause annoyance and resentment to other residents, LAs could consider more restrictions in place for non-residents. For example, cameras to record vehicles parking illegally and number plate recognition to try and reduce parents dropping their children right at the gate. Designated areas could be made, in which children can meet and walk together to school further to reduce congestion on local roads.

Proposition 7 - The policy allowing parental choice of schools leads to a considerable increase in vehicle miles travelled by car and associated wider impacts.

Thesis findings: There is clear evidence that the school choice policy has an impact on car use and impact on increasing levels of car use and associated effects.

It would be beneficial for the national Government to re-consider offering the school choice policy only to pupils of non-compulsory school age (i.e. Post 16 only). This is because the results showed that younger / primary school pupils are more reliant on travelling by private car than older pupils.

Therefore, if the school choice policy was no longer offered to pupils under the age of 16, car use should dramatically reduce and travel via non-motorised transport increase as was found in the results in Chapter 7.

Proposition 8 - Local authorities that offer only the statutory level of school transport provision experience lower levels of bus mileage per pupil on average than those with more generous policy guidelines.

Thesis findings: When free or subsidised travel is offered to pupils, bus passenger mileage increases. This is particularly evident when observing travel in London LAs. Yet it is also evident that it takes a great deal of funding to be able to provide more generous school transport policies and in the current economic climate this is difficult to offer.

Currently, the standard statutory bus provision policy offered to both age groups is relatively similar. It may help for LAs to reconsider the pupil and school level factors tested in the econometric analysis to further understand which factors are significant in influencing school travel.

To encourage more pupils to travel to school via public transport as opposed to the car, LAs should consider lowering the current distance limit set in the 1944 Education Act from 2-3 miles to 1-1.5 miles for pupils in England. This could help to ease congestion during peak travel times and reduce CO_2 emission by fewer pupils travelling to school by car who are currently not eligible for the statutory school transport provision but still living further than 1 mile from their school.

However, there is a risk that if all pupils were offered free unlimited bus travel, those living within walking distance (1 mile) of their current school could choose to travel by bus instead of walk or cycle. This could lead to further complications such as childhood obesity and too much capacity on the buses (which could lead to more buses required and therefore more VMT). If free travel was only offered to pupils living over 1.5 miles of their current school, this would still encourage pupils to walk and cycle when possible, but accommodate for those living over a reasonable walking distance (1 mile) but not far enough to be eligible for statutory bus provision (3 miles).

Proposition 9 - The higher the level of bus subsidy provided by a local authority per pupil, the greater the average bus mileage generated.

Thesis findings: Increasing levels of school transport subsidy to pupils tends to increase bus passenger mileage. However this comes at a cost and is sometimes not feasible particularly for LAs with less funding from the Government to spend on school transport and those with high SEN transport spending.

For this reason, it would beneficial for Government to reconsider the current budget allocated to LAs. Removing the current £400 million throughout England could result in 200,000 pupils travelling to school by other modes. It is likely that an increase in budget would have the opposite effect and would result in more pupils travelling to school by bus and therefore, mitigating traffic congestion and environmental impacts.

Wider Implications

However, in practice, if anything, the policy context seems to be moving in the opposite direction. In particular, budgets for managing access to school, measures such as promoting travel plans (particularly by walking and cycling), investments in infrastructure, non commercial bus services and safe routes to school and lollipop ladies / men have been cut. In addition, significant planning guidance has been relaxed potentially leading to housing and schools becoming more rather than less separated in some cases. Therefore, it is to be hoped that this thesis provides a warning light to policy makers in transport planning and education in continuing such an approach and perhaps might stimulate further research in this topic area.

Most recently, this summer the DfE stated that mode of travel to school will no longer be included in the School Census. This will mean that no monitoring or assessment of current school travel can now take place, nor any future analysis of the effectiveness of school travel plans and other school transport policies. Yet this thesis has shown how this information can be used in observing how pupils travel to school, and how changes in policy can significantly impact travel behaviour which can have further impacts on traffic and the environment. For this reason, it would be beneficial for national Government to continue to collect information on school travel annually to monitor how children are travelling to school and in particular, the distances that they are travelling.

10.4 Limitations

Prior to suggesting potential areas of future research, it is necessary to consider first the limitations of this thesis so far.

This study has provided insights into the impacts of policy on school travel focusing specifically on the school choice policy and the statutory home to school transport provision. During the research, inevitable compromises have been experienced during the undertaking of this study. The following section will elaborate on the limitations experienced in this study.

Interview Scoping Study

Interview based research presents some common limitations. Firstly, data can be too broad and therefore difficult to analyse (Davis et al, 2009, p.1398). To rectify this, the interview studies were carried out using a semi structured method to try and ensure the respondents referred to similar issues and themes.

The study would have benefitted from further interviews carried out with the stakeholders highlighted in the study. However, as found in the literature review, much of the research already undertaken has focused on the views of parents and children with regards to school travel. Also, many of the policy focused questions may not have been relevant therefore a different direction of the study may have been required.

Overall, the study could have been enhanced with more respondents taking part and from a more international background, and future studies may benefit from including more international examples of school travel policies in the future.

Multinomial logit and mixed multinomial logit modelling

The multinomial logit and mixed logit modelling techniques used in this study provided an in depth view of the impacts of the school choice policy on mode choice in school travel. The main limitation of this study was the restriction of sample size. Due to the size of the dataset, a full analysis was not possible due to computer and software limitations. Secondly, knowing each pupil's postcode would allow mapping of travel and what public bus alternatives are available, however currently this data is sensitive and access is limited.

Further research would require larger datasets being modelled to identify more trends and changes in travel. In particular, the inclusion of non-Government maintained schools (i.e. private, religious or specialist schools) to ensure the whole pupil population is included would greatly enhance this research. In addition if similar data was available for other countries which allow school choice such as the US, international studies would allow for further comparisons to take place to see how much VMT and CO_2 could be reduced.

Additional factors to enhance the current model would include school performance indicators as these may play a vital role in why parents choose certain schools over others.

Multilevel modelling

The multilevel model allowed an evaluation of the current statutory school transport provision policy to take place. It also measured the impacts that would occur if funding was to be removed and this policy no longer offered to pupils in England. The main implication for the multilevel model included the sample size, particularly in the case of school results. Not all results of schools surveyed in the School Census could be obtained and compared. Again, knowing each pupil's postcode would allow mapping of travel and what public bus alternatives are available, however this data is very sensitive and access is limited

In both exercises only Government maintained school were analysed as non-maintained school are not required to take part in the School Census. This excludes around 4,000 schools from the total number of schools in England. Further research could be undertaken to gather information direct from all non-maintained schools to provide a full country wide study of school travel in England.

10.5 Further Research

The findings from this thesis have been presented to the Knowledge Transfer Committee of Loughborough University with a proposal of a step change from transferring the theoretical findings of this research to producing the required resources to local authorities to enable them to model their own school travel behaviour and policy impacts.

£50,000 of funding for this project was granted in August 2011 from the Engineering and Physical Sciences Research Council to adapt the modelling techniques integrated in this research to creating a user-friendly programme which would allow local authorities, policy makers and school travel planners to model school travel and simulate the impacts that could occur as a result of changes in policy with the goal of helping practitioners and Government ensuring all school transport policies are cost effective and successful in ensuring children are travelling to school safely, on time and sustainably.

10.6 Contributions to knowledge

Current literature examined in the thesis identified the factors and issues which influence child travel behaviour. In particular, the level of parental influence was identified as one of the main reasons why children are increasingly being driven to school more by the personal car than walking, cycling or travelling by school bus. Parental concerns regarding safety were found to be one of the main influences of how children travel to school. Less direct parental influences included a parent's level of education and income. A child's surrounding natural and built environment were also found to have significant impacts on how children travel to school. Finally, current case studies were reviewed which investigated school transport policies have highlighted the issues of school choice resulting in increased levels of car. However, no current studies have investigated school transport policies at a higher national level.

An exploratory study into the views of current school travel experts further highlighted this gap and stressed the impact of the school choice policy in particular as causing an increase in school travel to school by car. The interviews also helped to illustrate the restrictions local authorities face in trying to discourage car use in school travel and the cost and legislative barriers they encounter.

The thesis attempted to address this research gap by undertaking a series of econometric models to analyse the impacts of both the school choice policy and the statutory bus transport provision in England using data collected from the 2009 School Census. The findings of these models reinforced how much individual school level and local authority factors influence school travel on top of the factors listed in the literature review.

The multinomial and mixed multinomial logit models sought to quantify the impacts of the school choice policy in England. The model results found that if all pupils travelled to their nearest school, vehicle miles travelled and CO_2 emissions reduced drastically for both primary and secondary school aged pupils. The multilevel model aimed to evaluate the impact of the statutory school transport provision policy and found that the removal of this policy and its funding would significantly reduce the level of bus passenger mileage in school travel. As a result, it is likely that this mileage would change to alternative modes but most likely change to car travel.

Overall, this study has presented a comprehensive investigation of the transport related impacts of policy on school travel. It has presented the extent to which car travel, bus travel and non motorised travel increases and decreases when policies are changed and the environmental impacts of these changes. It has shown how important the statutory school bus provision policy is to the pupils of England even though the initial policy was introduced almost 70 years ago.

Finally, it has shown some insight into the extent to which school travel as whole impacts on society. The traffic and CO_2 generated as a result of school travel becoming more car orientated.

Publications and Presentations

1. Van Ristell, J., Quddus, M, A., Enoch, M, P., Wang, C., Hardy, P., 2011 Quantifying the transport related impacts of parental school choice, University Transport Studies Group (UTSG) 43rd Annual Conference, Milton Keynes, 5th-7th January

2. Van Ristell, J., Quddus, M, A., Enoch, M, P., Wang, C., Hardy, P., 2011 The impacts of policy on school travel, Association of Transport Coordinators (ATCO) Summer Conference, Brighton, 15th-16th June

3. Van Ristell, J., 2011 Modelling the impacts of policy on school travel, University Transport Studies Group (UTSG) 44th Annual Conference, Aberdeen, 4th-6th January

4. Van Ristell, J., Quddus, M, A., Enoch, M, P., Wang, C., Hardy, P., 2011 Quantifying the transport related impacts of parental school choice, Transportation (under review)

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Appendices

Appendix 1 – Scoping Study

The scoping study will consist of 12 interviews with a combination of academics, consultants and transport planners.

The following questions are asked:

Context / Background

1. What do you feel are the main issues regarding school travel?
2. Do you feel these issues have changed over time and if so, how?
3. What do you feel should be the main objectives of a school travel service / policy?

Policy Design / Solutions

4. What do you believe are possible solutions to address the issues you have identified?
5. What issues do you see relating to the bus and school travel?

   5a. What role do you feel the bus plays with regards to school travel?
6. Who are the main stakeholders involved with school travel by bus? i.e. the school, children, parents, local authorities, DCSF?
7. Could you comment on what you believe are the main motivations for each of these stakeholders in relation to travel to school generally and to school in particular?
8. Could you comment on the main constraints preventing the use of the effective use of the bus in providing travel to school services?
9. What type of bus-based instruments do you see as being available to planners / bus operators / policy makers in delivering school travel?

   e.g. regulatory, fiscal, informational and technological

10. How effective do you feel some of your suggested bus-based instruments are in delivering school travel objectives?
11. What elements do you believe need to be in place for these types of bus-based instruments to be effective?

    e.g. Political support, economic issues, level of demand

12. Do you feel the bus is a suitable option for school travel as oppose to the personal car when compared to healthier alternatives such as cycling and walking?
13. Do you feel children can be encouraged to use the bus more as the main mode of transport travelling to and from school?
14. Do you think attitudes of parents, children and schools can be changed to encourage more school bus use?

Future

15. What kind of future challenges or circumstances do you see as potentially having an influence on this topic area?

    e.g. 14-19 education, changes in education system, changes in transport policy, changes in cost of travel

16. Are there any policy options you would like to see introduced or improved?

    What would need to be changed for this to happen?
17. Do you believe the bus has any future in school travel?
18. Why?

Appendix 2 – LA Spending Tables

Primary

La Ref	LA Name	Type of LA	La Primary Transport Policy	Annual Primary SEN Transport Spending (£)	Annual Primary (Non-SEN) Transport Spending (£)	No. Pupils in 2009	Spending per pupils in LA
201	City of London	Inner London	Generous	2,000	0	38	0.00
202	Camden	Inner London	Generous	1,855,123	39324	927	42.42
203	Greenwich	Inner London	Generous	38,294	31941	1891	16.89
204	Hackney	Inner London	Generous	1,419,508	0	1276	0.00
205	Hammersmith and Fulham	Inner London	Generous	0	0	902	0.00
206	Islington	Inner London	Generous	1,344,624	1344624	1184	1135.66
207	Kensington and Chelsea	Inner London	Generous	1,159,843	1159843	716	1619.89
208	Lambeth	Inner London	Generous	0	0	2134	0.00
209	Lewisham	Inner London	Generous	2,385,602	0	1440	0.00
210	Southwark	Inner London	Generous	2,709,322	23010	1483	15.52
211	Tower Hamlets	Inner London	Generous	0	0	1370	0.00
212	Wandsworth	Inner London	Generous	5,735	9486	1460	6.50
213	Westminster	Inner London	Generous	0	0	959	0.00
301	Barking and Dagenham	Outer London	Generous	2,153,259	0	1129	0.00
302	Barnet	Outer London	Generous	513,742	0	1905	0.00
303	Bexley	Outer London	Generous	395,000	0	940	0.00
304	Brent	Outer London	Generous	0	0	2074	0.00
305	Bromley	Outer London	Generous	985,872	985872	850	1159.85
306	Croydon	Outer London	Generous	781,812	0	1566	0.00
307	Ealing	Outer London	Generous	310,905	0	1557	0.00
308	Enfield	Outer London	Generous	352,579	72380	1473	49.14
309	Haringey	Outer London	Generous	513,327	0	2070	0.00
310	Harrow	Outer London	Generous	4,267,140	0	904	0.00
311	Havering	Outer London	Generous	198,690	37592	680	55.28
312	Hillingdon	Outer London	Generous	2,292,870	99885	902	110.74
313	Hounslow	Outer London	Generous	647,366	0	1234	0.00
314	Kingston upon Thames	Outer London	Generous	5,058	5058	452	11.19
315	Merton	Outer London	Standard	1,419,474	0	631	0.00
316	Newham	Outer London	Generous	0	0	1517	0.00
317	Redbridge	Outer London	Generous	348,863	55675	1309	42.53
318	Richmond upon Thames	Outer London	Generous	228,813	20845	498	41.86
319	Sutton	Outer London	Generous	355,800	79400	510	155.69
320	Waltham Forest	Outer London	Generous	0	0	1097	0.00
330	Birmingham	Metropolitan	Generous	525,498	214176	4523	47.35
331	Coventry	Metropolitan	Standard	182,628	429837	572	751.46

332	Dudley	Metropolitan	Standard	0	302307	515	587.00
333	Sandwell	Metropolitan	Standard	321,000	9000	707	12.73
334	Solihull	Metropolitan	Standard	231,403	242862	402	604.13
335	Walsall	Metropolitan	Standard	1,759,018	0	738	0.00
336	Wolverhampton	Metropolitan	Standard	424,400	0	619	0.00
340	Knowsley	Metropolitan	Standard	72,307	5872	207	28.37
341	Liverpool	Metropolitan	Standard	0	737077	1496	492.70
342	St. Helens	Metropolitan	Standard	0	35000	280	125.00
343	Sefton	Metropolitan	Standard	130,519	30169	543	55.56
344	Wirral	Metropolitan	Standard	300,200	59300	839	70.68
350	Bolton	Metropolitan	Standard	170,981	0	377	0.00
351	Bury	Metropolitan	Standard	326,400	4900	266	18.42
352	Manchester	Metropolitan	Standard	397,358	67493	1483	45.51
353	Oldham	Metropolitan	Standard	0	0	427	0.00
354	Rochdale	Metropolitan	Standard	69,542	28184	378	74.56
355	Salford	Metropolitan	Standard	708,099	0	440	0.00
356	Stockport	Metropolitan	Standard	0	0	616	0.00
357	Tameside	Metropolitan	Standard	0	0	460	0.00
358	Trafford	Metropolitan	Standard	299,702	40881	383	106.74
359	Wigan	Metropolitan	Standard	0	271460	378	718.15
370	Barnsley	Metropolitan	Standard	195,726	205152	249	823.90
371	Doncaster	Metropolitan	Standard	70,122	640645	735	871.63
372	Rotherham	Metropolitan	Standard	124,123	188946	486	388.78
373	Sheffield	Metropolitan	Standard	0	331933	1791	185.33
380	Bradford	Metropolitan	Standard	112,239	0	1197	0.00
381	Calderdale	Metropolitan	Standard	71,338	45126	594	75.97
382	Kirklees	Metropolitan	Standard	519,129	71880	1260	57.05
383	Leeds	Metropolitan	Standard	1,388,420	1192960	1775	672.09
384	Wakefield	Metropolitan	Standard	483,639	25317	417	60.71
390	Gateshead	Metropolitan	Standard	0	71030	637	111.51
391	Newcastle upon Tyne	Metropolitan	Standard	0	93644	1766	53.03
392	North Tyneside	Metropolitan	Standard	0	105155	494	212.86
393	South Tyneside	Metropolitan	Standard	285,406	25394	434	58.51
394	Sunderland	Metropolitan	Standard	212,850	62815	421	149.20
420	Ilses of Scilly	Urban	Standard	1,000	37,470	337	111.19
800	Bath and North East Somerset	Urban	Standard	1,232,331	772402	337	2291.99
801	Bristol, City of	Urban	Standard	919,267	354088	573	617.95
802	North Somerset	Urban	Standard	69,449	561902	448	1254.25
803	South Gloucestershire	Urban	Standard	532,000	459000	291	1577.32
805	Hartlepool	Urban	Standard	100,805	33792	185	182.66
806	Middlesbrough	Urban	Standard	407,907	35450	321	110.44
807	Redcar and Cleveland	Urban	Standard	260,088	186302	395	471.65
808	Stockton-on-Tees	Urban	Standard	275,657	368393	438	841.08
810	Kingston Upon Hull, City of	Urban	Standard	560,223	24800	587	42.25

811	East Riding of Yorkshire	Urban	Standard	2,002,858	2697077	849	3176.77
812	North East Lincolnshire	Urban	Standard	1,333,879	487236	250	1948.94
813	North Lincolnshire	Urban	Standard	62,577	335584	548	612.38
815	North Yorkshire	Rural	Standard	252,163	3948627	2831	1394.78
816	York	Urban	Standard	0	221093	268	824.97
821	Luton	Urban	Standard	0	506286	504	1004.54
822	Bedford Borough	Rural	Standard	0	1,447,698	1248	1160.01
823	Central Bedfordshire	Rural	Standard	0	801,815	1250	641.45
825	Buckinghamshire	Rural	Standard	2,802,100	4806070	1553	3094.70
826	Milton Keynes	Urban	Standard	0	437113	473	924.13
830	Derbyshire	Rural	Standard	727,927	852939	1352	630.87
831	Derby	Urban	Standard	456,563	89791	395	227.32
835	Dorset	Rural	Standard	0	1722524	2289	752.52
836	Poole	Urban	Standard	0	176967	278	636.57
837	Bournemouth	Urban	Standard	88,056	260439	275	947.05
840	Durham	Rural	Standard	42,725	966983	1283	753.69
841	Darlington	Urban	Standard	374,406	535278	241	2221.07
845	East Sussex	Rural	Standard	0	597716	668	894.78
846	Brighton and Hove	Urban	Standard	366,051	121543	832	146.09
850	Hampshire	Rural	Standard	1,164,300	2223200	2856	778.43
851	Portsmouth	Rural	Standard	100,881	6212	383	16.22
852	Southampton	Rural	Standard	1,627,324	150493	521	288.85
855	Leicestershire	Rural	Standard	47,562	1146913	1520	754.55
856	Leicester	Urban	Standard	1,674,550	258651	711	363.78
857	Rutland	Urban	Standard	0	0	159	0.00
860	Staffordshire	Rural	Standard	282,440	1462560	1908	766.54
861	Stoke-on-Trent	Urban	Standard	0	119935	406	295.41
865	Wiltshire	Rural	Standard	1,830,349	2207440	1575	1401.55
866	Swindon	Urban	Standard	936,699	856939	364	2354.23
867	Bracknell Forest	Urban	Standard	254,121	9622	57	168.81
868	Windsor and Maidenhead	Urban	Standard	511,541	72079	106	679.99
869	West Berkshire	Urban	Standard	25,580	395874	300	1319.58
870	Reading	Urban	Standard	81,396	40776	293	139.17
871	Slough	Urban	Standard	179,691	28000	259	108.11
872	Wokingham	Urban	Standard	0	71834	130	552.57
873	Cambridgeshire	Rural	Standard	0	2527123	1675	1508.73
874	Peterborough	Urban	Standard	207,492	194316	316	614.92
876	Halton	Urban	Standard	0	0	235	0.00
877	Warrington	Urban	Standard	368,360	0	348	0.00
878	Devon	Rural	Standard	2,429,759	7574702	2609	2903.30
879	Plymouth	Urban	Standard	473,689	94360	458	206.03
880	Torbay	Urban	Standard	174,020	88848	162	548.44
881	Essex	Rural	Standard	0	9589285	3124	3069.55
882	Southend-on-Sea	Urban	Standard	184,905	93519	122	766.55

883	Thurrock	Urban	Standard	0	560115	318	1761.37
884	Herefordshire	Rural	Standard	0	1097280	980	1119.67
885	Worcestershire	Rural	Standard	663,965	1340781	1835	730.67
886	Kent	Rural	Standard	3,913,476	8456934	2031	4163.93
887	Medway	Urban	Standard	1,483,960	623855	354	1762.30
888	Lancashire	Rural	Standard	4,341,008	3848638	2001	1923.36
889	Blackburn with Darwen	Urban	Standard	121,371	130273	192	678.51
890	Blackpool	Urban	Standard	716,255	139951	460	304.24
891	Nottinghamshire	Rural	Standard	0	2564920	1502	1707.67
892	Nottingham	Urban	Standard	1,309,085	407817	670	608.68
893	Shropshire	Rural	Standard	304,854	2413044	1553	1553.80
894	Telford & Wrekin	Urban	Standard	147,197	239786	397	603.99
895	Cheshire	Rural	Standard	886,811	1,043,951	629	1659.70
896	Cheshire and west Chester	Rural	Standard	564,334	935,934	630	1485.61
908	Cornwall	Rural	Standard	0	4627899	704	6573.72
909	Cumbria	Rural	Standard	899,060	3582812	2087	1716.73
916	Gloucestershire	Rural	Standard	321,522	1607611	1221	1316.63
919	Hertfordshire	Rural	Standard	0	3125687	1388	2251.94
921	Isle of Wight	Urban	Standard	0	83055	738	112.54
925	Lincolnshire	Rural	Standard	0	5051024	2378	2124.06
926	Norfolk	Rural	Standard	3,153,874	4169574	2266	1840.06
928	Northamptonshire	Rural	Standard	3,545,437	3620509	1309	2765.86
929	Northumberland	Rural	Standard	0	1133750	2421	468.30
931	Oxfordshire	Rural	Standard	1,316,832	2495144	1821	1370.21
933	Somerset	Rural	Standard	139,044	1669426	1700	982.02
935	Suffolk	Rural	Standard	3,669,328	7122810	3791	1878.87
936	Surrey	Rural	Standard	4,312,321	2233965	2302	970.45
937	Warwickshire	Rural	Standard	148,838	1640602	1318	1244.77
938	West Sussex	Rural	Standard	0	7837482	1168	6710.17

Secondary

La Ref	LA Name	Type of LA	La Primary Transport Policy	Annual Secondary SEN Transport Spending (£)	Annual Secondary (Non-SEN) Transport Spending (£)	No. pupils in 2009	Spending per pupil in LA
201	City of London	Inner London	Generous	7,000	0	0	0
202	Camden	Inner London	Generous	1,647,772	34929	2754	12.68
203	Greenwich	Inner London	Generous	86,162	24089	7332	3.29
204	Hackney	Inner London	Generous	924,702	0	3105	0.00
205	Hammersmith and Fulham	Inner London	Generous	0	0	2508	0.00
206	Islington	Inner London	Generous	692,804	692804	4303	161.00
207	Kensington and Chelsea	Inner London	Generous	476,283	476283	1515	314.38
208	Lambeth	Inner London	Generous	0	0	5473	0.00
209	Lewisham	Inner London	Generous	1,089,381	556	3959	0.14
210	Southwark	Inner London	Generous	877,984	7457	5785	1.29
211	Tower Hamlets	Inner London	Generous	0	253015	4096	61.77
212	Wandsworth	Inner London	Generous	14,336	79976	4851	16.49
213	Westminster	Inner London	Generous	0	0	2407	0.00
301	Barking and Dagenham	Outer London	Generous	1,518,637	0	3414	0.00
302	Barnet	Outer London	Generous	511,740	163319	7702	21.20
303	Bexley	Outer London	Generous	129,000	6000	5818	1.03
304	Brent	Outer London	Generous	0	0	6855	0.00
305	Bromley	Outer London	Generous	77,773	77773	9132	8.52
306	Croydon	Outer London	Generous	300,472	0	7420	0.00
307	Ealing	Outer London	Generous	109,237	0	4795	0.00
308	Enfield	Outer London	Generous	139,632	82560	5975	13.82
309	Haringey	Outer London	Generous	410,662	0	5029	0.00

310	Harrow	Outer London	Generous	1,916,357	0	3161	0.00
311	Havering	Outer London	Generous	318,950	32585	7077	4.60
312	Hillingdon	Outer London	Generous	1,699,569	74039	5394	13.73
313	Hounslow	Outer London	Generous	226,578	0	5933	0.00
314	Kingston upon Thames	Outer London	Generous	5,058	5058	3683	1.37
315	Merton	Outer London	Standard	828,027	0	4638	0.00
316	Newham	Outer London	Generous	0	0	5613	0.00
317	Redbridge	Outer London	Generous	470,477	75084	6284	11.95
318	Richmond upon Thames	Outer London	Generous	48,977	51233	3269	15.67
319	Sutton	Outer London	Generous	399,200	57000	5367	10.62
320	Waltham Forest	Outer London	Generous	0	0	3868	0.00
330	Birmingham	Metropolitan	Standard	1,505,851	397766	19794	20.10
331	Coventry	Metropolitan	Standard	168,846	12652	5182	2.44
332	Dudley	Metropolitan	Standard	0	234934	1885	124.63
333	Sandwell	Metropolitan	Standard	347,800	206500	3271	63.13
334	Solihull	Metropolitan	Standard	395,622	258742	3836	67.45
335	Walsall	Metropolitan	Standard	1,230,766	0	4451	0.00
336	Wolverhampton	Metropolitan	Standard	606,300	0	3744	0.00
340	Knowsley	Metropolitan	Standard	77,736	6313	841	7.51
341	Liverpool	Metropolitan	Standard	0	997792	11276	88.49
342	St. Helens	Metropolitan	Standard	0	337639	3262	103.51
343	Sefton	Metropolitan	Standard	326,310	75189	4837	15.54
344	Wirral	Metropolitan	Standard	209,400	399300	7560	52.82
350	Bolton	Metropolitan	Standard	313,465	261900	6735	38.89
351	Bury	Metropolitan	Standard	207,300	335800	3867	86.84
352	Manchester	Metropolitan	Standard	662,263	3022489	8695	347.61
353	Oldham	Metropolitan	Standard	0	0	4574	0.00
354	Rochdale	Metropolitan	Standard	128,326	309014	3713	83.22
355	Salford	Metropolitan	Standard	130,290	106860	2801	38.15
356	Stockport	Metropolitan	Standard	0	0	4782	0.00
357	Tameside	Metropolitan	Standard	0	0	5490	0.00
358	Trafford	Metropolitan	Standard	152,891	20855	4633	4.50
359	Wigan	Metropolitan	Standard	0	772618	6556	117.85
370	Barnsley	Metropolitan	Standard	254,555	195928	5414	36.19
371	Doncaster	Metropolitan	Standard	239,286	1163899	7211	161.41
372	Rotherham	Metropolitan	Standard	35,524	412046	5201	79.22
373	Sheffield	Metropolitan	Standard	0	304977	9835	31.01
380	Bradford	Metropolitan	Standard	72,340	3770559	11253	335.07
381	Calderdale	Metropolitan	Standard	1,394,487	882114	6635	132.95
382	Kirklees	Metropolitan	Standard	317,423	553160	7142	77.45

383	Leeds	Metropolitan	Standard	2,304,880	907360	15249	59.50
384	Wakefield	Metropolitan	Standard	898,186	475589	5538	85.88
390	Gateshead	Metropolitan	Standard	0	110034	3814	28.85
391	Newcastle upon Tyne	Metropolitan	Standard	0	338235	5238	64.57
392	North Tyneside	Metropolitan	Standard	0	105155	2024	51.95
393	South Tyneside	Metropolitan	Standard	152,896	53962	3657	14.76
394	Sunderland	Metropolitan	Standard	286,357	56914	3915	14.54
420	Ilses of Scilly	Urban	Standard	0	0	0	#DIV/0!
800	Bath and North East Somerset	Urban	Standard	1,320,177	827,463	5035	164.34
801	Bristol, City of	Urban	Standard	261,027	778257	3353	232.11
802	North Somerset	Urban	Standard	172,196	1393220	3311	420.79
803	South Gloucestershire	Urban	Standard	280,000	1579000	2416	653.56
805	Hartlepool	Urban	Standard	72,806	263153	1647	159.78
806	Middlesbrough	Urban	Standard	317,316	311964	1619	192.69
807	Redcar and Cleveland	Urban	Standard	75,859	536548	2009	267.07
808	Stockton-on-Tees	Urban	Standard	1,604,116	671935	2355	285.32
810	Kingston Upon Hull, City of	Urban	Standard	1,558,872	33408	4294	7.78
811	East Riding of Yorkshire	Urban	Standard	2,423,550	3477836	7542	461.13
812	North East Lincolnshire	Urban	Standard	782,408	1504472	1653	910.15
813	North Lincolnshire	Urban	Standard	125,154	386816	3397	113.87
815	North Yorkshire	Rural	Standard	828,932	12529500	18433	679.73
816	York	Urban	Standard	0	1164753	2525	461.29
821	Luton	Urban	Standard	0	681,853	1581	431.28
822	Bedford Borough	Rural	Standard	0	2,058,222	4035	510.09
823	Central Bedfordshire	Rural	Standard	0	4,457,064	4035	1104.60
825	Buckinghamshire	Rural	Standard	3,286,946	5,637,662	12893	437.27
826	Milton Keynes	Urban	Standard	0	1378541	1997	690.31
830	Derbyshire	Rural	Standard	989,337	5354824	14556	367.88
831	Derby	Urban	Standard	295,244	446823	3371	132.55
835	Dorset	Rural	Standard	0	5075776	9415	539.12
836	Poole	Urban	Standard	0	610020	1836	332.25
837	Bournemouth	Urban	Generous	29,352	5315	2558	2.08
840	Durham	Rural	Standard	62,725	7857917	12735	617.03
841	Darlington	Urban	Standard	239,374	342227	1767	193.68
845	East Sussex	Rural	Standard	79,649	2747859	6896	398.47
846	Brighton and Hove	Urban	Standard	100,080	253051	3580	70.68
850	Hampshire	Rural	Standard	1,825,500	6673800	14634	456.05
851	Portsmouth	Rural	Standard	208,446	12836	1701	7.55
852	Southampton	Rural	Standard	1,655,611	200207	1542	129.84
855	Leicestershire	Rural	Standard	346,701	7375954	15369	479.92

856	Leicester	Urban	Standard	1,424,816	220077	3585	61.39
857	Rutland	Urban	Standard	0	0	1262	0.00
860	Staffordshire	Rural	Standard	172,110	6553012	11133	588.61
861	Stoke-on-Trent	Urban	Standard	0	503715	1936	260.18
865	Wiltshire	Rural	Standard	2,107,506	6990226	8448	827.44
866	Swindon	Urban	Standard	606,694	555034	1902	291.82
867	Bracknell Forest	Urban	Standard	237,180	250323	504	496.67
868	Windsor and Maidenhead	Urban	Standard	625,216	736222	1422	517.74
869	West Berkshire	Urban	Standard	0	1820351	3248	560.45
870	Reading	Urban	Standard	509,732	255339	1345	189.84
871	Slough	Urban	Standard	81,678	285000	1500	190.00
872	Wokingham	Urban	Standard	0	808541	1697	476.45
873	Cambridgeshire	Rural	Standard	0	7142358	11463	623.08
874	Peterborough	Urban	Standard	385,342	1307351	2602	502.44
876	Halton	Urban	Standard	0	28839	1598	18.05
877	Warrington	Urban	Standard	835,041	0	3759	0.00
878	Devon	Rural	Standard	2,601,683	8110671	15997	507.01
879	Plymouth	Urban	Standard	475,394	714903	3241	220.58
880	Torbay	Urban	Standard	50,530	630673	1866	337.98
881	Essex	Rural	Standard	0	6200744	21684	285.96
882	Southend-on-Sea	Urban	Standard	55,471	225831	3083	73.25
883	Thurrock	Urban	Standard	0	767500	1567	489.79
884	Herefordshire	Rural	Standard	0	2321233	3943	588.70
885	Worcestershire	Rural	Standard	671,427	4833429	8724	554.04
886	Kent	Rural	Standard	3,460,705	7478506	30555	244.76
887	Medway	Urban	Standard	1,361,167	572369	2897	197.57
888	Lancashire	Rural	Standard	5,559,537	4928958	24064	204.83
889	Blackburn with Darwen	Urban	Standard	182,994	521094	2369	219.96
890	Blackpool	Urban	Standard	629,914	123062	1572	78.28
891	Nottinghamshire	Rural	Standard	0	2080798	11499	180.95
892	Nottingham	Urban	Standard	891,530	277737	3251	85.43
893	Shropshire	Rural	Standard	304,854	4378193	7043	621.64
894	Telford & Wrekin	Urban	Standard	373,804	839253	2643	317.54
895	Cheshire	Rural	Standard	800,313	3,672,879	6089	603.20
896	Cheshire and west Chester	Rural	Standard	524,909	3,257,915	6089	535.05
908	Cornwall	Rural	Standard	0	4439846	11368	390.56
909	Cumbria	Rural	Standard	1,031,940	7,921,527	11043	717.33
916	Gloucestershire	Rural	Standard	375,109	6480443	12830	505.10
919	Hertfordshire	Rural	Standard	0	7819296	17492	447.02
921	Isle of Wight	Urban	Standard	0	1662197	2495	666.21
925	Lincolnshire	Rural	Standard	0	13084749	18232	717.68
926	Norfolk	Rural	Standard	654,467	12508721	16259	769.34
928	Northamptonshire	Rural	Standard	2,819,125	2878817	13174	218.52
929	Northumberland	Rural	Standard	0	8491090	5871	1446.28
931	Oxfordshire	Rural	Standard	2,194,719	4158574	11580	359.12
933	Somerset	Rural	Standard	325,490	7762230	8325	932.40

935	Suffolk	Rural	Standard	2,357,077	4575500	12735	359.29
936	Surrey	Rural	Standard	2,479,483	8014257	14134	567.02
937	Warwickshire	Rural	Standard	1,141,094	6562409	8943	733.80
938	West Sussex	Rural	Standard	0	6196936	10193	607.96

Post 16

La Ref	LA Name	Type of LA	LA Post 16 Policy	Annual Post 16 SEN Transport Spending (£)	Annual Post 16 (Non-SEN) Transport Spending (£)	No. pupils in 2009	Spend per bus user
201	City of London	Inner London	Generous	8,000	0	0	0.00
202	Camden	Inner London	Generous	0	13	398	0.03
203	Greenwich	Inner London	Generous	0	0	1027	0.00
204	Hackney	Inner London	Generous	163,727	0	238	0.00
205	Hammersmith and Fulham	Inner London	Generous	0	0	266	0.00
206	Islington	Inner London	Generous	0	9310	65	143.23
207	Kensington and Chelsea	Inner London	Generous	0	0	115	0.00
208	Lambeth	Inner London	Generous	0	51000	264	193.18
209	Lewisham	Inner London	Generous	208,309	580	256	2.27
210	Southwark	Inner London	Generous	0	0	151	0.00
211	Tower Hamlets	Inner London	Generous	211,615	0	299	0.00
212	Wandsworth	Inner London	Generous	47,200	0	427	0.00
213	Westminster	Inner London	Generous	0	0	258	0.00
301	Barking and Dagenham	Outer London	Generous	0	0	335	0.00
302	Barnet	Outer London	Generous	41,150	28821	913	31.57
303	Bexley	Outer London	Generous	17,000	41000	435	94.25
304	Brent	Outer London	Generous	0	0	878	0.00
305	Bromley	Outer London	Generous	105,461	19425	939	20.69
306	Croydon	Outer London	Generous	0	0	401	0.00
307	Ealing	Outer London	Generous	0	0	314	0.00
308	Enfield	Outer London	Generous	140,850	0	414	0.00
309	Haringey	Outer London	Generous	29,700	0	732	0.00
310	Harrow	Outer London	Generous	0	0	158	0.00
311	Havering	Outer London	Generous	177,199	0	331	0.00
312	Hillingdon	Outer London	Generous	0	52630	504	104.42
313	Hounslow	Outer London	Generous	172,587	0	593	0.00
314	Kingston upon Thames	Outer London	Generous	11,802	6744	493	13.68
315	Merton	Outer London	Generous	56,840	0	203	0.00
316	Newham	Outer London	Generous	0	0	236	0.00
317	Redbridge	Outer London	Generous	393,592	0	865	0.00
318	Richmond upon Thames	Outer London	Generous	0	0	11	0.00
319	Sutton	Outer London	Generous	19,100	0	610	0.00
320	Waltham Forest	Outer London	Generous	105,364	0	97	0.00
330	Birmingham	Metropolitan	Generous	0	144632	1378	104.96
331	Coventry	Metropolitan	Generous	57,799	0	439	0.00
332	Dudley	Metropolitan	Generous	0	0	47	0.00

333	Sandwell	Metropolitan	Generous	0	119200	136	876.47
334	Solihull	Metropolitan	Generous	11,462	0	237	0.00
335	Walsall	Metropolitan	Generous	0	0	451	0.00
336	Wolverhampton	Metropolitan	Generous	106,800	0	356	0.00
340	Knowsley	Metropolitan	Standard	0	0	24	0.00
341	Liverpool	Metropolitan	Standard	438,911	74843	995	75.22
342	St. Helens	Metropolitan	Generous	196,000	0	150	0.00
343	Sefton	Metropolitan	Standard	184,600	352150	268	1313.99
344	Wirral	Metropolitan	Standard	86,400	82500	660	125.00
350	Bolton	Metropolitan	Generous	0	0	329	0.00
351	Bury	Metropolitan	Generous	0	0	26	0.00
352	Manchester	Metropolitan	Generous	352,268	480000	289	1660.90
353	Oldham	Metropolitan	Generous	0	0	286	0.00
354	Rochdale	Metropolitan	Generous	92,878	0	124	0.00
355	Salford	Metropolitan	Generous	0	152413	24	6350.54
356	Stockport	Metropolitan	Generous	111,949	0	9	0.00
357	Tameside	Metropolitan	Generous	0	30000	55	545.45
358	Trafford	Metropolitan	Generous	31,143	0	194	0.00
359	Wigan	Metropolitan	Generous	58,769	2971	112	26.53
370	Barnsley	Metropolitan	Generous	0	0	90	0.00
371	Doncaster	Metropolitan	Generous	197,506	405176	600	675.29
372	Rotherham	Metropolitan	Generous	49,512	0	277	0.00
373	Sheffield	Metropolitan	Generous	6823	1704	649	2.63
380	Bradford	Metropolitan	Generous	0	0	890	0.00
381	Calderdale	Metropolitan	Generous	0	0	573	0.00
382	Kirklees	Metropolitan	Generous	125,313	0	323	0.00
383	Leeds	Metropolitan	Generous	665,540	874440	978	894.11
384	Wakefield	Metropolitan	Generous	0	0	298	0.00
390	Gateshead	Metropolitan	Generous	145,839	421	276	1.53
391	Newcastle upon Tyne	Metropolitan	Generous	145,510	0	398	0.00
392	North Tyneside	Metropolitan	Generous	148,664	60521	103	587.58
393	South Tyneside	Metropolitan	Generous	180,000	20000	138	144.93
394	Sunderland	Metropolitan	Generous	248,071	0	236	0.00
420	Ilses of Scilly	Urban	Standard	0	25,000	0	0.00
800	Bath and North East Somerset	Urban	Standard	4732.8	218059	255	855.13
801	Bristol, City of	Urban	Standard	205,342	0	252	0.00
802	North Somerset	Urban	Generous	67,665	625	246	2.54
803	South Gloucestershire	Urban	Standard	140,000	0	237	0.00
805	Hartlepool	Urban	Standard	5,265	41460	65	637.85
806	Middlesbrough	Urban	Generous	119,592	71021	39	1821.05
807	Redcar and Cleveland	Urban	Generous	6,625	163686	26	6295.62
808	Stockton-on-Tees	Urban	Generous	0	138135	96	1438.91
810	Kingston Upon Hull, City of	Urban	Standard	0	0	120	0.00
811	East Riding of Yorkshire	Urban	Standard	0	0	376	0.00

812	North East Lincolnshire	Urban	Standard	181,914	0	37	0.00
813	North Lincolnshire	Urban	Standard	270,850	597110	37	16138.11
815	North Yorkshire	Rural	Standard	450,628	1806463	1370	1318.59
816	York	Urban	Standard	0	77725	157	495.06
821	Luton	Urban	Generous	0	435182	76	5726.08
822	Bedford Borough	Rural	Standard	184,266	228,410	323	707.15
823	Central Bedfordshire	Rural	Standard	276,398	342,615	323	1060.73
825	Buckinghamshire	Rural	Standard	738,115	136150	1489	91.44
826	Milton Keynes	Urban	Generous	0	191464	269	711.76
830	Derbyshire	Rural	Generous	843,065	0	946	0.00
831	Derby	Urban	Generous	143,057	3957	128	30.91
835	Dorset	Rural	Standard	222,200	213700	719	297.22
836	Poole	Urban	Standard	0	147685	237	623.14
837	Bournemouth	Urban	Standard	0	86008	247	348.21
840	Durham	Rural	Standard	199,247	1682322	915	1838.60
841	Darlington	Urban	Standard	7,535	51485	61	844.02
845	East Sussex	Rural	Generous	0	613619	191	3212.66
846	Brighton and Hove	Urban	Generous	266,170	95200	108	881.48
850	Hampshire	Rural	Standard	1,166,600	252900	163	1551.53
851	Portsmouth	Rural	Standard	8,152	62248	16	3890.50
852	Southampton	Rural	Standard	211,800	0	29	0.00
855	Leicestershire	Rural	Standard	499,931	961467	1336	719.66
856	Leicester	Urban	Standard	562,912	65888	149	442.20
857	Rutland	Urban	Standard	0	0		0.00
860	Staffordshire	Rural	Standard	108,210	566870	746	759.88
861	Stoke-on-Trent	Urban	Standard	0	0	51	0.00
865	Wiltshire	Rural	Standard	136,909	832582	513	1622.97
866	Swindon	Urban	Standard	0	0	96	0.00
867	Bracknell Forest	Urban	Standard	115131	0	39	0.00
868	Windsor and Maidenhead	Urban	Standard	78,016	81041	108	750.38
869	West Berkshire	Urban	Standard	17,700	257185	272	945.53
870	Reading	Urban	Generous	0	20000	161	124.22
871	Slough	Urban	Generous	0	21806	190	114.77
872	Wokingham	Urban	Standard	0	0	139	0.00
873	Cambridgeshire	Rural	Standard	0	1724445	408	4226.58
874	Peterborough	Urban	Standard	0	0	247	0.00
876	Halton	Urban	Generous	280,520	0	46	0.00
877	Warrington	Urban	Standard	0	476380	165	2887.15
878	Devon	Rural	Standard	0	2582371	856	3016.79
879	Plymouth	Urban	Standard	229,428	75970	389	195.30
880	Torbay	Urban	Standard	92,486	205817	191	1077.58
881	Essex	Rural	Standard	2,066,448	1491115	1312	1136.52
882	Southend-on-Sea	Urban	Standard	23,556	96600	308	313.64
883	Thurrock	Urban	Generous	0	388604	22	17663.82
884	Herefordshire	Rural	Standard	0	730726	94	7773.68
885	Worcestershire	Rural	Standard	499,401	604646	551	1097.36
886	Kent	Rural	Standard	215,946	1223690	2502	489.08

887	Medway	Urban	Standard	0	85200	219	389.04
888	Lancashire	Rural	Standard	0	0	902	0.00
889	Blackburn with Darwen	Urban	Standard	89,735	0	136	0.00
890	Blackpool	Urban	Standard	72,327	0	35	0.00
891	Nottinghamshire	Rural	Generous	0	474346	728	651.57
892	Nottingham	Urban	Standard	304,640	0	186	0.00
893	Shropshire	Rural	Standard	0	639717	247	2589.95
894	Telford & Wrekin	Urban	Standard	156,881	418345	204	2050.71
895	Cheshire	Rural	Standard	25,352	1,152,871	457	2522.69
896	Cheshire and west Chester	Rural	Standard	46,759	1,087,113	458	2373.61
908	Cornwall	Rural	Standard	71,263	1348708	412	3273.56
909	Cumbria	Rural	Standard	151,074	1127000	811	1389.64
916	Gloucestershire	Rural	Standard	728,085	436851	953	458.40
919	Hertfordshire	Rural	Generous	0	159650	1619	98.61
921	Isle of Wight	Urban	Generous	0	515631	174	2963.40
925	Lincolnshire	Rural	Standard	16,233	3818363	1149	3323.21
926	Norfolk	Rural	Generous	1,177,096	2746558	728	3772.74
928	Northamptonshire	Rural	Standard	361,920	0	964	0.00
929	Northumberland	Rural	Standard	97880	1205430	509	2368.23
931	Oxfordshire	Rural	Standard	1,019,253	28737	792	36.28
933	Somerset	Rural	Standard	17,043	2652857	241	11007.71
935	Suffolk	Rural	Generous	0	733780	927	791.56
936	Surrey	Rural	Generous	751,969	446675	634	704.53
937	Warwickshire	Rural	Standard	0	2057593	596	3452.34
938	West Sussex	Rural	Generous	325,400	233300	515	453.01