Active transportation to school

How shared space may enhance active and sustainable travel among children

Alessio Sitran

promotor :
Prof. dr. Tom BRIJS

co-promotor :
Drs. Marjolein DE JONG

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universiteit hasselt

Preface

This thesis is submitted in fulfilment of the Master of Science degree in Transportation Sciences at the Hasselt University.

The thesis discusses the topic of Active Transportation to School (ATS), and in particular examines how *Shared Space* may enhance active and sustainable travel among children for their school journeys.

The thesis provides an overview of the current children's mobility patterns and the impacts on their psycho-physical development generated by the increasing car use as main mode of transport for school trips. This sets, then, the rationale for the need to achieve a greater degree of active travel.

Having active travel to school emerged as a promising tool for addressing the decline of walking and cycling among children, the thesis also describes the main showcases across Europe and worldwide, where ATS has proved to successfully increase the rate of children making use of walking and cycling as preferred modal choice for school journeys.

This has been further linked to the concept of *Shared Space*. Though active travel to school is not a primary goal for *Shared Space*, the latter has the potential to improve those elements of the external built and traffic environment, which in turn may also promote a greater willingness to use more sustainable modes of transport, like walking and cycling for bringing children to school. Such conclusion has also been corroborated by the parents' views collected through the questionnaire-based survey in Castelfranco Veneto (North-Eastern part of Italy) which, on the one side, has further confirmed the predominant role of private car as main mode of transport for school trips, but, on the other side, offers the potential for: (i) creating opportunities for establishing human and social links, and (ii) enabling children to learn autonomously both nature and dangers of the traffic environment.

A key finding of the thesis is the elaboration of a theoretical model to define children's mobility patterns. Such model aims to explain the choice for a specific mode of transportation by incorporating a travel behaviour and the effects of urban structure in terms of accessibility. Specifically, this model may be regarded as an attempt to identify which determinants are key in coming to a specific decision about how children travel to school. In this respect, *Shared Space* positions itself as the long-term planning component of a more comprehensive urban mobility strategy, where the concept of sustainability goes beyond the simple reduction of mobility-related environmental impacts for also embracing elements like safety and healthy benefits of active travel.

Summary

Modern urban areas are progressively failing to create a suitable realm for children, which implies an increasingly problematic relationship between them and the urban environment where they live. This results in fewer social opportunities for children, but more importantly also impacts on their mobility as well, since one of the main implications is that walking and cycling rates have dramatically declined as children are increasingly accompanied by car by their parents either to school or to other activities. Partly, this is the product of our motorised society and new lifestyle trends that have been occurring during the last decades. Partly, this is tied to a number of complex factors (traffic and social safety concerns, too long distance from home, parental time pressure) that explain why parents motivate their modal behaviour by making use of their private car for bringing their children to school. This patterns are further confirmed by the presentation and discussion of how children use to travel to school in Castelfranco Veneto, a small-sized town located in the North-Eastern part of Italy. Data collected provided an opportunity to evaluate to what extent the observed mobility patterns align to the research in this field, and to identify those determinants that weigh the most in establishing children's mobility patterns during their school journeys.

Significantly, though school-related journeys generally constitute a small fraction of overall transport demand, they often take place at the busiest times of day, leading to congestion and subsequently more emissions. As a result, traffic and congestion are increased, which creates a vicious circle since fear about safety in traffic leads to less walking or cycling and more driving, which in turn generates more traffic.

Apart from the negative impact produced by the high car usage in term of road safety, air and noise pollution, GHGs emissions, a considerable body of research has widely investigated the effects and impacts on children of being accompanied by car for their school trips or for other everyday destinations, and found that such impacts may harmfully affect children's physical and psychological development, and may be a potential source for diseases like for instance: obesity, overweight, cardiovascular disease, excessive stress levels, apathetic and lack in dynamism and alertness.

As the journey to school is potentially considered as a good momentum and opportunity for promoting daily physical activity, and in parallel for reducing the car dependence of school travel, Active Transportation to School (ATS) schemes (School Travel Plans, Walking or Cycling School Buses, Safe Routes to School programmes) are emerging as an effective strategy for encouraging more healthy lifestyles among children. This also

explains why national policies on active travel across Europe and worldwide are focused predominantly on the school journey.

ATS may encourage among children a greater familiarity with sustainable transport modes, which – associated to an increased mobility independence – may enable them to develop positive attitudes and behavioural patterns that may be then continued into their adulthood. The purpose is to allow children to develop their own coping mechanisms and to devise strategies to do things in their own way. It is only through *the doing* that children become competent in negotiating a vast range of interactions and relationships.

Scope and purpose of the thesis

Based on the analysis of:

- nature, main characteristics and most significant showcases of ATS, and
- the key elements of the *Shared Space* concept,

and supported by the description of the children's mobility patterns in a selected town located in North-East of Italy (Castelfranco Veneto) according to the outcomes of the questionnaire-based survey conducted between December 2008 and January 2009, the **main purpose of the thesis of is to elaborate an hypothesis for establishing a model to define children's mobility patterns, which tries to propose a motivational perspective for explaining the choice for a specific mode of transportation by incorporating a travel behaviour and the effects of urban structure in terms of accessibility**. Specifically, this model may be regarded as an attempt to identify which determinants are key in coming to a specific decision about how children travel to school. Indeed, such decision may be considered as the final step or synthesis of a complex process that encompasses various variables, which weigh differently and, consequently, lead to different decisions.

Furthermore, the model recalls the role of those environmental correlates, that may facilitate or inhibit ATS and that are mostly associated with the tendency for children of using ATS, and takes into consideration three starting elements: (i) parents' resources, (ii) children's characteristics, and (iii) urban structure and the transportation infrastructure.

All this is of relevance for the analysis of *Shared Space*. *Shared Space* has, in fact, the potential to improve those elements of the external built and traffic environment, which in turn may also promote a greater willingness to use more sustainable modes of transport, first and foremost walking and cycling for bringing children to school. *Shared Space* may then be considered as a suitable approach in order to identify those elements

of behaviour and urban planning that may be integrated for elaborating solutions that are capable to remove barriers to the promotion of a more sustainable (environmental-friendly) mobility, namely for school journeys.

Nonetheless, *Shared Space* should be part of a more comprehensive package of measures where it could represent the long-term component of an integrated strategy that aims to achieve a more sustainable transportation for school trips, and where the concept of sustainability goes beyond the simple reduction of mobility-related environmental impacts for also embracing elements like safety and healthy benefits of active travel. In such strategy, the short-term component would be given by the ATS schemes (School Travel Plan, Safe Routes to School programmes, Walking School Buses) this thesis discussed about, but that are more likely to produce minor – even if important – changes if not complemented with urban planning improvements (both *soft* and *hard*) that create an incentive to children to autonomously roam and travel within their neighbourhood. To conclude, this is the field where the contribution of the *Shared Space* concept would be the most promising.

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List of Abbreviations

ATS Active Transportation to School

BMI Body and Mass Index

CSB(s) Cycling School Bus(es)

CDC Centers for Disease Control and Prevention

CVD Cardiovascular Disease

CO_2 Carbon Monoxides

dB(A) Decibel (A-weighting)

DfES UK Department for Education and Skills

DfT UK Department for Transport

DoTs US Federal States' Departments for Transport

EASO European Association for the Study of Obesity

EC European Commission

EEA European Environment Agency

EHN European Heart Network

EU European Union

EU-25 EU Member States before 2006 enlargement

GDP Gross Domestic Product

GHG(s) Greenhouse gas(es)

IEE Intelligent Energy Europe

IOTF International Ovesity Task Force

LA Local Authority Schools

LAAP Local Area Access Program

LundaMaTs I/II	(1st and 2nd) Lund Transport Master Plan
NCSRTS	US National Center for Safe Routes to School
NHTSA	US National Highway Traffic Safety Administration
NO_x	Nitrogen Oxides
OECD	Organisation for Economic Cooperation and Development
Pb	Lead
$PM_{2.5}$	Particulate Matter <=2.5 µm
PM_{10}	Particulate Matter <=10 µm
SAFETEA-LU	Safe, Accountable, Flexible, Efficient Transportation Equity Act — a Legacy for Users
SO_2	Sulphur Dioxides
SRTS	Safe Routes To Schools
STP(s)	School Travel Plan(s)
TSG	Traffic Snake Game
UN	United Nations
USD	US Dollar
WHO	World Health Organisation
WoW	Walk on Wednesday
WSB(s)	Walking School Bus(es)

CHAPTER I: INTRODUCTION AND RESEARCH METHODOLOGY

This Chapter presents the method chosen to conduct the research looking at children's mobility patterns in the city of Castelfranco Veneto (Italy), by linking it to the analysis of Active Transportation to School (ATS) and *Shared Space*.

1.1 Background and research objectives

Children's mobility is an issue that is receiving a greater research attention. Indeed, there is a growing acknowledgement that children's mobility has a strong influence on their parents' travel behaviour. This applies, in particular, to school journeys, for which trends across Europe and worldwide show a clear increased use of car as main transport mode for school trips. This poses a number of serious consequences, not only in terms of increased traffic congestion, related negative environmental effects, and road safety, but also in terms of harmful effects on children's physical and psychological development.

This study was inspired by the personal interest on observing children's mobility patterns. The knowledge, on the one side, gained about the *Shared Space* concept and, on the other side, the interest shown by a primary school in Castelfranco Veneto, provided the opportunity for investigating how and to what extent *Shared Space* may be an appropriate solution for enhancing a higher degree of ATS.

1.2 Characteristics of research and structure

The thesis is structured into six chapters. Following this introduction chapter on research methodology, *Chapter Two* presents a literature review on ATS and, especially highlights the increasingly problematic relationship between children and the urban environment where they live. Besides the missing opportunities for social and attitudinal learning, this has progressively implied that children are increasingly accompanied by car by their parents either to school or to other activities, where parents' concerns about traffic and safety emerge as the main reasons for limiting pupils' independent mobility and autonomy. ATS schemes are, then, proposed as possible solution for tackling these trends, though a proper understanding of the determinants that are mostly associated with the tendency for children of using ATS is paramount for their successful implementation.

Major ATS initiatives across the United Kingdom and Europe, and worldwide are illustrated in *Chapter Three*, which, namely, focuses its attention on specific ATS

schemes, like School Travel Plans, Safe Routes to School programmes, and Walking School Buses. These schemes were conceived for overcoming the barriers (for instance, perceptions of insecurity, lack of infrastructure, or even poor awareness on the benefits of active transportation) that may inhibit ATS.

Chapter Four follows up and discusses a major topic for this thesis, i.e. *Shared Space*. *Shared Space* is explained by making reference to the featuring elements that characterise this new concept introduced by Hans Monderman in the 90s, and to the EU-funded project that between 2004 and 2008 enabled some concrete application that are described as showcases in this thesis. Importantly, *Shared Space* may also a have a clear link with the ATS issue, since it may create the ideal conditions for improving safety levels around school environments and, therefore, it may enhance a greater willingness in the use of ATS solutions, like for example walking ad cycling for bringing children to school.

Chapter Five is dedicated to the case-study of Castelfranco Veneto. Based on the findings obtained with the data collected for a primary school in this small-sized town located in North-Eastern Italy, Chapter Five investigates how children's mobility in relation to school journeys is structured for this specific local context. This is the pre-requisite for the elaboration in *Chapter Six* of a model for defining children's mobility patterns, which integrates the impact of location (and to a certain extent urban structure) with a more behaviour/habits-oriented approach. Indeed, how a child travels to school is seen as the product of a number of factors, partly related to child's characteristics, partly related to the parents' characteristic, and partly related to where they live.

Finally, Chapter Six also concludes by summarising the findings of the thesis and outlining the key considerations that may be taken into account for forthcoming and future research in the field of children's mobility during school runs.

1.3 Research methodological approach

In order to collect the necessary information for developing this thesis, a mixed methodological approach was chosen, which combines qualitative analysis with a quantitative method.

The *qualitative analysis* provided the general framework for the study. It aimed to not only find specific information on the ATS topic, but more importantly it allowed to gain a deep insight and understanding of its main determinants and issues at stake. The literature review made use of both available scientific publications relevant for the issue

related to ATS, and technical studies and papers. The latter proved to be namely helpful when presenting the international ATS initiatives.
To highlight the children's mobility patterns during their school journeys in the town of Castelfranco Veneto, statistical information where gathered through a *quantitative method*, which involved a questionnaire-based survey. Section 1.3.1 provides an insight on the survey's characteristics and how the questionnaire was designed. The questionnaire is attached in Annex B.

1.3.1 Survey

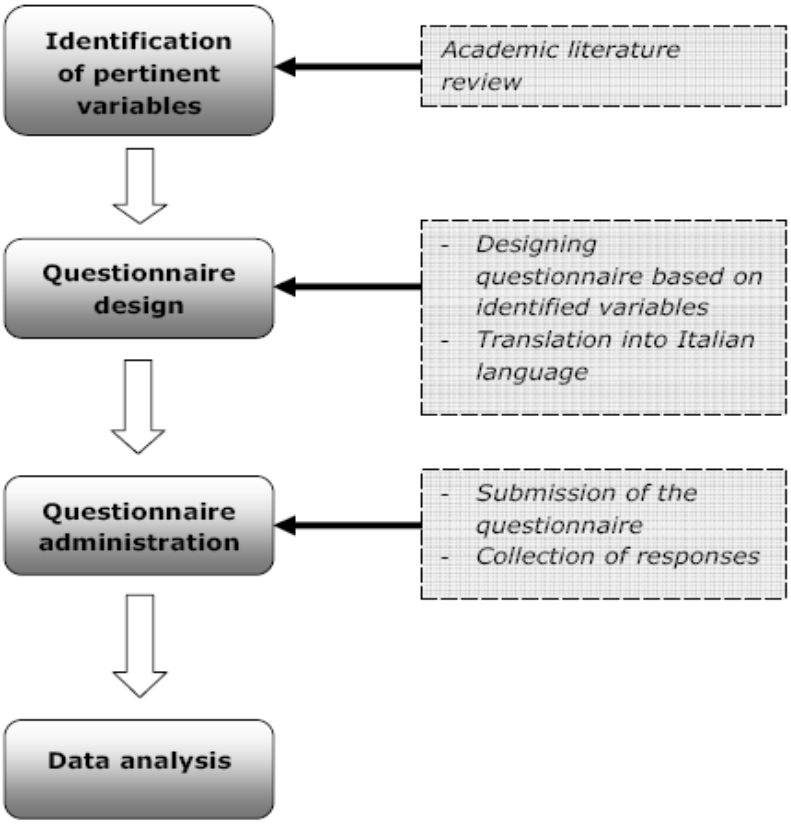
Introduction

A self-administered questionnaire was submitted to the primary school "A. Colombo" in Castelfranco Veneto and distributed via the school administrators to the children attending the five school grades. Children's age ranged between six and ten years old.
Questionnaire was chosen as information gathering technique because it makes possible to analyse attitudes, behaviour and characteristics from a number of people.
Furthermore, it offers a number of advantages, not least because it is familiar to most people and it does not create any particular apprehension in filling it.
Questionnaire proves to be cost-effective as well, especially if compared to face-to-face interviews. The latter were also more difficult given the fact that the primary school is located in a region which is different from that one where the research is analysed. Moreover, cost-effectiveness should also be intended as the possibility, through questionnaires, to reach a number of respondents large enough to enable analysis of results that is statistically relevant.
Finally, questionnaires reduce bias thanks to uniform question presentation. Additionally, with questionnaire researcher's own opinions do not influence the respondent to answer questions in a certain fashion.

Questionnaire design

The questionnaire was designed to provide findings that were as much objective as possible. Having this goal in mind, the questionnaire design followed a specific design flow chart, which is built upon a four-step approach, as illustrated in Figure 1.1. Such approach allowed the survey to be conducted in an orderly and accurate manner.

Figure 1.1: Questionnaire design flowchart



An introduction, summarizing the survey's purpose and briefly explaining the concept of *Shared Space*, was also included at the beginning of the questionnaire. The survey included 21 items (some of which requiring a sole response, others allowing multiple choice responses) all targeted to children, even if only 14 questions were considered as relevant and therefore selected for the analysis.

Specifically, children were asked to provide a feedback on: (i) their age, gender, grade and place of residence, (ii) approximate distance to school, most used transport mode for their school journeys, (iii) if they could independently reach their school or, alternatively, if they were accompanied by an adult during their school runs, and related reasons. Moreover, children were also asked to identify the main barriers that could hamper going to school by walking and/or cycling.

The last question made exception since it was addressed to parents, since it asked for an evaluation of potential *Shared Space* scheme along the route to the school. The reason for using an open question was so the parents could explain in their own words how they

perceived such kind of intervention in the view of enhancing a greater degree of active travel to school for their children.
Questionnaires were submitted in December 2008 and data were collected in January 2009. Response rate was calculated as the proportions of children issued with a questionnaire that returned it with useable information. No attempt was made to follow-up respondents.
Quantitative data were presented in form of tables and figures (charts), and frequency of responses was expressed as percentages. This facilitated the drawing of the conclusions.
Finally, when multiple choice was possible, the analysis was made on the sum of multiple replies that were given to the different options.

1.4 Ethical research issues

Permission was obtained through the school administration from parents in order to conduct this research with children attending the primary school "A. Colombo". In designing the questionnaire, and given the sensitivity of target group (children between six and ten years of age) questionnaire were anonymous, and parents were also secured that personal information and replies of their pupils would had remained confidential. This was also clearly mentioned in the cover page of the questionnaire.

1.5 Research limitations

To my knowledge, this research represents the first attempt to identify children's mobility patterns along school runs in the County of Treviso (to which Castelfranco Veneto belongs administratively). Nevertheless, three major limitations warrant mention.
First, the most important limitation is given by the fact that the survey: (i) had a voluntary nature, (ii) was limited to one school only, (iii) and results only represent those that replied in an useable way. Therefore, the sample and the outcomes may not be fully representative of the entire school community in Castelfranco Veneto.
Second, in relation to questions were multiple choice was possible, a pure sum of the number of times a certain option was selected was made, and no weighting system was applied. This did not allow to compare the different options, and consequently to analyse which options count the most among children and parents. It would be then beneficial to include this in the case of future research.

Third, the survey did not take into account whether the selected primary school had or not undertaken previous initiatives to promote ATS. Thus, a comparison between *ex-ante* and *ex-post* data was not possible.

CHAPTER II: ACTIVE COMMUTING TO SCHOOL: A LITERATURE REVIEW

2.1 Introduction

The United Nations Convention on the Rights of the Child defines children as "*individuals with inalienable rights of no less value than those of adults*", and embraces the principle that "*the lives and normal development of children should have first call on society's concerns and capacities*"[1] (Hillman et al., 1990).

As argued by Valentine (1997), in our modern societies the notion of childhood reflects a world that is considered to be wholly dependent upon adults, who not only feel themselves obliged to protect their children, but also responsible for shaping them into future competent adults. This implies that children's life is embedded and (constrained) into the private sphere of their respective families, where childhood is simply seen as a period for playing, clearly distinct from adults' state of being which is, conversely, characterised by the notion of responsibility (Wyness, 2006).

Today, being a child is significantly different than it was 40 or 50 years ago. The situation children actually live in our modern societies is the result of changes that occurred during the last decades in family, work life, urban environments. This differs, of course, according to the different countries as a reflection of their socio-cultural structure, but there is a general tendency that shows how the traditional models have been progressively replaced by new ones (Scott, 2000).

According to Scott (2000), this has raised a variety of issues (unemployment, safety concerns, increased pressure, family breakdown, environmental problems), which inevitably have an impact on child rearing values. Again, Scott highlights how parents are more likely to take on board these negative social messages and to transfer them in the way their children socialise with their peers or other adults. This reasoning is further strengthened by the fact that modern urban areas are progressively failing to create a suitable realm for children (Lennard and Crowhurst-Lennard, 2008). Thus, the relationship between children and the urban environment where they live is increasingly assuming a problematic nature.

High traffic levels, high urbanisation, limited amount of adequate spaces (parks, playing grounds, gardens) provide even less opportunities to children for freely circulating in their neighbourhoods, and meeting and playing with their peers without the continuous

[1] Ratified in 1990 by the UN General Assembly.

supervision and control of their parents. In other words, the current design of modern urban spaces does offer fewer learning social opportunities to children, therefore omitting the importance of public urban places for their attitudinal learning, which is also a key determinant in supporting social participation and sociability (Lennard and Crowhurst-Lennard, 2008).

All this has a clear consequence in terms of children's mobility as well, since traffic and social safety concerns are often the main reason for limiting their independent mobility and autonomy.

Indeed, children's independent mobility is probably the domain that is influenced the most by these negative indicators, since a sense of *Stranger Danger* seems to dominate parents perceptions about their children's safety, and thus inhibiting their children's ability to freely move in their neighbourhoods and beyond. (Thomson, 2009). This concept has been investigated by a considerable body of research (Carver et al., 2008; Timperio et al., 2004; Vietch et al., 2006; Valentine, 1997; Hillman et al., 1990, Prezza, et al. 2006), and in particular the fear of molestation and harassment has been regarded as the main barrier in permitting children to freely move.

Interestingly, in this respect Gill (2007) cites a double constraint that modern parents have to face when growing up their children: on the one side, they are aware of the need to grant them freedom and independence but, on the other side, they are subjected to external pressures related to social and community expectations about being good parents. The sociologist Frank Furedi has summed up this feeling by arguing that: "*Parents are almost forced to fall in line… The minority of parents who try to resist are stigmatised as irresponsible. When your own kid is the only one allowed to go shopping, to go to the swimming pool by himself, it looks very strange*" *(*cited in Gill, 2007).

This leads to a situation where parents tend to be *risk-averted*, where their risk aversion is a critical barrier in securing their children's social, emotional and physical development (Gill, 2007).

Besides safety concerns (though to a certain extent also closely interlinked with them), growing traffic volumes have steadily been increasing as a further factor that curtails children's opportunity to freely roam without the risk of being involved in a crash.

The consequence is twofold:

- firstly, children tend to be disconnected from the neighbourhoods where they live. The extent parents socialise and build social networks with other adults is also critical, as stressed by Prezza et al. (2006), which found that parents with more

extensive neighbourhood networks are more likely to associate the benefits of giving their child autonomy with their growth and maturity;

- secondly, the increase in traffic means that children are chauffeured everywhere by car, which not only generates a general problem of traffic congestion and environmental pollution, but again compounds the disconnection children have with their neighbourhood (Gill, 2008).

Finally, it has to be pointed out that, the way children travel to school is often based upon parents' choices, which are consistent with their needs. In many families both parents are paid employment, and for them it is perceived as quicker and easier to bring their children to school by car along the way to their working places, especially when parents cannot rely on efficient and timely public transport services.

All this, unfortunately, neglects that children may be a crucial measure of sustainability, and facilitator of sustainability themselves. Consequently, there is a need to make children familiar with sustainable transport modes, which – associated to an increased mobility independence – may enable them to develop positive attitudes and behavioural patterns that may be then continued into their adulthood.

This is of particular significance in relation to school journeys, since the latter represent an important activity in which they are engaged, and which provide a good opportunity for experiencing safe and environmentally modes of transport like walking and cycling. Furthermore, this would allow them to grow up in a specific behavioural setting that may lead them to choose sustainable transport modes when adults.

These preliminary considerations pave the way for the analysis carried out in this Chapter, whose aim is to describe the current overall scenario of children's mobility patterns. Namely, and based on a systematic literature review, this Chapter intends to shed light on the fact that an increasingly high rate of children are driven by car to school by their parents, reflecting the current role of private car as predominant transport mode.

This has, undeniably, specific consequences, especially in terms of harmful effects on children's physical and psychological development. Indeed, apart from the adverse effects produced by the soaring car usage in terms of road safety, air and noise pollution, greenhouse-gases (GHGs) emissions, there is evidence from a considerable body of research that children are more likely to suffer from an increasing variety of diseases (cardio vascular diseases-CDV, anxiety, stress, depression, obesity) that until recent times where only associated to adulthood.

Within this framework, Active Transportation to School (ATS) is then suggested as an appropriate solution for: (i) increasing children's physical activity rates, (ii) enhancing their social interaction and maturation, and finally (iii) promoting their independent mobility.

However, when investigating such role it is first necessary to soundly understand the environmental factors (or determinants) that may facilitate or inhibit it, and that are mostly associated with the tendency for children of using ATS.

A number of determinants will be illustrated, which were found by current research to be important factors in predicting higher or lower levels of ATS among children, but always bearing in mind that parents' perception of all these determinants is maybe a stronger predictor of children's active commuting (for example than urban forms are), which implies that any changes are unlikely to affect children's active commuting patterns unless parents' concerns and attitudes also are addressed.

2.2 Children's mobility patterns: private car use as main transport mode

As reported by the European Commission (EC) (2002), children and young people up to the age of 18 years constitute on average 21% of the European population, though this percentage ranges from a minimum of 15% to a maximum of 24% according to the distinct European Union (EU) Member States.

Looking at the mobility of children and young people, and more specifically to the number of their journeys, it may be noticed that between 15% and 20% of all journeys made involve these two population groups. These percentages approximately corresponds to the share of the European population they represent (EC, 2002).

In particular, during the weekdays two third of these journeys are in relation with school runs while, when including week-ends and holidays as well, it may be observed that school trips equal the number of recreational (two out of three) and private journeys (four out of ten). The first group of trips mainly refers to after-school activities (sport activities, for instance), while the second group mainly relates to visits to relatives, medical consultations, etc.

Importantly, for many of these journeys children are being accompanied by adults, and even more often are driven in car by them, a tendency confirmed by research in many European countries (Bradshaw, 2001; Mackett, 2002; Mackett et al., 2005; Jensen et al., 2004; Prezza et al., 2001).

For example, Fyhri (2005) showed that in Norway 25% of children are driven by car for their runs, while a British study (Gilhooly and Low, 2005) pointed out as the proportion of children accompanied by their parents by car had increased in 2001 up to 20% from 10% reported in 1985.

Again, for the United Kingdom Mackett (2001) indicates that car use for children is growing faster than in the rest of the population, and that children are making fewer, even if longer trips than previously in the past.

An other research focused on the United Kingdom (City of York, 2000, cited in EU, 2002) highlighted how only one child out of nine in the age ranged between five and ten years goes to school alone (or not accompanied). More importantly, this figure confirms a declining trend: ten years ago the number of children going to school unaccompanied was one out of five.

Moreover, according to the UK Department for Transport (DfT) about 20% of the morning rush-hour traffic is due to adults bringing their pupils to school by car. A survey made by the York City Council involving 15,000 schoolchildren (representing about 66% of the school population) revealed that:

- in the case of the primary education, 34% of interviewed children are taken to school by car, even if just 15% expressed of being in favour of this mode of transport;
- in the case of the secondary education, 15% of pupils are taken to school by car.

Interestingly, when questioned about what they dislike the most of their school trip, primary-school pupils (60% of the total concerned) identified the following negative aspects: too much traffic, excessive speed, scare of being involved in a crash. In particular, the high level of traffic congestion was also underlined by the secondary-school pupils (48% of the total concerned), which likewise replied that the private car use is the main the problem associated with their journey to school.

Similarly to what found in the United Kingdom, in France 46% of mothers aged between 25 and 49 years daily accompany their children to school by car, though 74% of them affirm that schools are less then five km far from their respective homes. Again, in Luxembourg 9.5% of the total amount of journeys made by adults belong to the "escort" category, where the large majority of those that are escorted are children, since it was found that three quarters of escort journeys are made by adults aged between 25 and 44, i.e. by persons of parental age (EC, 2002).

These examples confirm that increased use of car as main transport mode for journeys to and from school is a cause of major concern. The possible explanations why children are

more and more taken to school by their parents by car are related, as demonstrated in various studies (Hillman et al., 1990; Joshi and Maclean, 1995; Joshi et al., 1999; Valentine, 1997), either to traffic or to a *danger*.

In this respect, road safety is usually reported as one of the major concerns of parents, which often impedes children's independent mobility by walking or cycling either to school or to other leisure and playing areas.

Approximately, according to the EC, every year more than 1,100 children under the age of 15 are killed on European roads and 100,000 are injured[2]. In Europe the road safety situation is not homogenous across the Member States, as a gap exists between Northern and Southern European countries, where the former perform better in terms of road safety thanks to the implementation of innovative approaches and solutions over the recent years. Besides this gap, another one is emerging and refers to the differences amongst *old* and *new* Member States, with the latter positioning themselves below the EU average (Sitran and Bosetti, 2009).

Looking more precisely at some country data, a report of the UK DfT (DfT, 2007) on school casualties indicated that, in 2005 16% of all child casualties were recorded as occurring on the school journey. Significantly, the proportion of child killed and seriously injured rise to 23% during peak hours of 7-10 am and 3-6 pm on weekdays.

The World Health Organisation (WHO) (2004) also stresses that road traffic injuries are the leading cause of death among children aged between 5–14 years in the European region, representing about 5% (about 5,000) of the total estimated deaths from road traffic injuries per year. In addition, the WHO (2004) equally reports that the fear of accidents is argued by parents as being the main reason for taking children to school by car. This inclines parents to perceive as safer the option of bringing their pupils to school by car, instead of allowing them to travel by foot or by bike. Nonetheless, according to the Organisation this may hinder the development of children's independence and reduce their opportunities for social contact. It also has an influence on children's attitudes towards car use and personal mobility in adulthood.

A study made by the Organisation for Economic Cooperation and Development (OECD) is also worth mentioning in this regard, because it compared the traffic crash fatality in 30 of its member countries for young people (cited in Christie et al., 2004).

For those countries that were able to provide data on child (10-14 years of age) walking and cycling travelled distance, this study showed that countries with high levels of active

[2] Data from the European Commission's dedicated website on road safety: http://ec.europa.eu/transport/road_safety/users/children/index_en.htm

transportation generally also have low pedestrian and cyclist fatality rates, as illustrated in Figure 2.1 and Figure 2.2 for Germany, New Zealand, Norway, Sweden, Switzerland, The Netherlands, United Kingdom, and United States.

Figure 2.1: Fatality rate by distance walked (10-14 years)

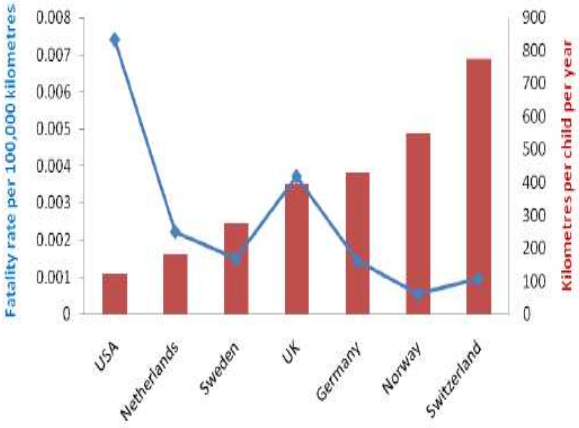
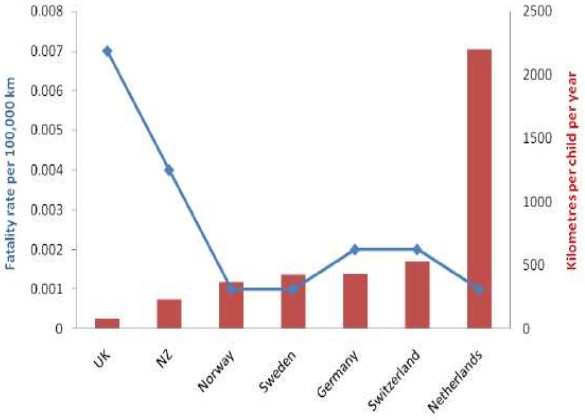


Figure 2.2: Fatality rate by distance cycled (10-14 years)



Source: Christie et al. (2004)

What emerges from Figures 2.1 and 2.2 is a clustering effect (Christie et al., 2004) where the countries that are the four top performers (The Netherlands, Switzerland, Germany and Sweden) also are the countries where there is a strong commitment to achieve high levels of safe walking and cycling, not least supported by the implementation of a comprehensive package of integrated traffic safety measures. This explains why a high number of km walked or cycled is not associated to high fatality rates, contrary to what one may argue.

2.2.1 Impacts of car travel on children's daily journeys

Apart from any considerations about the overall adverse effects produced by the high car usage in terms of road safety, air and noise pollution, GHGs emissions (Box 2.1 provides a brief summary of the main impacts due to pollution on children's health), there is a considerable body of research that has investigated the effects and impacts on children of being accompanied by car for their school trips or for other everyday destinations. It was found that such impact may harmfully affect children's physical and psychological development.

Box 2.1: Adverse effects of air and noise pollution on children's health

It may not be disputed that air and noise pollution produces harmful damages on people's health. This damages are more acute as far as children are concerned.

Air pollution

Air pollution is dependent upon many factors, from the fuel composition to engine characteristics and maintenance. Moreover, air pollution is measured by the emission and concentration of particular primary pollutants, which include nitrogen oxides (NO_x), carbon monoxides (CO_2), sulphur dioxides (SO_2), lead (Pb) and, finally, particulate matter (PM_{10} and $PM_{2.5}$) like dust and soot. According to the WHO (2005) there is evidence confirming that children's health is negatively affected by air pollution levels experienced in Europe. This is consistent with the findings of a comparative review of 13 studies made by Bråbäck and Forsberg (2009), which assessed the evidence of long-term traffic pollution effects on children in some European countries (Germany, Sweden, The Netherlands, Norway), in Japan and in the United States. Results have confirmed that traffic pollution may be a contributing factor in developing respiratory problems and diseases associated to asthma-like symptoms and allergic sensitization in children. Though the results sensibly vary according to the age of the child, the consistency in the results indicates that traffic exhaust contributes to the development of respiratory symptoms in healthy children.

Noise pollution

Noise is one of the main environmental impacts that arise from a transport scheme. Noise may cause serious impacts on individuals' wellbeing by leading to damage to both psychological and physical health. Hearing damages can be caused by noise level higher than 85 dB(A), whilst lower levels (above 60 dB(A)) can be sources of nervous stress reactions, including increase in heart rate, increased blood pressure and hormonal changes as well. Finally, damages particularly occur when exposure to noise is continued over a long period of time. In the case of children, it is a fact that exposure to chronic noise slows down the rate at which young children learn to read (EC, 2002). Noise causes sleep disorders, and this, in turn, is likely to affect school results. Noise in the classroom adversely affects concentration spans and oral communication. A number of studies suggest that noise suffered by children in the home increases their blood pressure.

For example, Fotel and Thomsen (2004; cited in Fyhri and Hjorthol, 2009) argued that the large predominance of the car use for school runs leads to less independence for children, while Preiss (1989) pointed out that children, who are often driven to school by car, do not learn to know their neighbourhood properly and, therefore, are less experienced in way-finding tasks.

Other studies (Zeiher, 2001; Kyttä, 2003) focused on the mobility patterns of the whole family, namely the parent's use of car compared to other transport modes. Zeiher (2001) concluded that children's lives can be characterized by *insularisation*, which means that their lifes are *institutionalized* through day care and school, and by transport from island to island of music or sports arrangements, through a landscape made for grown-ups. Kyttä (2003) observed the same phenomenon and called it *Glasshouse childhood*, where children can only familiarize with the environment through the help of parents.

Furthermore, research (EC, 2002) found that, when cooped up in car, children risk to become apathetic and lack in dynamism and alertness, which may seriously affect their school results. In this respect, a psychological study made in Switzerland in 2004 warrants mention (Hüttenmoser, 2004). The study concerned a psychological analysis of 239 drawings, which were made by as many children in a response to a competition launched by the local schools of the Capriasca community in the Canton Ticino (the Italian-speaking part of Switzerland). Topic of the drawings was the journey from home to school. Noticeably, the analysis made possible to understand that there was a difference in the way children imagine their school trips as they travel by car or by other modes of transport, like walking and cycling. Interestingly, the former drew their school journey as long and empty, whilst the latter as full of details related to the built environment, the nature, the people surrounding them, etc. Therefore, the major conclusion was that the school journey is an excellent opportunity for children to observe the surrounding environment, and experience new adventures, which, conversely, is a missing aspect in children being accompanied by car.

Not less important, it was observed that children suffer from the stress levels experienced by driving adults. This may imply the risk of undergoing stimuli that are too fast and too difficult to be managed for their age. As a result, they are more likely subjected to the risk of becoming frustrated and nervous with serious consequences for their psychomotor growth. Moreover, children may lose important opportunities to socialise with their peers, or may face serious difficulties in learning self-reliance, and in developing their ability to adapt to new situations (including traffic situations) because of excessive dependence upon their parents.

Analogously, there is a variety of studies that investigated the impacts in terms of physical activity. In this respect, Torsheim et al. (2004) (cited in Fyhri and Hjorthol, 2009) claimed that physical activity is key for childhood health and well-being, while other studies (Cooper et al., 2003; Evenson et al., 2003; Fox, 2004; Salmon et al., 2005) concluded that reduced physical activity, including that one occurring during daily travel, is an important cause for increased weight and obesity among children.

Physical activity is paramount for the growing up of children and young people in general: (i) it positively influences physical, social and mental development, (ii) it is a source of enjoyment and friendship, and (iii) it may be a good ally (Sallis and Owen, 1999) in addressing and facing the development of various emotional and mental health disorders (such as for example anxiety and depression). Indeed, physical exercise directly affects important personal factors like self-esteem and sense of achievement,

which are all aspects that may not only successfully influence school results and personal behaviour, but also encourage and establish healthy lifestyles that may be continued into adulthood. Additionally, a physically active lifestyle is a major contributor in preventing overweight and obesity.

Box 2.2: Health benefits of regular physical activity

According to the WHO, the health benefits of regular physical activity may be summarized as follows:
- 50% reduction in the risk of developing coronary heart diseases;
- 50% reduction in the risk of developing adult diabetes;
- 50% reduction in the risk of becoming obese;
- 30% reduction in the risk of developing hypertension;

Source: WHO (1999)

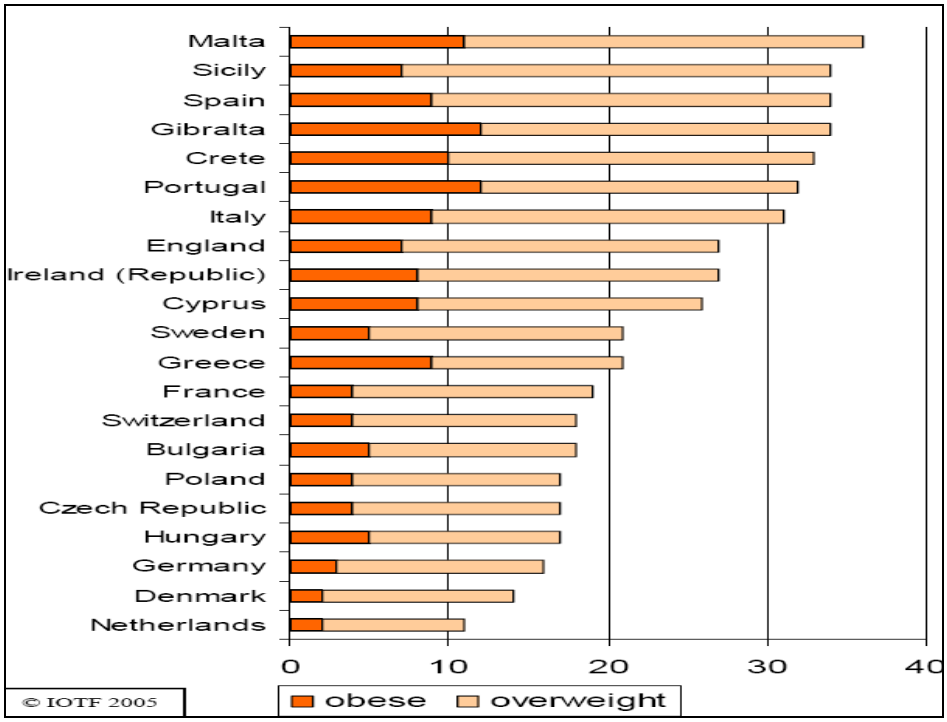
Nevertheless, though there is a strong body of research that demonstrates how regular physical activity is major contributor of adult health (EHN, 2001; Andersen et al., 2006), over the recent years many Western countries have seen a dramatic decline in the performed level of physical activity (Wedderkopp et al., 2004), and an increasing number of young people that are not taking part in physical activity to a level recommended to benefit their health (Booth et al., 2003; Freedman et al., 1997; Hedley et al., 2004; Troiano and Flegal, 2004; Wedderkopp et al., 2004). The WHO confirmed such negative trend by stressing how, in Europe, only one out of three young people do meet the recommended minimum levels of one hour of moderate/intense physical activity per day (WHO, 2006). This determined a significant increase in the number of diseases that until recent times were associated to adulthood only (Wedderkopp et al., 2004; Boreham and Riddoch, 2001; Cavill et al., 2001; Biddle et al., 2004). Diabetes, cardiovascular risk factors, hypertension, metabolic dysfunctions have become common health problems amongst children as well. In particular, overweight and obesity[3] are recognised as major concerns, especially because they may predispose children to the development of chronic diseases in their later stages of life (WHO, 2000). Globally, the European Environment Agency (EEA) (2008) pinpoints that child obesity rates tripled during the last 20 years, while more specifically in Europe two children out of ten are today classified as overweight according to the EC (EC, 2002). A similar trend is reported in the United States, where obesity affects a quarter of children aged between 6 and 17 years, i.e. 1.5 times more than in the 1960s. Some studies (Powers et al., 1997; Freedman et al.,

[3] The European Heart Network defines obesity as "a symptom of an imbalance between caloric intake as food and calories expended through physical activity" (EHN, 2001).

1999; WHO, 2000) argue, indeed, that obesity after three years of age is associated in the long term with a greater risk of obesity in adults, increased morbidity and mortality, persistence of associated metabolic disorders, as well as increased risk for cardiovascular diseases (CVD) and some types of cancer.

Recent data from the European Association for the Study of Obesity (EASO) show for the EU-25 (see Figure 2.3) a clear prevalence of overweight (including obese) amounting at 16-22%, of which the prevalence of obesity equals to 4-6%.

Figure 2.3: Percentage of schoolchildren aged 7-11 obese or overweight[4]



Source: EASO website (www.easoobesity.org/)

[4] Latest available survey data for European countries and regions. All figures are based on the IOTF criteria for defining overweight and obesity in children using age and gender-specific cut-offs equivalent to adult BMIs of >25 (overweight) and >30 (obesity).

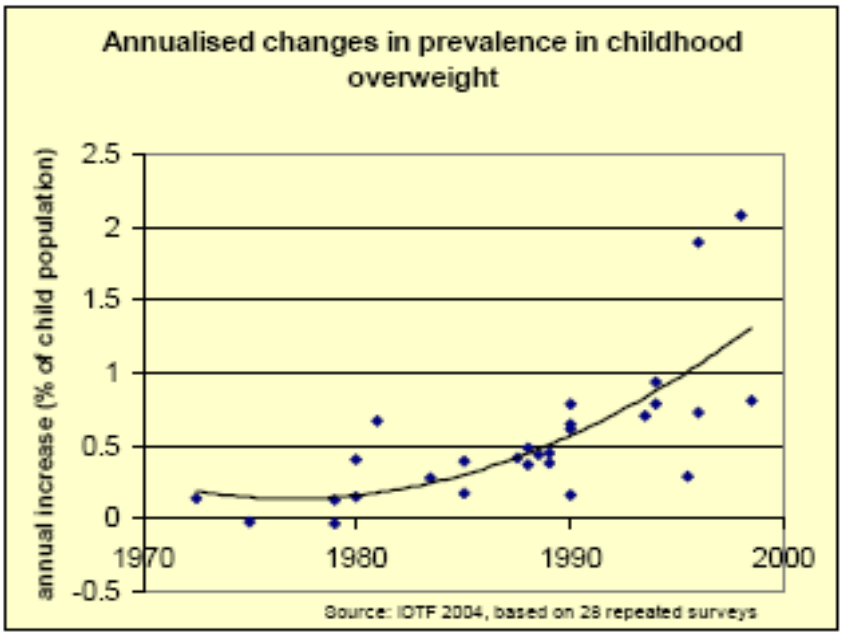
Overall, there are some 74 million school children (aged between 4 and 18 years) in the EU-25, out of which:

- a range between 11.8 and 16.3 million children are overweight, and
- a range between 2.9 and 4.4 million children are obese.

Even more important is the trend reported in the most recent years (see Figure 2.4), since data for Europe highlight an annual increase of the child population of:

- 0.2% during the 1970s;
- 0.2%-0.6% during the 1980s;
- 0.3%-0.8% in the early 1990s, and
- 2.0% in the late 1990s and early 2000s.

Figure 2.4: Annualised changes in prevalence in childhood overweight



Source: EASO website (www.easoobesity.org/)

If these trends are confirmed in the future, more than 15 million children will be overweight within ten/fifteen years, and five million of children will be obese.

Looking at the nature of the problem, childhood and adolescence obesity may be brought on a wide range of determinants, which in many cases act together (Ebbeling et al., 2002; Dietz, 1998; Speiser et al., 2005; Kimm and Obarzanek, 2002; Miller et al., 2004). Although these aspects are out of the scope of this analysis, it is worth noticing how, apart from very specific factors (medical illness, genetics, and psychological factors) dietary, advertising, home environment and sedentary lifestyles are generally

acknowledged as the leading causes that lead to children and young people obesity and overweight.

In addition also road traffic has increased (Hjorthol and Fyhri, 2009), which has generated a less comfortable and suitable environment for children to play or to carry out recreational activities. It is also worth underlining that children's leisure activities also changed over the last ten and fifteen years, and are much more "organised" in comparison to the past. Moreover, these activities are pursued far beyond the neighbourhood where children live (Valentine and McKendrick, 1997; Hjorthol, 2006), which consequently requires a transportation that is often served by their parents (Mattson, 2002; Tillberg, 2001). Importantly, children's daily mobility is also much more subjected to tight schedules related to all their school and after-school activities (Hjorthol, 2006).

Nowotny (1994) observed the time pressure experienced by families with children and labelled it *pressure of expectations*, which determines a situation where adults and children seem to prefer participating to those activities that are socially *meaningful*. This often results in an intensive weekly activity programme, for which the transportation needs are satisfied by the use of car, whose role becomes then central and in many cases it is the catalyst for development of this type of mobility pattern.

Based on these considerations, it may be noticed how, in the area of mobility, the rise in childhood obesity increased the relevance of how children commute to and from school (Anderson and Butcher, 2006).

2.3 Active Commuting to School: main features and determinants

2.3.1 Introduction

Active Commuting to School has been progressively suggested as an interesting strategy for facilitating children's physical activity, in the perspective of promoting healthy lifestyles.

Recent studies (Cooper et al., 2003; Tudor-Locke et al., 2003; Sirard et al., 2005) demonstrated that children walking or cycling to school perform more physical activity than those travelling by other means of transport (private car, for example). Nonetheless, two studies (Rosenberg et al., 2006; Metcalf et al., 2004) did not find such a positive association between ATS and level of physical activity.

Few studies also observed the association between ATS and children's Body and Mass Index (BMI) and cardiovascular fitness. Data from the European Youth Heart (EHN) show that children and adolescents who cycle to school are nearly five times as likely to be in the top quartile for fitness than are youth who walk or use motorized forms of transport (Cooper et al., 2006). Conversely, little research emerged for the association between ATS and children's BMI (Heelan et al., 2005; Tudor-Locke et al., 2003; Rosenberg et al., 2006; Fulton et al., 2005).

Despite the last weak evidence, ATS is a convenient opportunity to perform physical activity into the daily routine of children and adolescents, and this confirms the growing interest for this form of travel. Indeed, the benefits are twofold:

- **health benefits** generated by physical activity, since children who go to school by walking or cycling have higher energy expenditure (Tudor-Locke et al., 2003), perform more physical activity (Cooper et al., 2003), and are more likely to meet physical activity guidelines than children who travel to school by motorized transport (Tudor-Locke et al., 2002);
- **behavioural development**, since active travelling offers not only learning social opportunities, but also allows to develop (Jensen, 2008): (i) cognitive and meta-cognitive skills; (ii) the level of dependent and independent activity in traffic areas, and (iii) motivational and personality factors. From a behavioural standpoint, children may establish positive attitudes that may be later adopted during their adulthood, and even more important children become less and less dependent on adults with age.

Therefore, the therapeutic value of active travel may be extended, by relating children's behaviour to the health benefits produced by physical activity (Mackett et al., 2005).

This confirms that the likely health benefits for children of walking and bicycling to school stress the need to further examine ways to promote active commuting in this population group, and to understand the determinants of children's' physical activity in order to develop effective interventions.

2.3.2 Main determinants of Active Commuting to School

Section 2.3.1 has briefly illustrated the importance and the potential benefits of ATS among children. However, when investigating how ATS may be promoted, it is foremost necessary to soundly understand the environmental factors (or determinants) that may facilitate or inhibit it, and that are mostly associated with the tendency for children of using ATS.

Based on the existing literature examined for this subject, in this thesis such environmental determinants may be grouped into the following four categories:

- Children and parental patterns;
- Socio-cultural and physical environments;
- Economic environment, and
- School environment.

This review is in line with the work done by Pont et al. (2009) on the environmental correlates of children's active transportation, and based on the selection and analysis of 38 publications dealing with ATS. Table 2.1 provides a summary of the main environmental determinants covered by these studies.

Table 2.1: Summary of environmental determinants

Environment type	Variables
Physical environmental determinants	• Parks/play areas/sporting venues/ recreation facilities present in neighbourhood. • Increasing distance. • Increasing mixed land use. • Increasing residential/population density. • Neighbourhood (central city/small city/town/suburb/urban). • Walk and bike paths present.
Economic environmental determinants	• Increasing household income. • Increasing car ownership.
Socio-cultural environmental determinants	• Ethnicity. • Only child. • Parent (divorced/widowed/separated/single). • Parent concerned about child safety. • Parent concerned about traffic safety. • Increasing parent education.

Source: Pont et al. (2009)

Each of these determinants entails important aspects that may either positively or negatively influence a greater use of ATS, namely a greater use of walking and cycling.

Finally, regulatory and policy framework plays also a crucial role as determinant of children's travel choice and active travel. With respect to this determinant, Christie et al. (2004) argued that high rates of active travel are consistently associated with pedestrian

and cyclist safety in developed countries, where promotion of active travel and safety occurred concurrently.

Amongst the high active travel countries in Europe, Denmark is a remarkable case-study because it has reached the highest mode share of active trips by children (77%), while at the same times reduced by one sixth child pedestrian and cyclist fatalities during the period 1981-2001 (Christie et al. 2004). This was possible through the implementation of a range of safety measures in combination with the promotion of active travel and cyclist safety.

Children and parental patterns

Over the last five years a growing body of research has emerged with regard to the investigation of the main predictors of children's travel choices and, in particular, of ATS. The research work have progressively included in its analysis key categories of determinants, which even more often refer to the: (i) children and parents characteristics (age, sex, attitude towards physical activity), (ii) socio-cultural and parental environment (including the family characteristics) in which pupils grow up, (iii) the physical environment (including the role of urban form), (iv) school characteristics, and finally (v) demographic and economic factors.

Observing for example **children characteristics**, a variety of studies (Schofield et al., 2005; Tudor-Locke et al. 2003; Rosenberg et al. 2006; Evenson et al., 2003; Harten and Olds, 2004) showed that **boys are more likely than girls** to actively commute to school, while one of these studies (Harten and Olds, 2004) argued that boys almost twice as likely as girls walk or bicycle to school. This may be explained, for example, by the fact that parents are much more protective of girls than boys, and tend to impose greater restrictions to girls' independent mobility (Grunbaum et al., 2004).

Differences in ATS may exist in terms of **children's age**, with older children having a higher level of ATS than younger children, and this is usually tied to a gain in independent mobility for older children (DiGuiseppi et al., 1998; Merom et al., 2006; Evenson et al., 2006).

Finally, differences also emerge when looking at **demographic groups** that differ in terms of race, ethnicity or socio-economic status. For example, research in the United States, due to the *melting pot* nature of this country, extensively paid attention to this domain of analysis. Findings from various studies show that, in general, African and Hispanic children actively commute in a higher proportion that their white peers (Evenson et al., 2003; Fulton et al., 2005), or than children living in low-income families are more

likely to actively commute that children living in high-income families (Braza et al., 2004; Harten and Olds, 2004; McMillan, 2007; DiGuiseppi et al., 1998).

Looking, conversely, at the **children's behaviour**, there is evidence (Ziviani et al., 2004) suggesting that children's behaviour concerning ATS is influenced by their parents and family characteristics and attitudes. Findings from Davison and Lawson (2006) suggest that parents usually act as gatekeepers between observable environments and children's behaviours. Thus: how parents perceive: (i) environments in relation to traffic and child safety, (ii) their own child/children and their unique family context (marital status, ethnicity, availability of cars, or socio-economic status for example), and (iii) demands (time and financial demands, participating in extra-curricular activities) determines the decisions in relation to their children and active commuting.

Interestingly, McMillan (2007) also highlights the impact of parents' work on the children's level of ATS, having observed that when active commuting interferes with parents' work schedules children are less likely to actively commute. On the contrary, children are more likely to actively commute when their parents either actively commute to work too, or assign an important value to physical activity (Merom et al., 2006; Ziviani et al., 2004). Obviously, the perceptions about the traffic safety, distance from school, neighbourhood safety are all concerns that are usually raised by parents, and that will be analysed in greater depth in the next paragraphs of this Chapter.

Socio-cultural and physical environments

Socio-cultural environment refers to the context where children live and grow up. The notion of social environment is linked to the concept of **social and behavioural norms**, which are important determinants of individual behaviours (McKenzie-Mohr and Smith, 1999). The current research on this issue (Timperio et al., 2006; McMillan, 2007) demonstrated that children are more prone to actively commute when their parents perceive that other children do the same in their community, and that their families have a positive value on ATS, thus permitting their children to walk or cycle to school. In this research domain, parental concerns about traffic safety may be regarded as the most frequently observed socio-cultural environmental determinant (Pont et al., 2009), with in particular three studies (CDC, 2005; Timperio et al., 2004; Salmon et al., 2007) that reported an inverse relationship between this variable and children's ATS (the higher the concern, the lower the level of ATS).

Some publications (Frank et al., 2007; Clifton, 2003; Evenson et al., 2003; Shi et al., 2006; Mota et al., 2007; Martin et al., 2007) even indicate that the usage of walking and

cycling as transport modes among children is also related with the **education degree of their parents**: there is, indeed, evidence that the use of such non-motorised modes decreases as the education levels of parents increases.

Alongside with the social environment, **physical environment** is also a factor that intensively influences children's choice for ATS. The term physical environment includes a set of elements, like road and side-walk infrastructure, traffic safety, accessibility of public transportation, urban *vs* rural location. Therefore, it is strictly connected with the effects the urban form has on distance and, consequently on the school travel modal choice. According to Schlossberg et al. (2006), for example, urban forms are important in relation to walking or cycling to school, whereas intersection density and dead-end density are major predictors of walking rates to and from school, as is distance to school, which is a product of urban form.

Hence, the physical environment (and its relationship with ATS) has been the focus of considerable amount of research work, though such research has largely based its analysis and variables from studies on adults (Larsen wt al., 2009).

Within this framework, it is widely acknowledged that **distance to school** is the main variable that may be – when too long – inhibit the attractiveness and the rates of ATS among children (Nelson et al., 2008; Timperio et al., 2006; Timperio et al., 2004; Schlossberg et al., 2006; McDonald, 2007; Merom et al., 2006). A convincing relationships exists then between distance and ATS, and current evidence shows association between long distance with lower rates of ATS (Timperio et al., 2004; Gilhooly and Low, 2005; Merom et al., 2006; Schlossberg et al., 2006; Ziviani et al., 2006; Nelson et al., 2008; Ham et al., 2008; McMillan, 2007; Yarlagadda and Srinivasan, 2008; Heelan, et al., 2005).

The **characteristics of the built environment** is also crucial in determining the rates of ATS, although the evidence is somewhat mixed regarding how this occurs (Larsen et al., 2009). For example, the presence of parks, gardens, sport and recreational centres, playground areas in the neighbourhood is found in a number of studies as important variable that may lead to higher rates of ATS among children (Alton et al., 2007; Evenson et al., 2006; Timperio et al., 2004; Mota et al., 2007; Kerr et al., 2007).

Other publications also paid attention to the density of street intersections (that is the number of intersections per square mile in a neighbourhood). This is linked to route options and connectivity in the local neighbourhood, and it was shown to have positive associations with rates of active travel (Kerr et al., 2007; Frank et al., 2007; Braza et al, 2004). These studies even argued that higher residential densities are an essential factor

towards higher ATS rates among adolescents, though at least one study found no relationship between residential density and walking to school (Larsen et al., 2009; Ewing et al., 2004).

Similarly, other papers (Frank et. al., 2003; Frumkin et al., 2004) observed that the presence of sidewalks or bike paths may increase pedestrian safety, while Kerr et al. (2006), Boarnet et al. (2005) and Fulton et al. (2005) tied this variable with increased levels of walking and bicycling to school. On this issue, the work of Kerr et al. (2006) is worthy of mentioning, since it found that children whose parents reported walking and biking facilities in the neighbourhood were two and a half times more likely to walk or bike to school at least once a week, compared with children who did not have such infrastructure. This confirms that a possible positive association may exist between the presence of walk and/or bike paths and children's ATS

Finally, **land use mix** and **children's residential location** are two further variables that may influence ATS among children.

Concerning land use mix, on the one hand, a possible positive association was found between mixed or commercial land-use in the neighbourhood and children's ATS. Although some studies (Copperman and Bhat, 2007; Kerr et al., 2007 and Kerr et al., 2006; McMillan, 2007) reported significant positive associations, other papers (Yarlagadda and Srinivasan, 2008, Ewing et al., 2004) found non-significant associations. Therefore, on this point it may be concluded that a clear positive association between land use mix and children's ATS may not be drawn and that more research work is needed in this respect.

Regarding children's residential location, on the other hand, seven publications dealt with this subject and three of them found that living in a central city, small city, town, suburban or urban area has a non-significant association with rates of ATS (Timperio et al., 2004; Martin et al., 2007; Pabayo and Gauvin, 2008). The four remaining studies (Copperman and Bhat, 2007; Shi et al., 2006; Tudor-Locke et al., 2003; Yarlagadda and Srinivasan, 2008) reported non-significant associations and one (Tudor-Locke et al., 2003) also reported a significant inverse association.

Economic environment

Economic factors like income and gross domestic product (GDP) are important indicators in influencing the mode of transport to travel to and from school, and thus ATS. Likewise socio-cultural and physical environments, the economic environment is a key determinant that was studied in several publications.

In this respect, the most cited variable is usually **car ownership** and nine studies (Carlin et al., 1997; Copperman and Bhat, 2007; Ewing et al., 2004; Roberts et al., 1996; Timperio et al., 2006; Timperio et al., 2004; Tudor-Locke et al., 2003; Yelavich et al., 2008) observed a negative correlation between the rates of ATS among children and the number of households having the cars, i.e. the higher the latter, the lower the former. Additionally, six papers (Spallek et al., 2006; Tudor-Locke et al., 2003; Pabayo and Gauvin, 2008; Martin et al., 2007; McDonald, 2007; McMillan, 2007) found an association between increasing household income and decreased rates of children's ATS.

In conclusion, it may be assumed that as household increases, parents' value of time also increases in parallel. As a result, car is perceived as the most attractive transport mode for taking children to school, since it is a quicker and more efficient option.

A different discourse may be done by looking at the notion of **equality**. Research agrees in considering that more equal societies *almost always do better* (Wilkinson and Pickett 2009), for example in improving child traffic safety (Christie et al. 2004) and, possibly, active travel.

As described by Wilkinson and Pickett (2009) more equal societies present higher level of trust, social cohesion, greater people involvement in the community daily life, which enables, on the one hand, to keep low violence and crimes rates, and, on the other hand, to positively influence parents' willingness to let their children independently move in the public realm. Finally, it was observed that more economically equal countries are also more likely to support more equitable transportation systems that cater for the needs of all road users, including pedestrians and cyclists.

School environment

Finally, school characteristics are also further relevant factors affecting ATS. In this respect, **school choice** may affect the length and mode of trips to school, since parents may decide to enrol their children in schools that are not in their local area, because of a variety of reasons, like for example quality in the education provided, or the possibility to have a school that is designed for their children's specific needs. Similarly, **school closure** may also have direct effects on children's travel patterns, especially when it stretches the average distance to the nearest school.

School location (distance o school) and **accessibility from the community** (also referred to as *school siting*) result then as primary determinants in encouraging or discouraging rates of active commuting. This issue was raised by a large number of studies, which reported that distance is a key barrier to children's ATS; for example, CDC

(2005) and Heelan (2005) pointed out that distance is the most frequently reported barrier, while other studies (Harten and Olds, 2004; McMillan, 2007; Merom et al., 2006; Ziviani et al., 2004; Sjolie and Thuen, 2002) claimed that distance is the strongest predictor of children's walking and biking to school. These findings are also in line with Martin and Carlson (2002), which affirm that long distance to school may also represent a barrier against active commuting.

The role and importance of distance is also confirmed by two studies focused on Australia and the United States. For Australia, Timperio et al. (2006) found that children were more than five times children were more likely to walk or bicycle to school at least once per week if they lived within 800 m of their school, than were children who lived farther away. Similarly, McMillan (2007) concluded that in the United States children who lived within one mile of school were more than three times as likely to walk or bicycle to school than children who lived greater distances from school.

Interestingly, Braza et al. (2004) linked ATS with **school enrolment levels** and **population density**. This study focused on ATS in 34 Californian communities and found that lower school enrolment and greater population density within 0.5 miles of the school were associated with higher rates of walking and biking to school. According to this study, this may reflect school siting, because larger schools are located outside of general residential areas (with low population density) and draw on a larger pool of students from a broader geographic area.

2.4 Conclusions

Chapter 1 focused on a literature review on the concept of ATS, by linking the analysis to the dramatic decline in the Western countries in the number of children and adolescents that travel either to school or to other activities by walking and cycling. The main reason for this is that children are increasingly accompanied by their parents by car, which, apart considerations on the overall negative impacts produced by the high rate of car ownership (traffic congestion, environmental damages in terms of GHGs emissions, poor air quality and noise pollution), has direct physical and psychological harmful effects on children's health and development.

The underlining factors of such increase in car ownership may be summarised as follows:

- parents fears about road safety for their children if they walk or cycle to school;
- parents fears about the personal safety of their children if they travel to school unaccompanied;

- greater parental choice, school closures and other factors resulting in longer journeys to school.

In this framework, ATS has been suggested as possible strategy for encouraging more healthy lifestyles among children, by enhancing the rates of walking and cycling, namely as far as the journey to school is concerned, as this significantly engages children during their early life. ATS is, then, seen not only as a possible source for increased physical activity – thus, for example, reducing and preventing the risk of obesity, overweight, cardio vascular diseases – but also as a momentum for social, attitudinal and behavioural development. There are, nevertheless, many factors that should be examined since they are potential predictors of children's ATS. These factors have been defined as *determinants*, which reflect the characteristics of: (i) children and their families, (ii) schools and communities, and (iii) socio-cultural/physical/economic environments. For instance, it was found that differences in ATS may exist in terms of children's age, with older children having a higher level of ATS than younger children, or that children are more likely to actively commute when their parents either actively commute to work too, or assign an important value to physical activity.

Obviously: traffic safety, distance from school (and consequently travel time), neighbourhood safety are all factors that may facilitate or inhibit rates of ATS among children. All the observed determinants influence to what extent children are more or not likely to actively commute, bearing in mind that the parents' perception of all these determinants is maybe a stronger predictor of children's active commuting (for example than urban forms are), which implies that any changes are unlikely to affect children's active commuting patterns unless parents' concerns and attitudes are also addressed.

To conclude, ATS is growing in interest and a greater attention is paid to this strategy, without forgetting that it is also linked to a broader concept of mobility-related sustainability. As stressed in the introduction to this Chapter, ATS may encourage among children a greater familiarity with sustainable transport modes, which – associated to an increased mobility independence – may enable them to develop positive attitudes and behavioural patterns that may be then continued into their adulthood. This should be backed by greater valuing children's ability to address adverse situation like accidents, injuries, failure, conflict, abuse, neglect or tragedy (Gill, 2007). The purpose is to allow children to develop their own coping mechanisms and to devise strategies to do things in their own way. It is only through *the doing* that children become competent in negotiating a vast range of interactions and relationships, including how to respond to peer pressures as well as decisions about who to trust, and the extent of that trust (Gill,

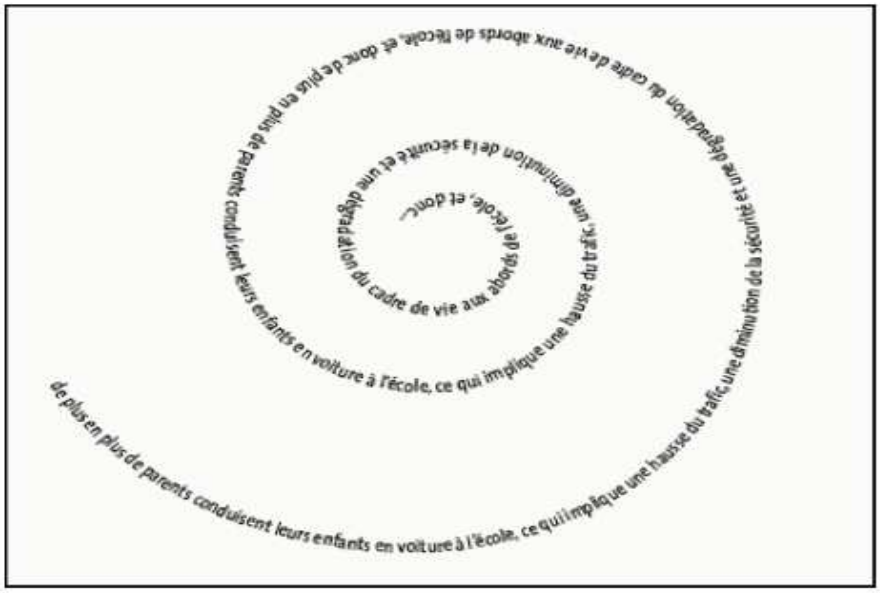
2008). In this perspective, a number of initiatives have been designed launched over the last ten years, both at European and international level. This will be subject of the analysis covered by Chapter Three, paving the way for the analysis of the *Shared Space* concept and the observation of the case-study selected for this thesis, i.e. the city of Castelfranco Veneto.

CHAPTER III: CHANGING SCHOOL TRAVEL PATTERNS: OVERVIEW OF ACTIVE TRANSPORTATION INITIATIVES

3.1 Introduction

The literature review in Chapter Two explored the current children's mobility patterns, and highlighted how a sharp decline in the rate of active commuting either to school or other non-school activities has been reported in all Western countries over the last 20 years. Besides the development of the modern urban structures, that failed to provide adequate and suitable public realms for children, the increasingly use of private car as main transport mode is one of the main phenomena that led to lower rates of active commuting among children. Indeed, as Chapter Two showed, there are a number of complex and interlinked factors that have an impact on school travel, which explains why for many of their journeys children are driven in car by their parents, as the latter motivate such modal choice because of traffic, too long distance from home, parental time pressure, or for other safety and security reasons. Though school-related journeys generally constitute a small fraction of overall transport demand, they often take place at the busiest times of day, leading to congestion and subsequently more emissions (Cairns et al., 2004). As a result, traffic and congestion is increased, which creates a vicious circle since fear about safety in traffic leads to less walking or cycling and more driving, which in turn generates more traffic (see Figure 3.1 in this respect).

Figure 3.1: Vicious circle on school travel patterns[5]



Source: MET, 2003

More importantly, all this may also have serious consequences on children's physical and psychological development. From a behavioural standpoint, it has been argued, for instance, that the large predominance of the car use for school runs leads to less independence for children, and hampers the chance for children to socialise or to have learning social and attitudinal opportunities, thus delaying their emotional maturity. Moreover, children may be exposed to levels of stress experienced by driving adults but that are excessive for their age. As a result, they are more likely at risk of becoming frustrated and nervous in their adulthood.

From a physical perspective, the fact of being largely accompanied by car produces a reduction in the rate of their physical activity which, as many studies concluded, may lead to obesity and overweight and subsequent serious diseases like: cardio vascular problems, hypertension, metabolic dysfunctions, diabetes, and some types of cancer as well.

Then, addressing school run has become a critical issue, not least because this implies challenging personal travel habits as the school travel is not separated from the overall general congestion problems, as well as the rest of the general car use.

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5 "More and more of parents drive their children by car to school, which implies an increase in traffic, a decrease in security, a degradation of the quality of life on the journey to school and therefore more and more of parents drive their children by car to school which results in an increase in traffic, a decrease in security…".

This explains why understanding how children commute to school is therefore receiving a particular attention, and a growing focus is dedicated to those commuting solutions that are more likely to encourage active travelling among children.

In this respect, a variety of initiatives have been launched internationally and in Europe, which aim to enhance the rate of active transportation (walking and cycling), with the belief that this may promote active and healthy lifestyles among children which may then be continued during their adulthood.

Such initiatives cover a wide range of actions and measures, from simple educational campaigns to a more structured approach where ATS is fully integrated into the overall mobility management strategy or transport master plan.

In particular, more effective and long lasting results are likely to be obtained when the initiatives for promoting ATS are integrated in a broader approach for mobility management, e.g. they are integrated and cooperate with a programme of measures (both incentives and restrictions – generally referred as *push and pull* measures) that are culled from the three *E's* of traffic safety: Engineering, Education and Enforcement, and that aim to encourage: (i) car pooling, (ii) a greater use of public transport means, (iii) a greater respect for pedestrian and cyclists facilities, or (iv) redesigning public spaces with more pedestrian walkways, cycling paths, playing areas, better liveable spaces.

That said, the purpose of Chapter Three is to explore the major experiences and best practices on ATS, by underlining their main features and outcomes. More specifically, this Chapter will focus on School Travel Plans, Safe Route to Schools and Walking School Buses by observing their key components, and how they are representing valuable tools for successfully supporting local authorities in promoting a more sustainable approach to school travel.

The findings reported in Chapter Three are largely derived from the results achieved by a selection of experiences that were identified for Europe, Australia and the United States.

3.2 School travel programming strategies

Inevitably all schools are different and have different travel issues which need to be addressed. Schools in rural areas may face poorer catchments and, therefore, are less able to achieve a lower level of car usage. Conversely, schools located in urban areas may have greater chances for achieving better results, thanks to the fact that they may benefit from specific conditions like, for example, the availability of public transport services. Finally, travel challenges for secondary schools are different in comparison to the ones of primary schools, since the rate of children travelling independently is higher.

That said, and in line with the current literature, the showcases that will be presented in this Chapter confirm that, as general rule, each school has a potential for significantly modifying travel habits and encouraging a more active approach to school travel patterns. This occurs regardless of size, location, catchments area, type (private/public, primary secondary). Then, all types of school may be successful in fostering a more sustainable approach to school travel patterns.

A number of actors and stakeholders have a key role in facilitating an education-based travel shift from carbon-based modes to alternative modes of transportation. On the one hand, educational institutions present an approach that particularly focuses on enhancing a positive behaviour towards sustainable mobility. Governments (at different levels: national, regional, local), on the other hand, usually have a primary role in: (i) providing appropriate legislative and regulatory frameworks for ATS, (ii) allocating adequate resources, (iii) planning and investing in infrastructures and alternative transport modes.

This namely applies in countries where power is devoluted from the central level to regional and local ones, which is, for example, the case of countries with a federal structure (Germany, Switzerland) or with increased devolution (United Kingdom). In this context: (i) integrating ATS into the overall planning strategy, (ii) incorporating transport impact assessments in educational decisions, or (iii) providing infrastructure (like cycle paths, safe crossing, walk-paths) may be quoted as specific actions that may be implemented at a local level.

In this respect, the case of the Swedish City of Lund is of particular interest, since it is an example of how initiatives for promoting active commuting to school may be well integrated into a broader strategy for sustainable mobility.

Indeed, the project "**Walk and cycle to school**" is part of the Lund transport master plan – also referred to *LundaMaTs* – whose concept dates back to 1996 when the first version of the master plan (LundaMaTs I) was released. Today, an updated version of the Plan (LundaMaTs II) provides a vision up to 2030, which was widened from an environmentally adapted transport system to a sustainable development of the transport system covering three sustainability aspects – environmental, economical, and social (City of Lund, 2007).

Safe routes to school as part of the pedestrian traffic priority is one of the key aspects of this strategy.

The project has started in 1999 following a consultation that involved 4,500 parents of children between six and nine years of age, which showed how 40% of the parents were

used to accompany their pupils to school by car, mainly because in their opinion school routes were considered not enough safe.

Based on this consultation, the first step for improvements was the identification of those routes and intersections that proved to be the most dangerous. This led to the preparation of a plan that embedded all critical sites to be gradually rebuilt or improved (for example: installing a better street lighting, or separating the different categories of road users).

In parallel to interventions on the infrastructure, a considerable effort was undertaken in order to make parents aware about the adverse effects tied to driving their children to school. This was done via the direct involvement of school staff and education experts, which regularly met the parents and explained them the good reasons for stopping escorting their children to school. Indeed, school staff secured an active cooperation, as a sign of taking responsibility for children's transport to schools. This also confirms to what extent directly informing parents on the positive effects in terms of environment and health was a point of strength for this project.

Positive results were reported already after the first two years of implementation, since an evaluation made in 2002 of the *Walk and cycle to school* project showed:

- more than 25 schools participated to the project;
- a reduction of 5% in the number of children driven to school;
- a reduction of 13 tonnes in amount of CO_2 emissions in one school year (40 weeks) as a consequence of the lower rate of children driven to school;
- an increase of 6% in the number of school children that chose the bicycle as transport mode;
- an increase in children's perceptions and knowledge of their neighbourhood and a greater feeling of security.

Finally, this project raised significant awareness in Sweden, and introduced a method that later was initiated in other Swedish cities.

Within this framework, innovative programmes are currently under implementation in Europe and worldwide. **School Travel Plans** (STPs), **Safe Routes to Schools** (SRTS) are programmes that in general encourage children to walk and bicycle to school by lobbying for improved street design, traffic calming and creating traffic-free zones around schools. Both are often regarded as promising programmes that potentially may address the issues tied to the increase of car use as preferred transport mode also for school trips, as well as building up children's capacity to shift from a supervised form of travel to independent travel.

STPs and SRTS are responses that over the last 20 years have been implemented in Europe (called by various names, such as *School Travel Plan* in the United Kingdom and Ireland, *Schulverkehrsplan* in Germany, Switzerland and Austria; *Plan de déplacement scolaire* in France; *Pedibus* in Italy; *Schoolvervoerplan* in Belgium and The Netherlands), and in several industrialised countries (Australia, New Zealand, Canada and the United States) around the world. Their goals are similar, since they all aim to:

- increase the use of cycling, walking, car sharing and walking bus, and in parallel encourage parents to opt for these modes with confidence;
- increase road safety and travel awareness;
- cut congestion around school environments;
- improve children's fitness and health;
- give children an opportunity to have a say on decisions that affect them directly;
- consolidate links within the local community.

Looking specifically at the notion of STPs, they may be defined as a plan which is designed in order to target children and to reduce the amount of car traffic that occurs around schools, by levering on a package of soft and hard measures like: road safety education, increased education of road safety, travel awareness, installation of cycle lanes, a walking-bus scheme or a car-sharing program.

The basic idea is to put forward a set of measures which are shouldered by a partnership involving the school, education and transport officers from the local authorities, the police and the health authorities. It is based on consultation with teachers, parents, pupils and governors and other local people.

Therefore, STPs present themselves as a comprehensive process, which makes use of a collaborative community approach, where all concerned stakeholders look at the barriers to active transportation, and work together towards the implementation of initiatives that not only deal with infrastructure changes, but also with positive behavioural changes. The framework is necessarily flexible, so to enable each community to tailor the plan to its specific needs and characteristics even if usually within a set of minimum standards, targets or requirements.

A partially different approach is followed, conversely, by SRTS schemes, a concept that was originally conceived in Denmark in the 1980s, and that endeavours to positively impact a child's travel and health by making the school route safer for non-motorized modes through:

- education (of both the child and the driver) on road safety;
- enforcement of traffic laws around schools; and/or

- engineering of the street environment along the routes to school to control traffic and to enhance pedestrian and bicycling facilities (the three E's of transportation engineering) (Transportation Alternatives, 2002).

A further programme is called "**Walking School Buses**" (WSBs), which was launched for the first time in 1992 in Australia and later introduced in 1998 in the United Kingdom by the Hertfordshire County Council. While still very popular in the United Kingdom, WSBs gained an important level of popularity elsewhere in Europe, North America and New Zealand.

A WSB is mostly a volunteer programme that engages parents on a rotational basis to escort small groups of children to school by foot or by bike from an established meeting point (or "bus" stop) and along a fixed route. The added-value of such programme not only consists in potentially impacting on children's physical activity, but also in requiring a role model parents. WSBs' proponents usually draw the attention on the fact that WSBs may:

- encourage physical activity;
- teaching children a safe behaviour while walking and interacting with real traffic conditions;
- raising concern for the environment;
- reducing car-based school journey and, therefore, traffic congestion, pollution, and speed around schools environments;
- strengthening community social relations.

In summary, all these programmes are conceived to enhance and encourage ATS, even if the scale of their action is different since STPs and SRTSs may be depicted as broad-scale efforts that push forward changes in transport infrastructure and school policies, within a more institutionalised framework where minimum requirements are set and *ad hoc* financial resources allocated.

By contrast, WSB (or Cycling School Buses-CSBs) are essentially smaller-scale efforts that may be incorporated into SRTS or STP schemes. In fact, WSB mainly aims to mobilise groups of parents and stakeholders to create supervised walking routes for children without addressing structural changes to promote safe walking and bicycling.

Sections 3.2.1, 3.2.2 and 3.2.3 will give an overview of selected, remarkable experiences of these three ATS schemes in Europe, Australia and the United States.

3.2.1 ATS schemes: reference cases for Europe

As previously mentioned STPs and WSBs have increasingly found an important place amongst the mobility demand management strategies in various European states. Amongst them, and with **a specific focus on STPs**, the United Kingdom has probably the most extensive experience in travel school planning, since this has been a priority since the beginning of the 1990s, partly because of road safety concerns, partly due to increasing concerns on children's health and well-being (Cairns, 2005). The concept of STPs was developed during the years 1997-1998 and has seen a progressive implementation amongst schools: in 2003, more than 2,000 have completed their travel plans (DfT, 2003).

In September 2003, the DfT and the Department for Education and Skills (DfES) jointly set a target of 100% schools having their school travel plans by 2010 (Cairns, 2005); a target that was backed by a financial support of £ 50 million (allocations per school range between £ 15,000 and to £ 189,000) to be allocated for STPs over two years (2004-2005 and 2005-2006). At present, nearly all Local Authority Schools (LA) (non-fee paying) have a travel plan in place, which helped deliver an approximate reduction of 10% car journeys to school over the past five years (Kelly, 2010).

The overall policy responsibility for the STP is shared between the DfT and the DfES, whilst the management responsibility is split between:

- the regional level, where: (i) a progress evaluation of individual local authorities and (ii) verification that minimum standards and objectives are met;
- the local level, where the programmes are run.

Throughout the process, monitoring is a key feature, since it ensures that consistent and effective STP programmes are delivered, though a certain flexibility is allowed in order that the programme is tailored on local needs and solutions. Indeed, a distinction is done between *what is essential*, on the one side, and *what is desirable*, on the other side, with reference to nine categories of elements:

- description of the location, size and type of school;
- description of travel/transport problems/issues faced by a school/cluster of schools;
- survey results;
- clearly defined objectives and targets;
- details of proposed measures;
- detailed timetable for implementation;
- clearly defined responsibilities;
- evidence that all parties are consulted;

- monitoring and reviewing proposals.

Every year, annual audits of STPs are carried out, which summarise the number of schools at each stage of STPs development. Table A.1 in Annex A illustrates an abstract of the UK STP essential and deliverable supporting evidence, while Box 3.1 and Box 3.2 provide an overview of the experiences of Bromley and Brighton-Hove boroughs, whose positive outcomes confirm the effectiveness of the approach followed in the United Kingdom on the issue of STP.

To conclude, the STP in the United Kingdom has proved to be an effective tool for enhancing active transportation amongst children, and thus more sustainable patterns in their daily mobility. In particular, the UK approach made possible to establish a coordination and a comprehensive endorsement of the program at all governance levels (central, regional and local). This also made possible an official recognition of "school travel" as an indicator for sustainable development, adequately backed by an extensive financial commitment. Moreover, schools have a direct ownership over STPs and the possibility to fine-tune the programme at their local level, though within the framework of a minimum set of requirements and targets that are necessary for nation-wide program evaluation (Green Communities, 2007). This successful approach is also confirmed by some final figures of positive results, since:

- in 1999 only 500 schools endorsed a STP program. In 2003 this number soared to 2,000 covering over 10% of all schools in the United Kingdom (DfT, 2003);
- in 2006, though still far from achieving the objective of 100% of school having endorsed a STP programme, it was estimated that approximately 50% of UK schools had a STP in place;
- when local authorities engage with schools, data show that a high proportion (between 60% and 90%) may be expected to achieve positive modal shift, and a significant percentage (between 15% and 40%) may be expected to reduce car use by over a fifth. This implies that the overall reduction of car use at all engaged schools is likely to be in the order of 8-15% (Green Communities, 2007);
- Sustrans also reported that a [Walking School Bus] evaluation found a marked improvement in child alertness (SUSTRANS, 2000).

Box 3.1: STP in Bromley

Borough of Bromley (Greater London)

Bromley is geographically the largest borough in London and is located in the South-Eastern part of the Greater London. This means that the borough has also one of the highest car ownership levels in London, where most of shorter journeys are travelled by car. This results in sever traffic congestion levels, especially during the peak hours in the morning and in the evening, thus including also school runs. On this last issue, data collected by the 2001 London Area Travel Survey show that 43% of resident children were accompanied to school by car. The local Council decided to thoroughly address this concern by approving in 2004 a Sustainable School Transport Strategy which develops schemes and initiatives to improve the physical environment in and around schools site. Such schemes cover a number of actions (Walking Buses, car sharing, training and safety education, information and awareness campaigns), amongst which the Walk on Wednesday (WoW) scheme is probably the most successful one. In 2008 (latest available data), the results achieved may be summarised as follows:

- 99 schools (out of 113) approved a STP;
- 18 WSBs operational, with more than 200 pupils participating;
- the establishment of a comprehensive programme of education and training, covering aspects such as pedestrian skills, cycle training and traffic education;
- the design of an integrated approach to school travel, linking with other work areas such as road safety, travel awareness, walking, cycling, education and the environment;
- a 15% reduction in the number of school runs made by car.

Source: French (2008)

Box 3.2: STP in Brighton-Hove

Borough of Brighton-Hove (East Sussex)

In referring to the UK Government's Integrated Transport White Paper (DfT, 1998), which focused on the journey to school, the Full Local Transport Plan 2001/2002–2005/2006 marked the beginning of the Borough's efforts in promoting active and safer journeys to school, through an invitation to local schools to take part in the development of STPs. Such efforts were refreshed with the second Local Transport Plan 2006/2007–2010/2011, which set the objective of a 6% reduction in the use of the car for school–run journeys. Overall, the local Council set the goal to have one in five journeys to school by car by 2012 - at present it is one in four.

So far, main achievements are:

- a 10% reduction in car journeys to school (Local Authority Schools-LA);
- raising the profile of sustainable travel in all schools;
- partnership working with other departments which contribute to the climate change agenda;
- completion of many school travel plans (LA schools are entitled to receive a Government grant to support travel planning).

Main challenges may be summarised as follows:

- engaging with Independent Schools (not entitled to grant);
- schools finding the time to cooperate;
- schools not reviewing their travel plans;
- keeping sustainable travel high profile in a difficult economic climate when there is pressure on resources.

Source: Brighton-Hove County Council (2007); Kelly (2010)

Looking further at **WSBs most relevant case-studies**, the United Kingdom is again a frontrunner in this area of intervention. UK local authorities have been promoting walk to school events since 1994, though, as previously pointed out, the WSB scheme was introduced for the first time in 1998, and it was first used by students of Wheatfields Junior School in Hertfordshire.

Since then, walk to school initiatives have dramatically grown in size, which is confirmed by the number of children and scholars that have been progressively involved: few hundreds in 1994, more than 12,000 schools in 2002 (Marchetti and Smith, 2002).

Outside the United Kingdom, other interesting examples of WSBs may be drawn from the experiences gained in Italy, Switzerland, France.

In **Italy**, the city of Monza (located in the Lombardy region, North of Italy) is the WSBs national coordinator for Italy and started walk to school initiatives in 2001 (Vittoria, 2010) with 14 participating schools. Last year (most recent walk to school event) the participating schools were 42. Such initiatives are organised on a yearly basis, and generally take place between end of September and beginning of October. The walk to school event usually lasts one week, during which the participating schools located in the five City of Monza's administrative boroughs commit to organise a WSB on one working day following the rule *one borough, one working day*.

Last year a pilot project also started and has involved a kindergarten, a primary and a secondary school. Results were not fully satisfactory, namely with the kindergarten and the secondary school. For the former, difficulties were reported in modifying opening hours, whilst for the latter, having focused the intervention on the promotion of cycling, safety concerns and large catchments area for that school were the main reasons leading to failure. Conversely, positive results were achieved with the primary school, where 80 out 100 children involved in the initiative *Pedibus* have participated on a regularly basis. The success was such that it was decided to held the *Pedibus* in Winter as well (one week in February).

Similarly to the City of Monza, other interesting case-study from Italy refers to the experience of the City of Lecco, which likewise the City of Monza is located in the Lombardy region, in Northern Italy. Here strong emphasis was put on the association between WSB, healthy benefits and safety increases. To date, 12 lines are operational in the Lecco area, with more than 500 children using the routes.

Feedback on such initiative is positive, since the *Pedibus* was rated by 87.4% of children as their "preferred mode of transport" (Rossi et al., 2004, cited in EEA, 2008). A positive evaluation was also reported among parents and schools staff, mainly thanks to the benefits in terms of reduced traffic congestion and pollution, and increased socialization. Concerns, and thus negative views, were expressed with regard to adverse weather conditions, and heavy rucksacks children have to carry. Figure 3.2 summarises positive and negative aspects of the *Pedibus* initiatives according to parents and school staff.

Figure 3.2: Overview of positive and negative aspects of the *Pedibus* initiatives according to parents and school staff.

Positive aspects	Number of respondents	%	Negative aspects	Number of respondents	%
Socialising	30	21.0	Adverse climatic conditions	35	49.3
Combating inactivity	30	21.0	Heavy backpacks	25	35.2
Road awareness	18	12.6	None	8	11.3
Enhancement of community project	16	11.2	Children's fatigue	1	1.4
Education on mobility	16	11.2	Lack of respect of motorists	2	2.8
Reduction of traffic congestion	15	10.5			
Education of pollution	8	5.6			
Learning about surrondings	7	4.9			
Other responses	3	2.1			
Total responses	**143**	**100.0**		**71**	**100.0**

Source: Rossi et al., 2004 (cited in EEA, 2008)

In **Switzerland**, WSBs have especially grown in popularity in the French-speaking part of the country, as they have been implemented since 1998. The cities of Lausanne and Geneva are very much active on this front, with respectively: 35 and 42 lines covering a walking network of more than 15 km.

In **France** the case-study of the region of Lyon is worthy of mentioning. WSB schemes (called *Pédibus*) started in 2002 with a first group of school children. At present, more than 76 schools in the entire Lyon region participate with more than 5,000 children, that

on a daily basis actively travel to school along the existing 152 routes located in the 37 municipalities of the Lyon region.

The efforts made in the rural region of Tremblay are also remarkable (Arene and Ademe, 2008, cited in EEA, 2008). The WSB was implemented in 2002 in two of the schools where car dependence was the highest. For these two schools an accessibility study was carried out, which was later integrated by interviews with the families in order to understand distance-related barriers and to identify potential routes.

Positive effected were noticed, firstly in terms of reduced congestion and traffic flows around school opening and closing times, and secondly in terms of strengthened social relations and increased awareness of air pollution and smarter travel among children in the two participating schools.

3.2.2 ATS schemes: reference cases for Australia

In Australia, STP is embedded in a broader strategy which is labelled "**TravelSmart**", and which encompasses three different kinds of programmes: (i) TravelSmart for Communities, (ii) TravelSmart Workplaces, and (iii) TravelSmart Schools which is relevant for the analysis covered by this thesis.

TravelSmart Schools is a federal initiative, but the individual States are left free of choosing the fields of action on which they intend to focus their efforts, as well as the approach they wish to follow. The basic idea is that the majority of children live within a short distance (less then three km) from their school, and therefore should be encouraged to walk, cycle or to use public transport for the school trips (Thomson, 2009).

Besides the positive effects in terms of GHGs and traffic congestion reduction, TravelSmart has a strong focus on enhancing children's physical and psychological health, since it is based on the belief that ATS is an unique opportunity for establishing and strengthening social connectedness in local neighbourhoods (Thomson, 2009). Although children's independent mobility is not a stated objective, TravelSmart Schools aims to bring children to a degree of greater independence.

Some studies (Whitzman, 2007; DiPeitro and Hughes, 2003) observed the role and effectiveness of the TravelSmart School programme. Travel behaviour was the subject of the analysis made by Whitzman, who concluded, however, that TravelSmart may not produce any long term changes in children getting to and from school. On the other hand, DiPeitro & Hughes argued that the whole school community need to be involved, which is a pre-requisite for a positive response to TravelSmart interventions.

Amongst all STPs undertaken in Australia, the one designed from the State of Victoria appears to be the most comprehensive, since not only safety or education aspect were considered, but these issues were integrated with a more general planning decision-making process. The programme started in 2002 and was run at different stages:

- a first pilot stage in the years 2002-2003 engaging 17 schools (DiPeitro and Hughes, 2003);
- a second stage in the years 2003-2005 with the participation of 34 schools (Peddie and Somerville, 2006);
- a third stage in the years 2005-2006 which launched a new major intervention called *School Travel Planning Congested Precinct Pilot*;
- since the end of 2006, the Sustainable Transport Programs Branch of the Victorian Department of Transport has administered a new TravelSmart program of grants which has sought to increase the capacity of councils and other organisations to develop and implement a range of projects that encourage changes in travel behaviour. The grants address the attitudinal, physical, and institutional barriers to walking, cycling and public transport.

This project was designed as an extension of the original planning concept embedded into the former STPs, trying also to address some deficiencies in the methodology used in the STPs, for instance:

- the STP worked with individual schools rather than clusters of schools, thus not properly considering that a number of traffic adverse effects are caused by a number of schools rather than a single one;
- the 34 piloted schools in the STP were located in 26 different local government authorities, which made difficult establishing strong relationships with the local governments;
- the STPs initially focused on primary schools only, without testing the plans with other types of schools (for example secondary) (Peddie and Somerville, 2006).

Finally, a complementary program of grants, the Local Area Access Program (LAAP) has also been implemented in 2006, and provides funding for small-scale infrastructure projects which aim to improve access to walking, cycling and public transport within local areas. While each program has specific objectives, some projects have both a TravelSmart and LAAP component.

The STP process in the Victoria State proved to work effectively, since a survey data from the *School Travel Planning Pilot* showed that across all 33 schools the number of car trips to and from school was reduced by an average of 9%. In the schools that were

successful in substantially completing implementation of their action plan, the reduction in cars trips was as high as 33%, with an average of 16% (Peddie and Somerville, 2006). TravelSmart is not, nonetheless, the unique banner covering STPs-related interventions, since in Australia (as in the United States) SRTS programmes are also developed in most States. Both TravelSmart and SRTS follow a similar approach, but the latter pays a greater attention on the safety/reduction of accidents determinants (Green Communities, 2007).

Even if SRTS programmes are often carried out independently of any TravelSmart initiative, due to the fact that they potentially create the ideal conditions for establishing safer environments for walking and cycling trips around school environments, they are usually considered as the initial step for later putting in place valuable and effective STPs.

3.2.3 ATS schemes: reference cases for the United States

Contrary to the United Kingdom and Australia, and though their strong commitment to safe school travel, in the United States very little activity is being referred to the concept of STP. Indeed, the work done in the US on this issue falls under the strategy defined by the SRTS programmes, which represents the major efforts undertaken at the federal level to increase active modes of transport among children for their school journeys. The SRTS programme represents the evolution and rationalisation of all state-level efforts for promoting safe routes to schools that were carried out during the 1990s (Davison et al., 2008), namely by providing to all federal States a common framework for defining their strategy and interventions.

The STRS programme was launched in August 2005, when the US Congress passed Section 1404 of the *Safe, Accountable, Flexible, Efficient Transportation Equity Act — a Legacy for Users* (SAFETEA-LU), which dedicates a total of USD 612 million for the period 2005-2009 to address a number of issues which are related to the decline in walking and bicycling occurred in the US during the last 30 years: (i) adverse effect on traffic congestion and air quality around schools, (ii) poor pedestrian and bicycle safety; (iii) low rate of physical activity as a consequence of unhealthy lifestyles which may lead to serious diseases like obesity, diabetes, and cardiovascular problems. Each State is required to appoint a Safe Routes to School Coordinator, that serves as a central point of contact for the state. The legislation also required the creation of a clearinghouse, which is the role of the National Center for Safe Routes to School (NCSRTS) (Pullen-Seufert, 2009)

Box 3.3: The National Center for Safe Routes to School (NCSRTS) at a glance

The National Center for Safe Routes to School (NCSRTS) serves as the clearinghouse for the Federal Safe Routes to School program. The Center backs the three basic objectives of the federal program:

- encouraging children, including those with disabilities, to walk and bicycle to school;
- making walking and bicycling to school a safer and more appealing transportation alternative; and
- facilitating planning, development, and implementation of projects that improve and reduce traffic, fuel consumption, and air pollution in the vicinity of schools.

Source: NCSRTS (2008)

Thus, the SRTS aims to empower local communities and schools for putting in place a wide variety of programs and projects, from building safer street crossings to establishing programs that encourage children and their parents to walk and bicycle safely to school.

From a financial standpoint, the SRTS program allocates resources to States through the Department of Transportation, and which are based on student enrolment, even if no States receives less then one USD million per year. These funds are dedicated to a wide range of measures, both infrastructure-based (i.e. improvements in roads and sidewalks) and non-infrastructure-based (education, enforcement), whereas the former typically absorb 70% to 90% of awarded funds, whilst the latter usually account for the remaining 10%-30% of awarded funds (Pullen-Seufert, 2009).

As it has been observed head on for the UK experience, monitoring plays a key role in the STRS programmes as well, since it enables to soundly identify those strategies that are more likely effective in rising the number of children that either walk or cycle safely to schools.

As showed in Table 3.1, six key indicators are used to monitor and evaluate the success of SRTS programmes, each of them entails a number of specific evaluation criteria

Table 3.1: SRTS key monitoring indicators

Key indicators	Evaluation criteria	Desired direction of change
Behaviour of children	• Numbers of children walking to and from school. • Numbers of children bicycling to and from school. • Skills for walking and bicycling safely.	More More Better
Behaviour of drivers	• Numbers of vehicles arriving and departing school at morning drop-off and evening pick-up times. • Speed of vehicles in and around school area. • Aggressive driving behaviour, e.g. not yielding to pedestrians. • Number of driving trips by parents and length of morning and evening commute.	Fewer Slower Less Less
Community facilities	• Quality of walking environment: number and usefulness of sidewalks and bike lanes. • Safely designed intersections.	Better More
Crashes and injuries	• Number of traffic crashes involving children walking or biking to and from school. • Severity of injuries to children from traffic on their way to and from school. • Number of conflicts between vehicles and pedestrians/bicyclists which would be likely to lead to crashes, e.g. near misses.	Fewer Less severe Fewer
Community buy-in	• Number of different types of people involved in the SRTS effort. • Level of commitment and energy displayed by the SRTS collaborators. • Parent enthusiasm about SRTS and allowing their children to walk/bike.	More Higher Higher
Environmental quality	• Level of air and noise pollution in school area. • Land devoted to parking and drop-off/pick-up areas.	Lower Less

Source: NHTSA (2004)

The monitoring activity is done at schools and national levels, where:

- at *school level*: each local community is left free to decide its own specific school travel-related challenges and to develop their SRTS program accordingly (NHTSA, 2004). Usually, student surveys are devised to assess the walking/biking levels

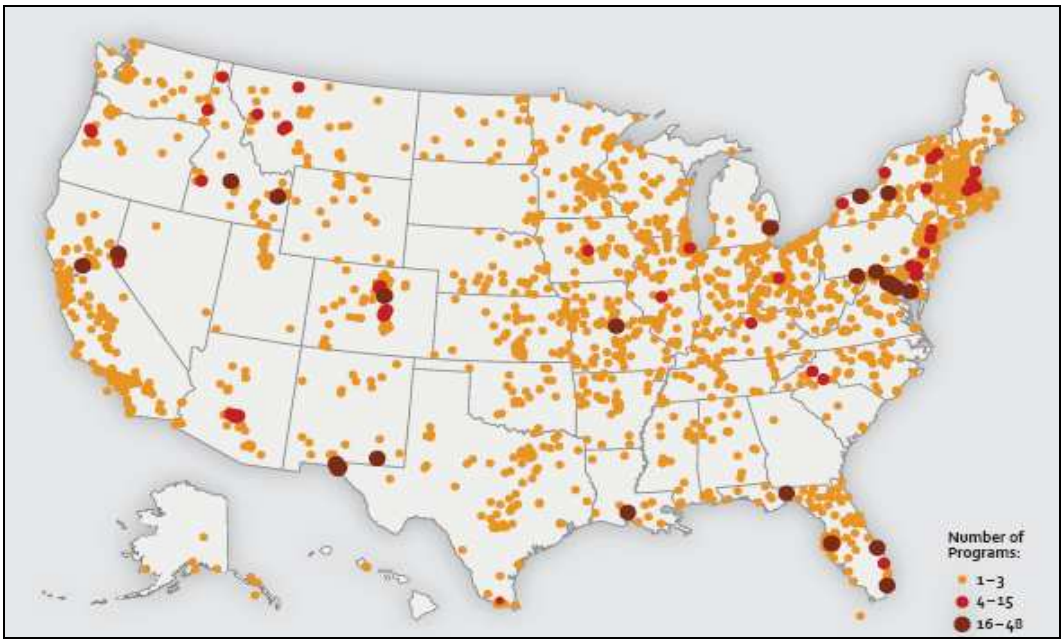
among students, while parent surveys are used to assess distance from home to school and physical and attitudinal barriers.

- at *national level*: SRTS publishes monthly Tracking Briefs[6] which are prepared by the NCSRTS and report information about States' SRTS programs. The Briefs, which are available online, analyse each month one key trend across all State programs and gives a tracking table summarizing program status in each State.

To conclude, an evaluation of the first three years of implementation shows the successful progress achieved thanks the SRTS program. Indeed, as reported in 2008 by the NCSRTS (NCSRTS, 2008) (latest report available):

- all 50 States plus the District of Columbia have Safe Routes to School Coordinators;
- USD 370.6 million in Federal funds have been awarded by State Departments of Transportation as of 1 January 2009;
- State Departments of Transport (DoTs) have awarded 89% of the USD 416 million available to States;
- more than 4,566 funded schools throughout the US have been awarded funds;
- 47 States contribute information to the SRTS national database;
- more than 4,500 schools are engaged in SRTS programs.

Figure 3.3: SRTS programs across the US



Source: NCSRTS (2008)

[6] Tracking Briefs are published online at: www.saferoutesinfo.org/resources/status-reports.cfm

At State level, successful outcomes were, for example, gained in California where Staunton et al. (2003) provides evidence of the SRTS in Marin County, which resulted in a 64% increase in the number of children walking to school by incorporating elements of classroom education, walking and biking days, mapping of routes, and walking trains and newsletters.

The work done in the State of New Jersey is also interesting, since it tried to make use of SRTS for improving conditions of disadvantaged urban communities. In fact, the main struggle in New Jersey continues to be communities making poor land use and transportation choices, and schools are often built in non-walkable areas (von Hagen, 2010). Examples for that are the SRTS schemes implemented in three disadvantaged communities (Newark, Trenton and Camden), which are characterised by high poverty (higher than the national average) and violence rates, lack of resources available, and are in the top ten cities in New Jersey for pedestrian fatalities (von Hagen, 2009).

In the city of Boulder (Colorado State), the local community saw the number of children actively travelling to school increasing from 41% to 70%, which was also associated to a 30% reduction in cars and corresponding traffic near the school.

Alike the United Kingdom, WSB schemes are very popular in the United States and have significantly emerged as a way for creating an environment that encourages walking as both a mode of travel to school, and an activity during the school day (Marchetti and Pullen, 2004).

Historically, walking to school programmes started in 1997 in the United States. By 2003, more than 3,000 schools from all 50 states have joined and more than three million children and adults participated in Walk to School events.

3.2.4 Educational campaigns

Educational and information campaigns play a crucial role in stimulating children and their parents to go to school in a safe and healthy way. Thus, the major goal is to break the vicious circle which parents and children live on a daily basis, and where the increased car traffic creates unsafe conditions that consequently further increase the feeling of insecurity amongst parents. The result is that parents continues to drive their children to school by car, hence generating more car traffic around the school environment.

Interesting examples of such kind of initiatives are the *Traffic Snake Game* (TSG) and the *ECO-TRIP Campaign*, both launched by the EU-funded CONNECT project, coordinated by the Belgian consultancy Mobiel21.

Box 3.4: The CONNECT Project at a glance

The CONNECT project is coordinated by Mobiel21 (Belgium) and gathers eight partners from as many EU Member States. The project was launched in 2008 and is funded through the Intelligent Energy Europe Programme (IEE) of the EC.

Specific project objectives are:

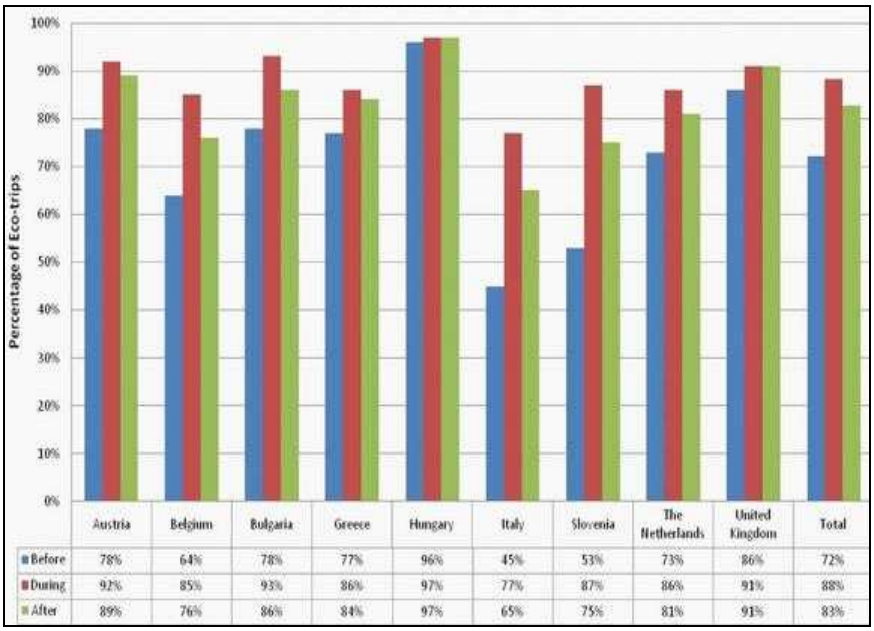
- informing children, students and parents of the benefits of travelling to and from school using sustainable modes such as walking, cycling, public transport, school bus transport or carpooling;
- teaching children to travel safely to school by increasing their knowledge and skills, as well as increasing their visibility in the public domain;
- encouraging children, pupils and parents to travel to school using sustainable modes;
- making use of local communities and authorities as promoters and champions of sustainable school travel behaviour through their role of monitoring the local implementation, but also as a champion for other communities and authorities, hence ensuring long term follow-up and project validity.

Source: Mobiel21 web site (www.mobiel21.be)

The TSG is a fun game, whose purpose is to offer children the possibility to travel to school safely and in an eco-friendly way. The game may be adapted to offer education concerning traffic and mobility, environmental and health issues.

In its first year of implementation, 15,854 children were involved from more than 70 schools in the project partners' countries. In terms of results, the *before* data indicated 72% of trips to school were made by sustainable modes of transport, while the results *during* the game show an increase of 16% to a total of 88%. The *after* results show an 11% increase in eco-trips compared to the *before* data. Figure 3.4 gives a breakdown of results for each partner for the *before*, *during* and *after* percentages (the total percentage of results for all European partners is shown on the far right column), while Table A.2 in Annex A summarises the results achieved by country after the first year of implementation.

Figure 3.4: TSG: results for the first year of implementation (2008)



	Austria	Belgium	Bulgaria	Greece	Hungary	Italy	Slovenia	The Netherlands	United Kingdom	Total
Before	78%	64%	78%	77%	96%	45%	53%	73%	86%	72%
During	92%	85%	93%	86%	97%	77%	87%	86%	91%	88%
After	89%	76%	86%	84%	97%	65%	75%	81%	91%	83%

Source: Schoolway web site (www.schoolway.net)

Significantly, parents and teacher positively evaluated this initiative: 82% of parents would recommend the game to others, which is line with the teacher's answers with 100% stating they would recommend the game to other schools.

The second campaign promoted by the CONNECT project is called *ECO-TRIP* campaign and, while the TSG targets primary school pupils, this one targets secondary schools. The ECO-TRIP is structured along four steps:

- 1st stage: a debate session;
- 2nd stage: pupils take part in a video competition organised at school, national and European level;
- 3rd stage: the ECO-TRIP week is the third stage of the project, in which pupils, teachers and other school personnel keep count of all sustainable trips to and from school during one week.
- 4th stage: a final event, where the winners of the European video contest will be announced.

3.3 Conclusions

The case-studies and approaches illustrated in this Chapter confirm how ATS has increasingly become an important strategy in response to the lower levels of physical activity among children. A greater priority has been called to be given to (both transport

and land-use) planning public choices and initiatives that should encourage a higher rate of walking and cycling, by making both easier and safer.

The journey to school is potentially considered as a good momentum and opportunity for promoting daily physical activity, and in parallel for reducing the car dependence of school travel. This explains why national policies on active travel across Europe and worldwide are focused predominantly on the school journey. The benefits are clear: more physical activity contributes to children's health, less car use allows a reduction in traffic congestion and pollution around school environments, without neglecting the positive impacts in terms of increased road safety.

However, this has to take into account the concerns that exist around ATS. In particular, these concerns are related to the feeling of *non safety* that many parents avert in relation to the external environment where their children live. This risk aversion implies that parents act in a way that reduces their children's exposure to risk, and consequently their independent mobility as well. Such risk aversion is partly the consequence of the modifications produced by the increased level of traffic congestion (as a product of our motorized society) which prevents children's freedom of movement, and partly are due to the social and cultural changes that characterize our modern societies (Thomson, 2009): fear of being involved in an accident, fear of what has being called *Stranger Danger*. As a result, children experience a disconnection with their neighbourhoods and, more importantly, a disconnection with the social relations in their communities.

ATS schemes, like STPs, SRTS, and WSBs have then been conceived for overcoming these barriers, and facilitating a new approach through the implementation of a range of initiatives. Nature and scope of such initiatives vary from physical infrastructure measures, essentially paths for walking and cycling, to the design and promotion of potential alternatives that encourage families to shift from car use to other forms of transport modes like walking, cycling, public transport, and car sharing.

The case-studies described in this Chapter have generally proven to work successfully. Nonetheless, some considerations may be drawn.

Infrastructure is certainly a key point, because the lack of adequate infrastructure facilities (cycle paths, crossing facilities, footpaths, etc.) is often a serious limitation to walking or cycling to school. Despite important, the lack of infrastructure may not appear, however, as significant as one would think, and the urban form is important but not the sole factor that influence school travel modal choice (McMillan 2007).

Indeed, central to the concept of ATS, and therefore to its further development, is that modifications in behaviour and attitudes may provide more opportunities to change

towards a mobility culture that prefers more sustainable transport modes (thus, including ATS) as alternatives to car use and dependency. This also explains why a long-term vision is necessary since community-based collaborative approaches like STPs or SRTS take a lot of time to get through.

As demonstrated by the selected showcases covered by this Chapter, namely those from the United Kingdom, all initiatives have seen a strong commitment and support from the whole school communities, which have engaged school staff, parents and local authorities towards a greater support to independent mobility among children. ATS measures may not be able to automatically lead to increases in levels of walking and cycling if a package of promotional measures (including parental and community promotions, mapping safe routes to school, walk and bike to school days) is not designed.

Education is here a key issue and plays a twofold role. Firstly, education should be intended towards parents, which should be made aware of the vicious circle generated by their perception of fear when escorting their children by car to school, which, in turn, increases the level of traffic congestion and the adverse impacts on road safety and the environment, resulting in further fears by parents. Parents should also be educated about the damages (physical and psychological) of keeping their children indoor and of not allowing them to freely and actively commute to school. Secondly, and not less important, children have also to be educated to the rules for pedestrians and cyclists, so to safely behave within the traffic context. With regard to this last point, securing an active participation among children is of utmost importance, since they should be given the opportunity to *have a say*, so to investigate their perceptions of active commuting as well. Levering on children's enthusiasm proves to be a contributing factor to success, namely because it helps building parents' interest and confidence in ATS initiatives.

Furthermore, the issue of parental habits and routine is fundamental, thus understanding the factors influencing the choice of the transportation mode. Often, parents' time or commitment constraints and working needs make the choice for the car unavoidable, since it is perceived as a quicker and more flexible.

Finally, a clear political commitment from the national and local authorities is crucial for providing opportunities for active travel. Governments at all levels may potentially push forward measures to promote ATS, by supporting partnerships involving all concerned stakeholders, and designing appropriate funding schemes. Importantly, public authorities may push forward a comprehensive and integrated approach whose interventions go beyond single ATS treatments and measures.

CHAPTER IV: SHARED SPACE

4.1 Public spaces: introducing the context for *Shared Space*

Historically, cities' public spaces performed three main, vital functions in relation to their daily life covering both a social and an economic dimension. They, indeed, functioned as meeting place, economic centre and connection (traffic) space, where people respectively met each other, merchandised and moved around (Gehl, 2003).

For centuries, a balanced relationship existed between these three functions and spaces, which, however, was markedly upset by a variety of factors, firstly the expansion of motorised traffic.

The increasing motorisation deeply modified the shape of urban spaces, whose design was progressively re-defined according to transport and traffic objectives, often to the detriment of the quality in the public realm and the living environment of people.

In particular, the growth of motorised traffic led to the introduction of a landmark principle, i.e. the principle of *traffic segregation*, where vehicular traffic was clearly separated from pedestrian activities.

From an historical perspective, such principle was introduced at the beginning of the 19th century by French traffic engineer Eugene Henard, who is credited to have introduced in 1905 the concept of roundabout for organising the traffic circulation around the Place de l'Opera in Paris, based on a grade separation between pedestrians and horse-drawn traffic.

Nonetheless, the real development and application of his proposals appeared only few decades later in the United States by William Phelps Eno, who elaborated the earliest set of US traffic-engineering guidelines, later codified in 1932 by Arthur Tuttle and Edward Holmes. In the United Kingdom, Holroyd Smith was the first traffic engineer to introduce Henard's ideas in the 1920s (Lay, 1992), while the segregation principle was pushed forward in 1963 by the Buchanan's 1963 report (Buchanan, 1963), which further stressed the need that the two major purposes of streets and public spaces - movement and social interaction - should be strictly segregated as traffic volumes increased. The main conclusion was that, being fundamentally incompatible, vehicular traffic and pedestrian activities have to talk place in separated spaces. A conclusion that was taken further by the Ministry of Transport, who sentenced in its 1966 publication *Road in Urban Areas*, that "*Traffic segregation should be the keynote of modern road design*".

However, the scenario considerably changed over the past decades, as concerns about the declining quality of public spaces were emerging. Importantly, this produced a

phenomena of increasing car dependency, and in parallel of growing traffic congestion, whose implications embrace issues like environmental pollution (GHGs emissions, other pollutants emissions, noise), negative effects on economic activity (low regeneration, poor accessibility), health disease (low level of active travel, obesity, increase in cardiovascular diseases namely among children, increase in stress levels), poor community cohesion (antisocial behaviours, mobility-related social exclusion).

This reasoning underpins the idea that motorisation has a twofold impact: on the built environment and on the measures that are elaborated to reduce and cope with traffic (Hamilton-Baillie, 2006). Hamilton-Baillie writes that the "*accumulation of street clutter – the signs, markings, signals, bollards and barriers associated with traffic engineering – is the most evident visual manifestation of measures aimed to regulate and control movement, and remains a source of growing concern about the decline in visual and spatial quality in the public realm*" (Hamilton-Baillie, 2006). Additionally, he suggests that such clutter has a even a greater impact on the psychology of road users and on their interrelationships.

Behaviour and its relation with the built environment emerge, then, as key factors. In this respect, a distinction may be made between public behaviour, traffic behaviour and social behaviour (Keuuning Instituut, 2005).

Public behaviour refers to the fact that human behaviour in social spaces is unfocused, unpredictable and relatively slow. In other words, human behaviour is not defined by pre-determined decisions.

Traffic behaviour is the behaviour people show when they move quickly along a specific direction. Contrary to the human behaviour, this behaviour is more predictable, focused and faster. Speeds are higher and people are guided in their movements by: (i) the legal traffic systems, (ii) other vehicles on the road, and (iii) road marking and signals.

Social traffic behaviour is, finally, a traffic behaviour that entails a social and a technical/legal component. The blend between these two components is dependent upon various factor, not least: speed, the spatial layout, and personal aspects. Central to this is the understanding of the relationship between behaviour and the built environment, especially to what extent the latter influences people's actions and decisions. The environmental context may, in reality, determine people's behaviour more powerfully than legislation and formal rules (Hamilton-Baillie, 2005).

4.2 *Shared Space*: shifting from segregation to integration

4.2.1 Historical background

In itself, as also underlined by Hamilton-Baillie (2006), the idea of *Shared Space* is not new, since it could be regarded as "*the default mode before the separation of vehicles and pedestrians became the accepted approach to designing public spaces*". *Shared space* schemes existed already in the past before the introduction of the traffic segregation during the last century, and furthermore it may be argued that they represented the status quo before the segregation principle linked to the conventional highway design was introduced (Hamilton-Baillie, 2006; 2008). Again, in Methorst et al. (2007) it is argued that *Shared Space* concept would be the continuation of previous *Shared Space*-like principles, like for instance: the *Woonerf* idea, sojourn-play areas, *Shopping Erfs*, traffic calm neighbourhoods, home zones, 30 km/h zones, etc (Loiseau, 1990), which were formulated over the last three decades for addressing the problem of deteriorating urban environment and growing road safety concerns.

That given, the first experiments aiming at deliberately integrating traffic into social space date back to the late 1960s and early 1970s thanks to the research efforts made in The Netherlands by traffic engineer Joost Vàhl and his colleagues. In the search for a way to minimise the conflict between vehicles and people, thus reducing the impacts of traffic on the quality of social space, they proposed to take away all conventional forms of road signing and markings, kerbs and barriers. Such approach was recognised and formalised by the Dutch Government in 1976, and provided the basis for establishing the concept of *woonerf* (plural *woonervonen*) which identifies a residential street where pedestrians and cyclists have legal priority over motorised traffic, which, furthermore, is restricted to walking pace.

Soon, however, standards and formal signalling were developed for the *woonerf* areas, thus introducing those rules that Vàhl's original approach wanted to avoid by, on the contrary, levering on unstated rules of social behaviour. As a result the interest and enthusiasm for this innovative design approach started to decline.

In parallel, though, the Northern Provinces in The Netherlands started to develop a new concept for traffic integration based on the use of informal social rules. Pioneer in this respect, was Hans Monderman, who was unconvinced about the traditional road hierarchy defined by conventional traffic engineering. Conversely, he started from a simpler definition where two zones are defined (Hamilton-Baillie and Jones, 2005):

- the *traffic zone*, i.e. the space that is dedicated to movement of traffic;

- the *social zone* (or public realm), i.e. the space where traffic is only one of the existing activities.

In his view, while in the traffic zone segregation is usually appropriate, traffic may also coexist with other social activities in the social zone "*so long as the cultural messages that govern human behaviour are made explicit. The driver becomes a citizen. Eye contact and human interaction replace signs and rules. But for this to work, the transition between the two worlds needs to be made clear*" (Hamilton-Baillie and Jones, 2005).

Monderman's first experiment took place in the small village of Oudehaske and results were encouraging since a drop of 40% in the number of road accidents (compared to a reduction of 10% with conventional traffic calming) was reported. A second experiment was performed in 1992 in the village of Makkinga where all road signs and markings were entirely removed, whilst in 1998 two subsequent interventions were made in the towns of Wolvega and Oosterwolde. The case of Oosterwolde is particularly important, since after ten years of operation a significant reduction in the number of serious road accidents was reported, while, at the same time: traffic flows remained unchanged and the public space was re-designed into a pleasant point with new shops around its perimeter.

Significantly, these two successful experiences demonstrated that traditional road markings and signals were not necessarily essential requirements for achieving fluent and safe traffic flows. On the contrary, the distinctive spatial quality of the public spaces seemed to be a better determinant in reducing number and severity of accidents.

Hans Monderman developed further schemes in busier and larger urban areas, thus providing a response to some criticism that pointed how *Shared Space* interventions were more feasible and convenient to small villages rather then big centres.

The interventions in Haren (nearby Groningen) and Drachten (South of Leeuwarden) are notable examples of how people - irrespective from being car drivers, cyclists or pedestrians – have a capability to cope with potential conflicts by making use of informal rules and human interaction. Here, communication is key and allows users to adopt anticipatory behaviours that, in continuously-dynamic traffic conditions, enable them to keep risk levels low while moving.

4.3 *Shared Space*: from idea to practice

As described in Section 4.2.1, the concept of *Shared Space* was originally developed by the Dutch traffic engineer Hans Monderman, whose basic idea was to regulate traffic flows on the basis of human activities and social rules, rather through the use of traffic control measures (Methorst et al., 2007; Gerlach, et al., 2009). As later described in

Section 4.4, the validity of such concept was further developed and tested in an EU-funded Interreg IIIB cooperation project, which involved seven local authorities from five EU Member States.

As its names clearly indicated, *Shared Space* alleges that people share public space together, and looks at public spaces as spaces for people, where people's activities are facilitated rather than discouraged. Consequently, purpose of *Shared Space* is to combine and not separate the variety of functions existing in public spaces, so to improve the quality of public spaces and the built-environments where people live and move (Keuning Instituut, 2005).

More specifically, the peculiarity of *Shared Space* is a greater emphasis on the voluntary behavioural change in the relationship amongst road users in public spaces, which should be adequately backed by design and layout of public space (Methorst et al., 2007; Gerlach, et al., 2009). This implies that the role played by behaviour is central to *Shared Space* schemes, and where its improvement is made possible by levering on informal (social and culture) rules, which replace more traditional traffic rules and engineering components, like for instance: traffic lights and road markings, which are fully removed to ensure a clear and open design of public space.

New in *Shared Space* is an attempt to regain a balance between traffic and living activities, on the one side, and spatial functions, on the other side, where the main purpose is not banishing or restricting motorised traffic to enter a public space, but to slow it down such in a way that it may co-exist with the people's right of freely move in the built-environment. People, and not traffic, have the centre stage and take full responsibility for their own and others' safety.

This explains why behaviour plays a major role, and *Shared Space* schemes assume that traffic behaviour is more influenced by the local character of built-environment rather than formal rules, where human mutual interaction and interpersonal understanding becomes the primary principle guiding and regulating traffic flows (Methorst et al., 2007, Gerlach et al., 2009). Here communication between road users is key in determining their behaviour, and low speed creates the conditions for having the time for communicating and interpreting verbal and non-verbal utterances. The underlying assumption is that when communication is understood and interpreted, road users behave accordingly. Anyhow, as stressed by Methorst et al. (2007), this should also take into account that this does not apply to all road users, because there are some groups like children and impaired people (with visual or mental handicap) that are not in the

position of communicate. Similarly, elderly people may have serious difficulties in this respect, namely when they need to anticipate and respond quickly to traffic conditions.
The position of the VRUs is particularly regarded as critical when conditions of whole mixing traffic are set. In the view of the Dutch road authority knowledge institute CROW, "*strong road users have a natural tendency to demand space. This results in perceived danger, which can lead to avoidance of 'shared space'-spaces by vulnerable road users or even that they do no longer dare be in public spaces*" (cited in Methorst et al., 2007).
The role and importance of a safer road user behaviour is further reinforced by what appears to be one of the main features of *Shared Space*, i.e. the removal of traffic regulation elements, which creates a feeling of insecurity and uncertainty (Methorst et al., 2007), though it is supposed to increase safety (Gerlach et al. 2009), since people that feel unsafe in a specific (traffic) situation are more alert of potential dangers coming from other road users (they show a greater degree of risk perception) and act (move) consequently in a safer manner.
According to Methorst et al. (2007), this statement may be, however, questioned for a number of reasons:

- firstly, because it is not self-evident that **all road users have the capability to detect and recognise danger and risks**;
- secondly, because it is not self-evident either that **all (endangered) road users respond to dangers by performing a safe and correct behaviour**;
- thirdly, because on field observations (in Drachten and Haren) show that **strongest road users demand more space and dominate the weakest ones** (firstly, pedestrians).

4.3.1 Featuring elements of *Shared Space*: what's new in the *Shared Space* approach

The current literature on *Shared Space* (Gerlach et al., 2009; Methorst et al., 2007) agrees in assuming that it encompasses a principle of design, which implies that urban areas should be designed according to participative processes setting the conditions for balancing public spaces' three main functionalities (**connectivity**, **access** and **sojourn**), and where motorised traffic is tolerated as *guest*. As underlined by Methorst et al. (2007), major goal of *Shared Space* is integrating the three functions mentioned head on into one single design, tailored to the characteristics of the local built-environment and without splitting up street space into specific user zones.

Further on this point, Gerlach et al. (2009) classifies a project as *Shared Space* when a set of conditions are met, i.e.:

- the mixed-modal principle applies to sections of town high streets, local shopping streets or main shopping streets, preferably in intersection areas;
- the mixed-modal principle accommodates, to the greatest possible extent, all traffic subsystems (at least bicycle and pedestrian traffic on at-level surfaces);
- the motor vehicle, bicycle and pedestrian traffic subsystems (and, if applicable, public transport as well) make use of these sections;
- stationary vehicles are prevented from these sections as much as possible;
- signs are largely taken away.

Methorst et al. (2007) argues, however, that the mixing principle is not rigidly applied in all *Shared Space* projects, as demonstrated by the experiences in Drachten and Haren, where:

- in the former the intersection Laweiplein is a "classic" roundabout, where the carriageway for motorised traffic is split from space dedicated to bicyclists and pedestrians, but unlike other locations, bicycles and pedestrians use the same space;
- in the latter, only the intersection area is designed for mixed traffic, while on the road sections in between pedestrians and bicyclists benefit from shielded space.

The discourse described in Methorst et al. (2007) is that *Shared Space* projects do not have as primary goal the improvement of traffic capacity and road safety, but, on the contrary, they are first of all projects that aim at fostering local urban development through an upgrade of the existing streets and plazas. This would confirm the above mentioned argument that *Shared Space* is more about balancing out all spatial functionalities, even if this is done such in a manner that traffic flow and road safety are optimised.

Nevertheless, Methorst et al. (2007) acknowledges the innovative character of the *Shared Space* concept, in particular with regard to the fact that: (i) that traffic signs are left out, and (ii) traffic is mixed in contexts that present high quantities of traffic and that priority on intersections is regulated by simple right-hand-give-way regulations. The showcase of the roundabout in Drachten is worthy of mentioning because, though traffic was not diverted and the traffic function of the road was not modified, the traditional right-hand-give-way regulation proved to successfully allow to handle considerably more traffic than it was usually possible for such intersections, associated with larger traffic flows.

4.3.2 The *Shared Space* process

As illustrated in the publication "Shared Space. Room for Everyone. A new vision for public spaces" (Keuning Instituut, 2005), the *Shared Space* concept is based a newly designed approach called as the *Nine-cells model*, illustrated in Figure 4.1.

Figure 4.1: The "Nine-cells" model

	The administration	The design	The implementation
Vision	Gives the instructions People space or traffic space	Sustainable designs Social behaviour versus traffic behaviour	Objective of technology as tool
Working method	Holistic Empowerment and participation Vision provides direction Process rather than product	Creativity Co-operation with other disciplines Communication	Co-operation within the organisation Creativity
Tools	Process skills	Participative design methods Insight into relationship with other disciplines Communication methods	Choice and placement of materials Using new materials

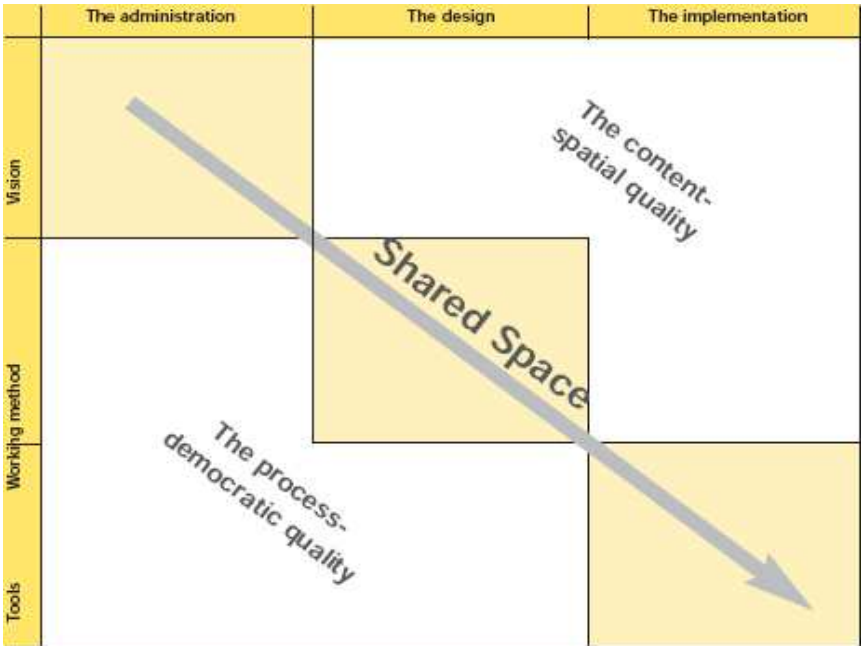
Source: Keuning Instituut (2008)

The reasoning behind this model is linked to the nine steps that are required for running the design process in *Shared Space* schemes, which operates on the diagonal path and shows the good approach (from administration to design, and from design to implementation) to be followed for securing a successful end result.

- In the **first step**, the **vision for improvement of public realm** through a *Shared Space* intervention is presented by the local administrators, which receive a first **feedback** on their proposals.
- The **second step** concerns the **design phase and sees a direct involvement of the design team**, which is asked to translate the vision into functional design by taking into account that communication and cooperation with all different users of the public space are essential.
- Finally, the **third step** encompasses the **implementation level**, which leads to the **concrete realisation** of the planned intervention.

By making use of this process, *Shared Space* (see Figure 4.2 in this respect) aims to achieve a twofold quality: (i) a spatial quality, and (ii) a democratic quality.

Figure 4.2: The combination of spatial and democratic qualities in *Shared Space*



Source: Keuning Instituut (2008)

Spatial quality, on the one hand, is pursued by combining knowledge and experience that come from different working areas, reinforced by mutual cooperation and coordination. *Shared Space* makes use of a multidisciplinary approach which, still, requires a holistic working method and, thus, new organisational structures.

Democratic quality, on the other hand, is guaranteed by a continuous and widespread consultation process, which allows citizens to be actively involved and committed to the project.

Both qualities, interacting and mutually supporting each other, are than determinant for the good end of the results.

4.4 The *Shared Space* Interreg IIIb Project

The *Shared Space* research project is an EU-funded project that was implemented during the period 2004-2008 within the EC cooperation programme Interreg IIIB North-Sea. The project gathered seven local authorities from five EU Member States (Belgium, Denmark, Germany, The Netherlands, and United Kingdom). Main project was to develop and

disseminate knowledge and understanding in relation to the *Shared Space* principles. In its initial phase, specifically in the occasion of the first *Shared Space* workshop held in Leeuwarden in September 2004, the *Shared Space* project identified the following four core themes (Keuning Instituut, 2008):

- **Road Safety**, thus the need to reduce the number of deaths and serious injuries, together with the removal of the perception of danger, which is the main barrier to walking, cycling and wider use of public space.
- **Community Safety**, which is associated to the need for reducing fear of crime and feeling of insecurity, by improving public realm as a place for confidence and cohesion among people.
- **Economic Regeneration**, which requires opportunities for renewing deprived neighbourhoods, by increasing confidence in public real as a lever for local investment and economic development.
- **Public Engagement**, in the sense that the widest possible public participation should be secured in the design and decision-making process leading to new mobility schemes. Involving people and giving them the opportunity to have a say is not only a pre-requisite for success, but does increases the potential for enhanced social cohesion and democratic participation.
- **Liveability**, which implies the need to improve the qualitative relationship between the built and natural environment.

These themes have further been developed within the so-called *Nice cell model* (see Figure 4.1 in this respect in Section 4.3.2), which was intended as a method for identifying shortcomings and achievements, so to guide the various players and processes concerned by the introduction of *Shared Space* principles. Remarkably, this model worked as reference tool for monitoring and testing progress achieved with the development of the new methodologies proposed by the *Shared Space* project.

Moreover, during its implementation the project further added some additional themes that emerged from the analysis, research and engagement of the involved authorities. These additional themes are summarised in Table A.3 presented in Annex A.

To conclude, all these themes were tested in a number of local contexts (those of the project partner cities), which provided the opportunity for evaluation and fine-tuning the usefulness and suitability of the working methodologies and approached suggested by the *Shared Space* concept. Sections 4.4.1 and 4.4.2, and Section 4.5 provide respectively an overview of such pilot projects and the main lessons learnt.

4.4.1 *Shared Space* project examples

Within the *Shared Space* project, knowledge was shared by several local authorities (all located in five Northern European countries, and in particular in The Netherlands), where a number of pilot projects were undertaken in order to concretely put into practice concepts, methods and new solutions for addressing issues like: road safety, traffic congestion, enhancement of the economic vitality in streets and public spaces.

The local authorities were the following:

- Emmen, Haren and Fryslân in The Netherlands;
- Oostende in Belgium;
- Bohmte in Germany;
- Ejby in Denmark, and
- Suffolk in the United Kingdom.

Each of these cities presented different and, in some cases, contrasting contexts, which permitted to test consistency and validity of the *Shared Space* concepts under different local conditions. The key issues (Keuning Instituut, 2008) for each cities are summarised in Table 4.1.

Table 4.1: **Key issues for the participating cities in the *Shared Space* project**

Key issues	Bohmte	Ipswich	Haren	Emmen	Ejby	Oostende	Fryslân
Built environment	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓	✓✓✓	✓
Natural environment	-	-	✓✓	-	-	-	✓✓✓
Safety	✓	✓✓✓	✓✓✓	-	✓	✓✓	✓✓
Traffic speed	✓✓✓	✓✓	✓✓✓	-	✓	-	✓✓✓
Culture & History	✓	✓✓	✓✓	✓	✓✓✓	✓	✓✓✓
Spatial quality	✓✓	✓✓✓	✓✓	✓✓	✓✓✓	✓	✓✓
Social quality	✓✓✓	✓✓	✓✓✓	✓✓✓	✓✓	✓✓	
Traffic volumes	✓✓	✓	-	-	✓✓	-	✓✓
Landscape qualities	✓	✓	✓✓	✓	✓	-	✓✓

Source: Table elaborated based on data taken from Keuning Instituut (2008)

4.4.1.1 Municipality of Bohmte (Germany)

Bohmte is a small-sized urban area located in the German region of Lower Saxony, with a local community accounting for about 13,500 inhabitants. The *Shared Space* pilot projects focused on the *Bremer Strasse*, which is a main street passing through the city centre, and characterised by an average daily traffic of about 12,600 cars and trucks. This street has a linear form and plays a vital role in the local economy since the latter mostly depends upon the passing trade. However, such importance declined over the years, mainly because of the various measures that were implemented and that progressively eroded the spatial quality of the town. Taking advantage of the opportunity to enter into the *Shared Space* project, and thanks to the financial support granted by the regional government which integrated local funds for a total budget of EUR 1.54 million, the Municipality of Bohmte started in re-planning the *Bremer Strasse* intersection by transforming it into a town square with high quality paving. Paving and lighting were also complemented with shop fronts and spaces between the surrounding buildings, so to secure an integration between the street space and the surrounding built environment. The main works were over in June 2008.

A crucial role in the Bohmte's experience was played by the commitment and willingness of the local political partnership, which continuously guaranteed an open procedure where citizens and economic operators were constantly involved and listened to.

4.4.1.2 Municipality of Ipswich (United Kingdom)

The UK application of the *Shared Space* concept focused on the regeneration of the Ipswich Village's neighbourhood, located in the Suffolk County. Here, major achievements were sought in terms of reduction in traffic speeds and improvements in public perception of safety. The *Shared Space* approach aimed, therefore, at improving such negative perceptions by implementing a package of measures ranging from public art, lighting, and landscape, up to urban design and traffic engineering. Such approach was successful, as traffic flows slowed down in the city centre, while local park and surroundings were improved, and public perceptions of safety enhanced.

4.4.1.3 City of Oostende (Belgium)

In the City of Oostende, located in the Flanders region, the purpose of the *Shared Space* principles application was to re-vitalise the deprived quarter of Konterdam. The low degree of spatial and social quality was, indeed, due to a major highway which cut-off the quarter from the city centre, thus producing a segregation effect. Purpose of the

Shared Space interventions was to renew the streetscape of Konterdam, by enhancing the importance of the *slow* traffic network in order to encourage a greater rate of walking and cycling within and around the area. Central in this approach was the design and implementation of high quality, small-scale and simple improvements in the landscape, instead of high-scale new infrastructure schemes. This made possible to positively influence public perceptions on this area, which is not seen any more as isolated and deprived. Consequently, volumes of pedestrians and cyclists increased. Importantly, Oostende was acknowledged by the Flemish Platform of Centre Cities as a best practice for extending the use of *Shared Space* principles in other Belgian cities as well.

4.4.1.4 Municipality of Ejby (Denmark)

Ejby is a small-sized town located in the Funen region, in the Western part of Denmark, with a local community of around 2,000 residents. In particular, Ejby is centred around the intersection of a busy railway with a county road, along which economic activities and trade historically developed. The *Shared Space* project focused on a long-standing problematic issue, i.e. the need to construct a grade-separated rail crossing for road traffic and pedestrians, which would have caused major damage to the spatial quality and economic welfare of the town. A further difficulty was given by safety concerns tied to the high number of accident records, mainly due to high traffic speeds. Thus, with the contribution of the *Shared Space* project, new solutions were elaborated, which essentially proposed a re-modelling of the road crossing and space around the town square and station, by removing intrusive highway elements, and adding an appropriate central median.

4.4.1.5 Province of Fryslân (The Netherlands)

In the Dutch Province of Fryslân (North-Eastern part of The Netherlands) the *Shared Space* project explored the possibility to increase road safety and community value of a rural road that is located along a canal, whose construction dates back to the 17th century. The road is nine km long, traverses the municipalities of Kollummerland, Dongeradeel and Dantumadeel, and guarantees an important link to the local highway network. Project goal was to increase road safety, by reducing traffic speeds and promoting *soft* modes of transport like walking and cycling, being the latter also regarded as important ways for promoting tourism activities, locally. Focus of the interventions was to encourage road users to consider this road as part of the local cultural history and landscape, which was delivered by creating a new vocabulary of historically and culturally

places which highlighted the most significant key points along the route. In parallel, interventions were also carried out for improving paving and lighting of the road, which was also visually narrowed. Finally, centre line markings were removed, too.

4.4.1.6 Municipality of Emmen (The Netherlands)

In the Dutch city of Emmen, located in the Province of Drenthe in the North-East of The Netherlands, *Shared Space* project was introduced for potentially renewing the housing layouts (dating back to the 1960s and 1970s) of the Hesselterbrink neighbourhood. Such layouts were built following the *woonerf* scheme, though they were never able to fully integrate living public spaces with movements and parking of cars. The basic idea was to introduce new design principles, aimed to provide a clearer spatial organisation, and extending local ownership and control over the public realm. Such approach proved to work successfully, and general public satisfaction about the project achievements at Hesselterbrink seems to confirm the validity of this new model for urban regeneration.

4.4.1.7 Municipality of Haren (The Netherlands)

The City of Haren in the Dutch Province of Groningen was a frontrunner in the development of *Shared Space* concepts over the last ten years. Within the *Shared Space* project, two villages were involved: Noordlaren and Onnen. The first village – Noordlaren – concerned intervention in favour of the local primary school which is situated alongside the main road to the village. Here, responses were needed for addressing parents' concerns about traffic road safety for their children, although, and contrary to the traditional approach based on the separation of the school from the road, the relationship between the two was emphasised by increasing to the drivers the visibility and psychological influence of the school playground. Consequently, the school became a very visible benchmark when entering into the village, which consequently resulted, on the one hand, in reduced traffic speed, and, on the other hand, in greater understanding among children of their surroundings. The second village – Onnen – benefited from a redesigned town centre, whose social and historical quality was eroded by growing traffic and intrusive highway elements.

4.4.2 Other *Shared Space* showcases in Europe

Outside The Netherlands, the concept of *Shared Space* found application in various European countries, where streets and intersections were remodelled and redesigned according to its main principles.

This applies, for instance, to **Spain**, where in cities like Bilbao, Barcelona, Madrid and San Sebastian, streets have been designed in a way to enable the local context to influence driving behaviour. In **France**, *Shared Space* ideas go under the name of *Ville plus Sûres* (Safer Towns), a programme that was launched in 1984 and which, since 2008, has been associated to a new initiative called *Zone de rencontres* (meeting points) where:

- priority is given to pedestrians, which have no obligations to walk on footpaths;
- speed is limited to 20 km/h.

Such concept is also applied in other European countries like, for instance, **Switzerland**, where it is called *Begegnungszone*, and exists since 2002. Its main features are as follows (Baker, 2010):

- are initiated by the local street residents:
- only 20 km/h speed is allowed:
- pedestrians have right of way in front of cars everywhere in the zones;
- parking only allowed in specially marked car parking places.

The *Begegnungzone* are quite popular in Switzerland, especially in the larger cities like Bern, Zurich and Geneva.

Denmark and **Sweden** are two further countries where *Shared Space* principles knew important applications. For Denmark, in the Copenhagen suburb of Lyngby the main shopping street was remodelled in 2003, while for Sweden, in the Swedish university town of Norrköping (South-West of Stockholm), a major intersection close to the town centre was redesigned and transformed into a single and coherent square where all suggestion of priorities were removed, and all conventional signals were stripped out. Tough in presence of a daily traffic volume of 13,000 vehicles: (i) pedestrians volumes considerably lifted, (ii) traffic speeds were markedly reduced, (iii) delays and congestion as well as (iv) serious accidents dropped (Hamilton-Baillie, 2008).

Finally, the **UK experience** on *Shared Space* is also noticeable. Though matured later than in the other European countries, the introduction of *Shared Space* principle has been taking an increasing pace if compared to the rest of the mainland of Europe (Hamilton-Baillie, 2008).

As suggested by Hamilton-Baillie (2008), though still not so numerous, there are, nevertheless, remarkable examples that are paving the way for an important application of *Shared Space* ideas in the United Kingdom. For example, the English county councils of: Devon, Dorset, East Sussex, Essex, Hampshire, Kent, and Wiltshire started incorporating *Shared Space* principals in their town and landscape planning. More

importantly, progress are reported in larger cities as well, like: Bristol, Liverpool, Manchester, Sheffield, and London, where conventional traffic engineering approaches are rethought, so to readjust the complex relationships between vehicular traffic, people and public realm.

4.5 Main lessons learnt from the *Shared Space* pilot projects

As mentioned head on, and as demonstrated by the selected case-studies, *Shared Space* principles were implemented in a variety of different local contexts, each of them presenting different and specific mobility issues. This allowed to understand the different aspects of *Shared Space* methodologies, and how they could be adapted to the local circumstances. Nevertheless, some key lessons may be drawn by the experience gained by the illustrated showcases.

Firstly, as the case of Bohmte demonstrated, politic commitment is crucial through the design and implementation process. This allows a greater ownership of the decision-making process, and that measures are implemented on an appropriate scale.

Secondly, as the cases of Ejby showed, public participation and involvement is a pre-requisite for success. People must have a say and the continuous possibility to actively and concretely contribute to the process leading to a *Shared Space* proposal. People have to feel themselves as part of the process, and not just as *end-users*. This of utmost importance with regard to impaired people, whose mobility needs and behaviours are necessarily different. For this reasons, clear communication and thorough discussion are essential, in order to let people fully understanding the main contents of the proposed scheme, in particular those aspects (for instance, risk compensation) that may be counter-intuitive and that needs clear illustration and explanation.

Thirdly, as confirmed by the cases of Ipswich and Fryslân, local culture and history are central to *Shared Space* schemes. *Shared Space* proved to work effectively in integrating such themes into more traditional mobility measures, by assigning them a clear distinctive role in enhancing character and expression of the space.

It goes without saying that *Shared Space* solutions are not a panacea for solving all mobility and traffic problems at local level. Nonetheless, it provides useful direction for introducing measures that are able to promote the quality of public realm without banishing motorised traffic completely.

4.6 Conclusions

The Chapter described the main features of the *Shared Space* concept, and in particular the idea, as conceived by its inventor Hans Monderman, that *Shared Space* would have the capability to enhance communication among users behaving in a specific built environment. In other words, communication would replace road signs as the key tool for encouraging users to regulate their road behaviour. Lowering down speed is crucial in this respect, since lower speed allows a more balanced relationship between users, and namely between, on the one hand, the vulnerable road users (elderly people, children, impaired people, etc.), and, on the other side, those users that are in a stronger (in some cases dominating) position (like car drivers).

The *Shared Space* concept, thanks also to the implementation of an *ad hoc* project funded by the European Union during the period 2004-2008, received concrete application in a number of case-studies, first in the Netherlands, and second in other EU countries like Denmark, Belgium and the United Kingdom.

Though only few studies directly addressing the issue and implications of *Shared Space* exist (de Haan, 2010), it may be argued that, where applied, the *Shared Space* concept provided a promising opportunity for re-thinking traditional street design and layout, and for bringing back users (people) at the heart of the urban planning strategies.

In particular, the showcase of Noordlaren in Haren showed that *Shared Space* may also be successfully applied where the major concern is to increase the level of road safety around school environment. Indeed, besides the direct effect of decreasing accident risk, an indirect effect also emerges, which is somehow the consequence of the direct effect. Such indirect effect links to the possibility to promote a greater level of ATS, since increased safety level may be a primary reason for leading parents to perceive differently the risks around the school environment, and consequently for pushing them to either opt for more sustainable forms of transport like walking and cycling for bringing their children to school, or to let their pupils free to go to school independently or with their peers.

This is of interest with reference to the case-study surveyed in next Chapter Five, as it will outline that car use is the predominant mode of transport for accompanying children to school, and parents' fears about safety is amongst the most important causes for such modal choice.

Even if ATS is not a primary goal for *Shared Space*, the latter has the potential to improve those elements of the external built and traffic environment, which in turn may also promote a greater willingness to use more sustainable modes of transport, first and

foremost walking and cycling for bringing children to school. *Shared Space* may then be regarded as a suitable approach in order to identify those elements of behaviour and urban planning that may be integrated for elaborating solutions that are capable to remove barriers to the promotion of a more sustainable (environmental-friendly) mobility, namely for school journeys.

CHAPTER V: CHILDREN'S MOBILITY PATTERNS: A CASE STUDY IN NORTH-EASTERN-ITALY

The purpose of Chapter Five is to illustrate and discuss how children use to travel to school in Castelfranco Veneto, a small-sized town located in the North-Eastern part of Italy. Data collected provided an opportunity to evaluate to what extent the observed mobility patterns align to the general trend studied in the previous chapters, and to identify those determinants that weigh the most in establishing children's mobility patterns during their school journeys.

5.1 Method

A self-administered questionnaire was submitted to the primary school "A. Colombo" in Castelfranco Veneto and distributed via the school administrators to the children attending the five school grades. Children's age ranged between six and ten years old. Similarly to the other primary schools in Castelfranco, the primary school "A. Colombo" is mainly attended by children living in the district where the school is located within the municipality's border. However, the siting of the primary schools in Castelfranco Veneto is only partially capable to satisfy the demand for places. This undoubtedly influences the modal choice for school trips and determines a preference for car use (TRT and Architetto Magro, 2008).

The survey included 21 items (some of which requiring a sole response, others allowing multiple choice responses) all targeted to children with the exception of the last question which, conversely, was addressed to their parents since it asked for an evaluation of a potential *Shared Space* scheme along the route to the school.

More specifically, children were asked to provide a feedback on: (i) their age, gender, grade and place of residence, (ii) approximate distance to school, most used transport mode for their school journeys, (iii) if they could independently reach their school or, alternatively, if they were accompanied by an adult during their school runs, and related reasons. Moreover, children were also asked to identify the main barriers that could hamper going to school by walking and/or cycling.

Finally, as mentioned above, parents were asked to provide their comments and feedback on the last question as well, which addressed the issue of *Shared Space*, so to understand how parents would see such kind of intervention for enhancing a greater degree of active travel to school for their children.

Questionnaires were submitted in December 2008 and data were collected in January 2009. Response rate was calculated as the proportions of children issued with a questionnaire that return it with useable information. No attempt was made to follow-up respondents.

5.2 Results

5.2.1 Descriptive analysis of participants

A total of 260 questionnaires were distributed and 220 useable surveys were returned, yielding an overall response rate of 84.6% (220 questionnaires out of 260). Respondents were children (*n* = 117 boys and *n* = 103 girls) belonging to age groups ranging between six and ten years old, and were approximately evenly distributed among grades (1, 2, 3, 4 and 5 classrooms), as well as gender.

Looking at their place of residence, the overwhelming majority of the recruited children live in Castelfranco Veneto (83.2% of respondents, *n* = 183), while only a small part of them declared to live in other neighbouring villages (16.8%, *n* = 37). Participants' characteristics are presented in Table 5.1.

Table 5.1: Children's characteristics as reported by the survey

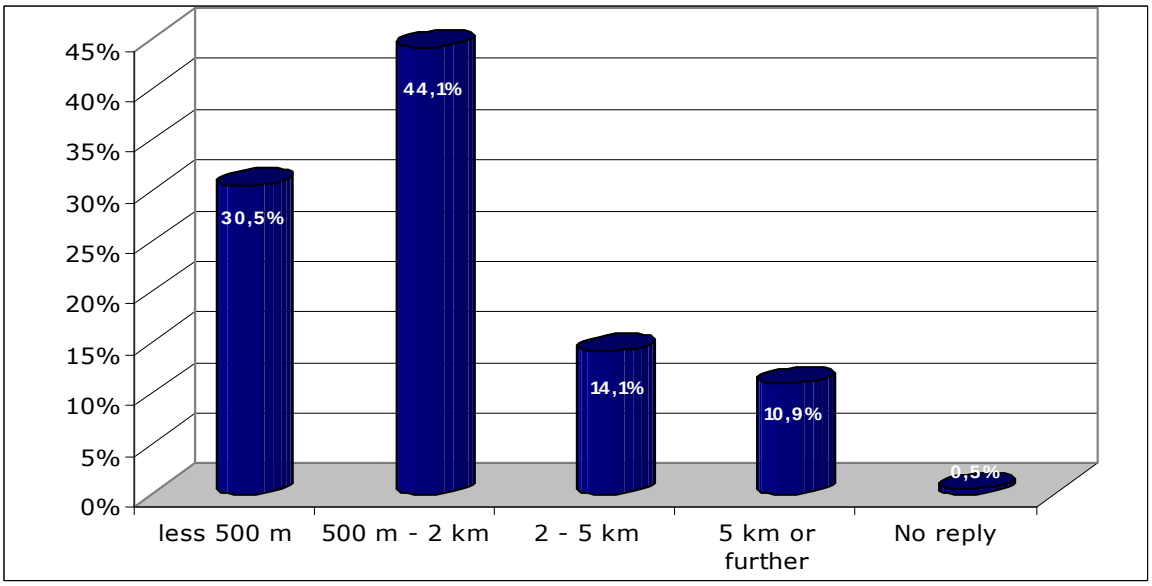
Characteristics	% (*n* = 220)				
Gender	*Male* 53.2 (*n* = 117)			*Female* 46.8 (*n* = 103)	
Grades of children	*Grade 1* 18.2 (*n* = 40)	*Grade 2* 20.5 (*n* = 45)	*Grade 3* 18.2 (*n* = 40)	*Grade 4* 17.7 (*n* = 39)	*Grade 5* 25.5 (*n* = 56)
Place of Residence	*Castelfranco Veneto* 83.2 (*n* = 183)			*Other locations* 16.8 (*n* = 37)	
Distance to school	*Less than 500 m.* 30.5 (*n* = 67)	*500 m. to 2 km* 44.1 (*n* = 97)		*2 to 5 km* 14.1 (*n* = 31)	*5 km or further* 10.9 (*n* = 24)

Source: own elaboration based on collected data

This finding, as illustrated in Figure 5.1, is further confirmed by the short travelled distance that was reported from home to school, as 30.5% of children replied to live less then 500 metres, and 44.1% of them affirmed to live no more than two kilometres from the school (for a total of 74.6% of children, *n* = 164). About 14.1% of pupils declared to

live between two and five kilometres, while 10.9% reported to live five kilometres or further far from the school.

Figure 5.1: Reported travelled distance from home to school



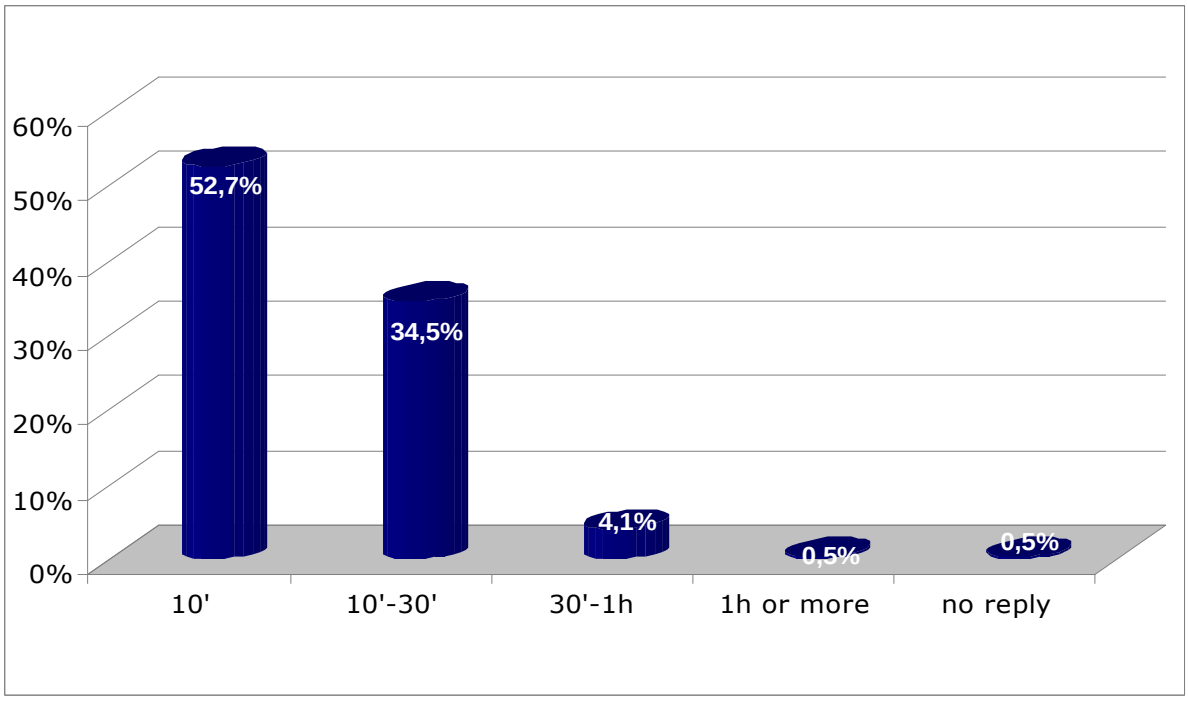
Source: own elaboration based on collected data

Data were also gathered with reference to the time that is usually needed on a daily basis to reach the school. In this respect, a distinction was made between good and bad weather conditions, respectively, so to verify whether significant differences could be highlighted in terms of travelling times.

With good weather conditions (see Figure 5.2 in this respect), ten minutes is the normal time frame reported by children for their school journey (52.7%, *n* = 116), while 34.5% of them (*n* = 76) reach the school within a time frame ranging from ten and 30 minutes. Only 4.1% of children (*n* = 9) declared their travel journey lasting between 30 minutes and one hour. Figure 5.3 displays that with bad weather conditions travelling times are longer, as confirmed by the fact that an increase in the number of children arriving at school within the time frames 10-30 minutes (47.7%, *n* = 105) and 30 minutes-1 hour (5.9%, *n* = 13) was observed.

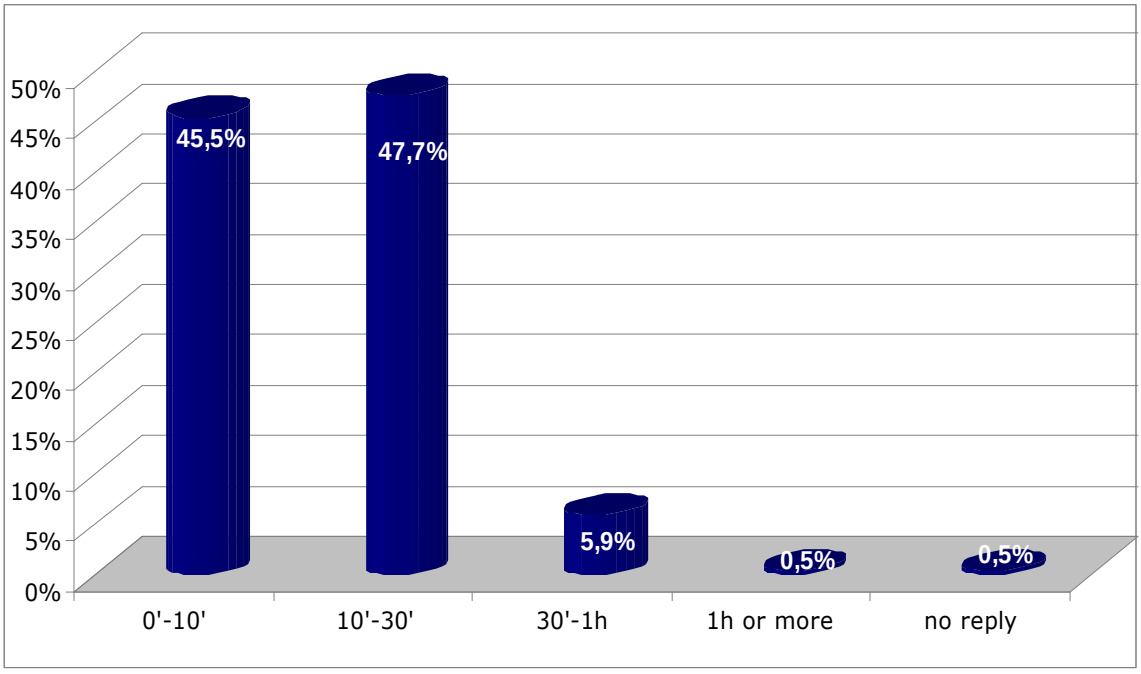
Finally, no significant differences were noticed for the three remaining travelling times categories.

Figure 5.2: Reported average daily travel time (good weather)



Source: own elaboration based on collected data

Figure 5.3: Reported average daily travel time (bad weather)



Source: own elaboration based on collected data

5.2.2 Accessing to school: mode choice and main determinants

Comparison between the transport modes used by children to travel to school was also investigated, and findings are reported in Table 5.2.

Table 5.2: Number and percentage of children travelling to school according to the various modes of transport used

Mode of transport	Grade 1 % (n)	Grade 2 % (n)	Grade 3 % (n)	Grade 4 % (n)	Grade 5 % (n)	All
Walking	20.5 (9)	13.3 (6)	24.4 (11)	24.4 (10)	24.6 (14)	**21.6 (50)**
Cycling	22.7 (10)	8.9 (4)	8.9 (4)	4.9 (2)	5.3 (3)	**9.9 (23)**
Public Transport	0.0 (0)	6.7 (3)	17.8 (8)	14.6 (6)	15.8 (9)	**11.2 (26)**
Car	54.5 (24)	66.7 (30)	48.9 (22)	56.1 (23)	54.4 (31)	**56 (130)**
Other	2.3 (1)	4.4 (2)	0.0 (0)	0.0 (0)	0.0 (0)	**1.3 (3)**

Source: own elaboration based on collected data

As expected, the analysis of the data collected reveals that car is by far the preferred mode of transport. Car use accounts, indeed, for 56% of all school trips, followed by walking which is, however, selected in only 21.6% of trips. Public transport and cycling are, finally, used by only a minority of children, since they are chosen as primary mode of transport for only 11.2% and 9.9% of school journeys.

These findings are further confirmed when the relationship between the choice of mode of transport and the covered distances is observed. In fact, data provided in Table 5.3 and displayed in Figure 5.4 show how, with the only exception of the shortest distance (i.e. when school is reported to be only less than 500 metres far from place of residence and for which walking is the preferred mode: 13.4%, n = 29), car is generally chosen as main mode of transport for covering all distances. More interesting, car is chosen to cover the short/medium distance of 500 m – 2 km, while it may also be observed the poor performance scored by public transport (11.6%, n = 25), which surprisingly is not used for covering the longer distances, but instead for travelling the distance ranged

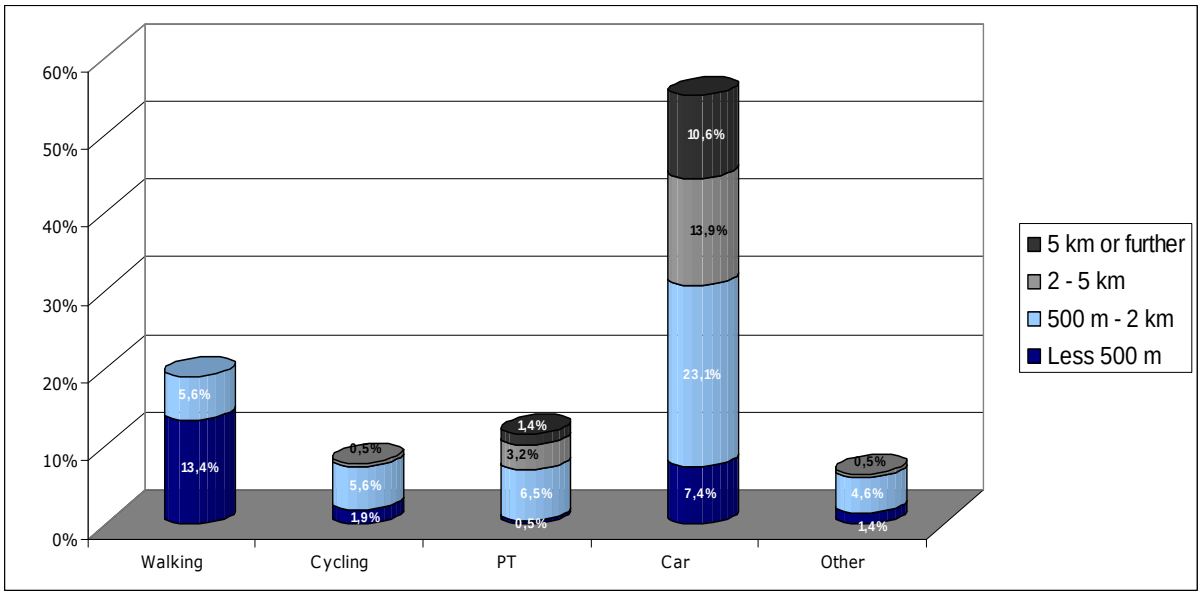
between 500 metres and 2 km. Finally, the other form of active transportation (cycling) performed the worst, with only 17 children affirming to travel to school by bike (7.9%).

Table 5.3: Relationship between choice of mode of transport and distance covered

Distance covered	Walking % (n)	Cycling % (n)	Public Transport % (n)	Car % (n)	Other % (n)
Less than 500 m	13.4 (29)	1.9 (4)	0.5 (1)	7.4 (16)	1.4 (3)
500 m - 2 km	5.6 (12)	5.6 (12)	6.5 (14)	23.1 (50)	4.6 (10)
2 - 5 km	0.0 (0)	0.5 (1)	3.2 (7)	13.9 (30)	0.5 (1)
5 km or further	0.0 (0)	0.0 (0)	1.4 (3)	10.6 (23)	0.0 (0)
All	**19.0 (41)**	**7.9 (17)**	**11.6 (25)**	**55.1 (119)**	**6.5 (14)**

Source: own elaboration based on collected data

Figure 5.4: Relationship between choice of mode of transport and distance covered



Source: own elaboration based on collected data

A third element of confirmation about the fact that car is used in the majority of school trips is given by looking at relationship between gender and choice of mode of transport. Overall data are reported in Table 5.4 and summarised in Figure 5.5. Once more, car is used for 57.5% (*n* = 127) of all school journeys (almost evenly distributed between girls and boys: 29.4%, *n* = 65 and 28.1%, *n* = 62, respectively), followed by walking (overall 18.6%, *n* = 41) and public transport (11.3%, *n* = 25). Cycling confirms again its poor performance, being selected for only 7.7% (*n* = 17) of children as preferred mode for travelling to school.

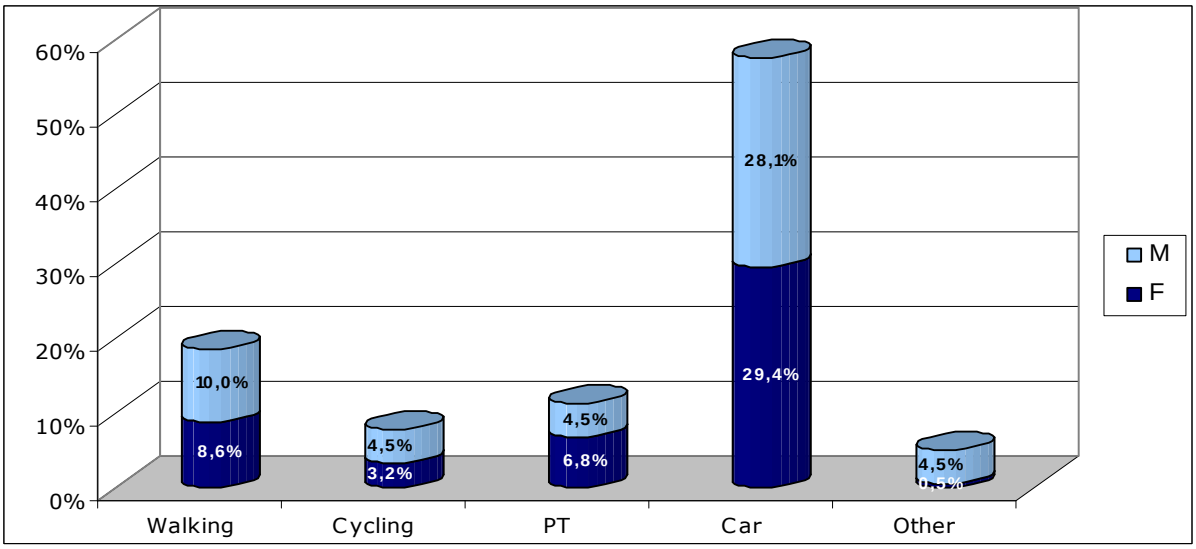
Table 5.4: Relationship between gender and mode of transport

Gender	Walking % (n)	Cycling % (n)	Public Transport % (n)	Car % (n)	Other % (n)
Female	8.6 (19)	3.2 (7)	6.8 (15)	29.4 (65)	0.5 (1)
Male	10.0 (22)	4.5 (10)	4.5 (10)	28.1 (62)	4.5 (10)
All	**18.6 (41)**	**7.7 (17)**	**11.3 (25)**	**57.5 (127)**	**5.0 (11)**

Source: own elaboration based on collected data

Note: item "Other" includes no replies and/or multiple replies

Figure 5.5: Relationship between gender and mode of transport

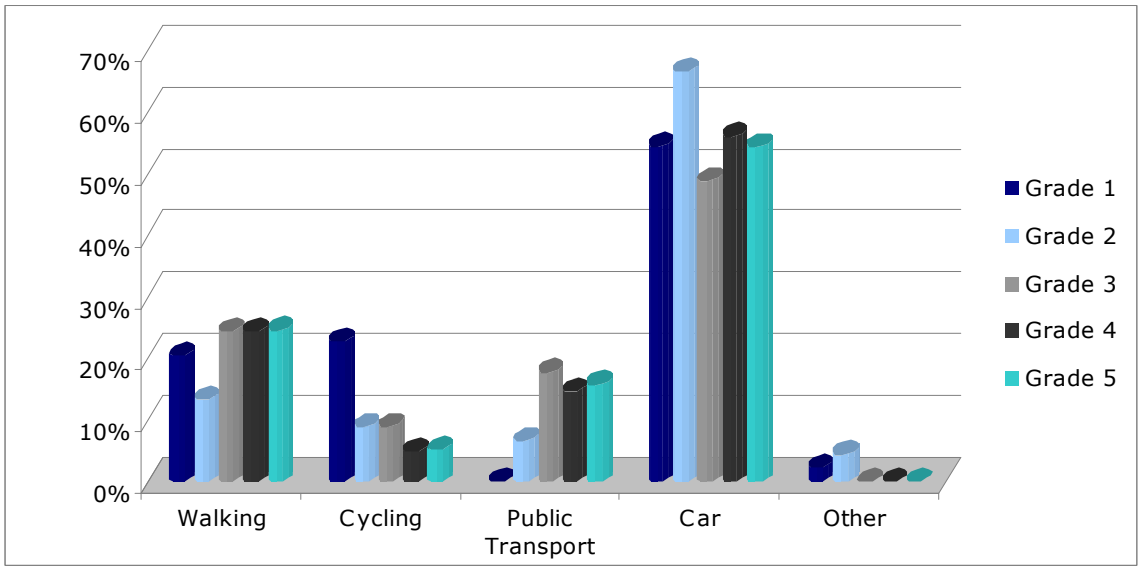


Source: own elaboration based on collected data

Note: item "Other" includes no replies and/or multiple replies

Finally, as demonstrated in Figure 5.6, the predominant role of car use is generally widespread among all grades, though it is worth noting how the use of public transport tends to increase in parallel with the higher children's age, which is namely the cases for grades 3, 4 and 5, and where on average public transport accounts for about 16% of school trips. The same occurs with walking, which raises up to an average of 24% of school journeys. Importantly, both may be read as an element of greater confidence among parents about their children's capacity to independently roam and travel to school. By contrast, cycling suffers a sharp decline from grade 2 onwards, declining from 22.7% for grade 1 (n = 10) to 5.3% (n = 3) for grade 5.

Figure 5.6: Preferred transport mode for school trip (by grade)



Source: own elaboration based on collected data

Note: item "Other" includes no replies and/or multiple replies

Not surprisingly, the fact that car is the most preferred transport mode for bringing pupils to school is corroborated by the analysis that may be drawn when observing to what extent children are escorted by adults.

Table 5.5: Comparison between children being accompanied and travelling alone to school

	Grade 1 % (n)	Grade 2 % (n)	Grade 3 % (n)	Grade 4 % (n)	Grade 5 % (n)	All
Parents	81.5 (44)	76.8 (43)	60.5 (26)	76.5 (39)	63.5 (40)	**71.9 (192)**
Grandparents	11.1 (6)	10.7 (6)	7.0 (3)	2.0 (1)	4.8 (3)	**7.1 (19)**
Alone	0.0 (0)	1.8 (1)	7.0 (3)	5.9 (3)	7.9 (5)	**4.5 (12)**
Other	7.4 (4)	8.9 (5)	25.6 (11)	13.7 (7)	22.2 (14)	**15.4 (41)**
No reply	0.0 (0)	1.8 (1)	0.0 (0)	2.0 (1)	1.6 (1)	**1.1 (3)**

Source: own elaboration based on collected data

Based on data reported in Table 5.5 head on, there is evidence that, if combining the findings related to parents (71.9%, i.e. *n* = 192) with those referring to grandparents (7.1%, i.e. *n* = 19), children are accompanied for 79% of their school journeys. Only 4.5% of them reported to go to school autonomously and, significantly, this figure concerned the last three grades only. This issue was further investigated in relation to the journey back home, which, however, did not present major differences as, again, children are accompanied by adults (parents and grandparents) for 76.9% of trips. The percentage of children travelling alone remains steady at about 4.8%, which once more applies to the last three school grades.

Interestingly, when observing children's mobility patterns for their journeys back home, the share represented by grandparents rises up to 10.6%, thus a increase of 3.5% if compared to trips to school in the morning. Even if this increase is marginal and not statistical relevant, it fairly demonstrates a usual trend of our contemporary society, i.e. the important role played by grandparents as "substitutes" of the parents in taking care of the children.

Finally, data collected also confirms that role of mothers as "taxi driver" for their children, since for the journeys to school 58.8% of children declared to be accompanied by their mother and 41.2% by their father. The proportion appears then quite evenly distributed between mothers and fathers taking in charge the function of getting their children to school. The gap, nonetheless, considerably increases when children are

brought back at home, since the large majority of them 68% travels with their mothers, while only 32% with their fathers.

A further element of analysis is investigating whether there are differences in being accompanied or not to school based on children's gender, namely whether boys benefit of a greater degree of independence if compared to girls (Table 5.6 and Figure 5.7). Not only data gathered by the survey did not report significant differences between boys and girls, but boys were also *slightly more* accompanied to school that girls. Though not statistically relevant since the very low result, those children that reported to go to school *alone* were all boys.

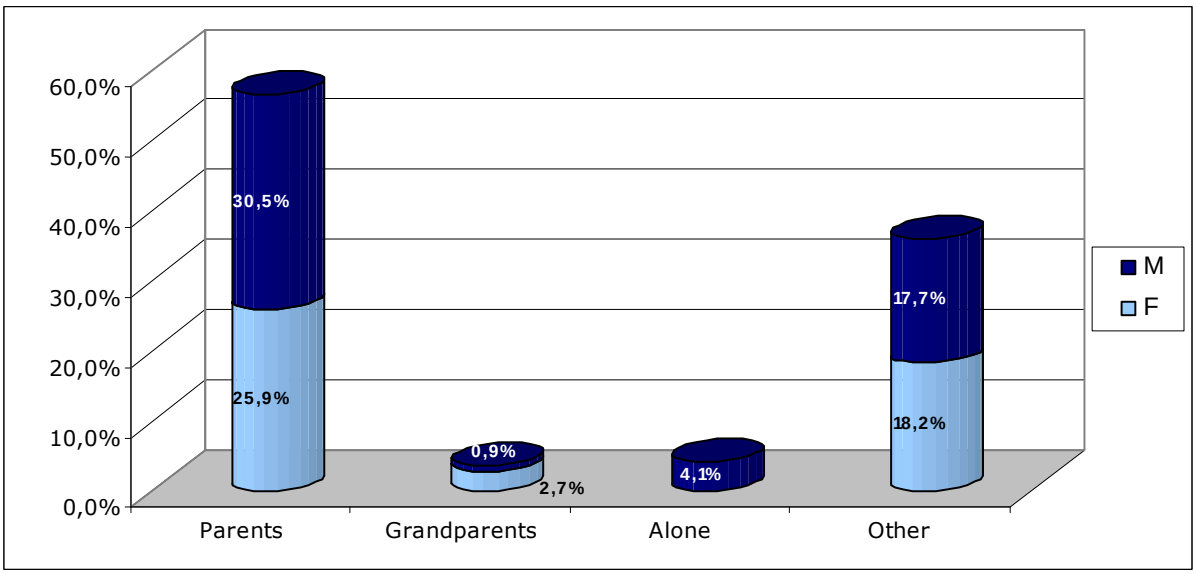
Table 5.6: Relationship between gender and with whom children are accompanied to school

Gender	Parents % (n)	Grandparents % (n)	Alone % (n)	Other % (n)
Female	25.9 (57)	2.7 (6)	0.0 (0)	18.2 (40)
Male	30.5 (67)	0.9 (2)	4.1 (9)	17.7 (39)
All	**56.4 (124)**	**3.6 (8)**	**4.1 (9)**	**35.9 (79)**

Source: own elaboration based on collected data

Note: item "Other" includes no replies and/or multiple replies

Figure 5.7: Relationship between gender and with whom children are accompanied to school



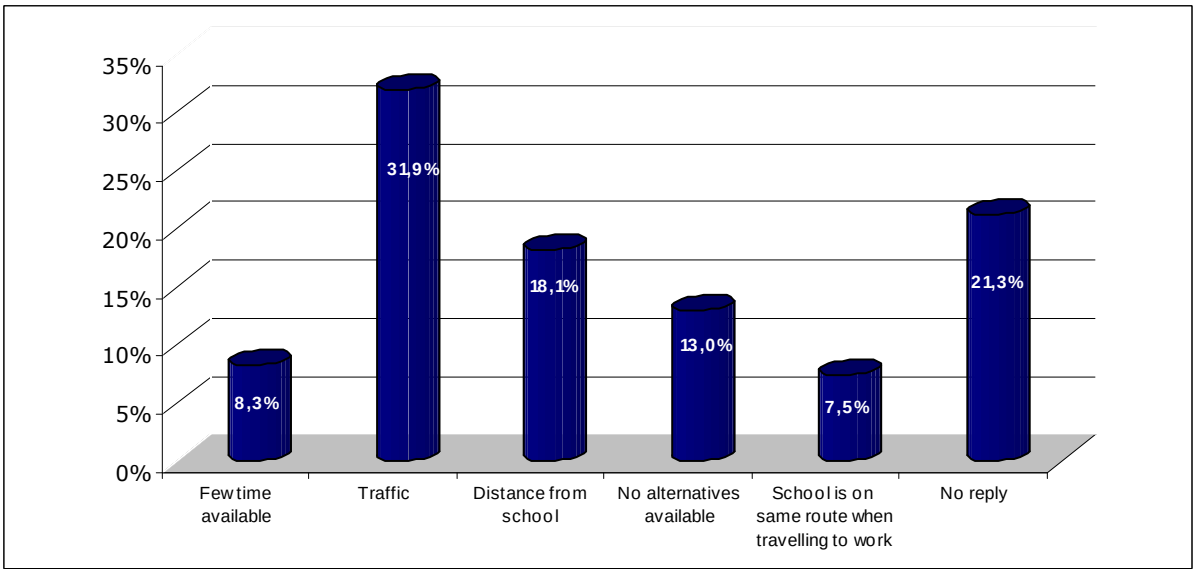
Source: own elaboration based on collected data

Note: item "Other" includes no replies and/or multiple replies

Moving to the main reasons explaining why children are mainly chauffeured to school by adults (parents or grandparents), data reveal that: (i) traffic (and its related impacts in terms of safety), (ii) distance from school, and (iii) no valuable alternatives available are cited as the three main reasons that lead parents to the decision of accompanying their pupils to school.

As shown in Figure 5.8, traffic is judged as dangerous by 31.9% of parents, while distance is the primary reason in 18.1% of the cases for choosing car as preferred mode of transport. The absence of valid alternatives to travel to school weighs for 13% of all responses, and 7.5% of respondents also motivated the choice of accompanying their children to school by the fact that school is located on the same route to their respective working places.

Figure 5.8: Main reasons for accompanying children to school



Source: own elaboration based on collected data

5.2.3 Perceived barriers to active commuting to school

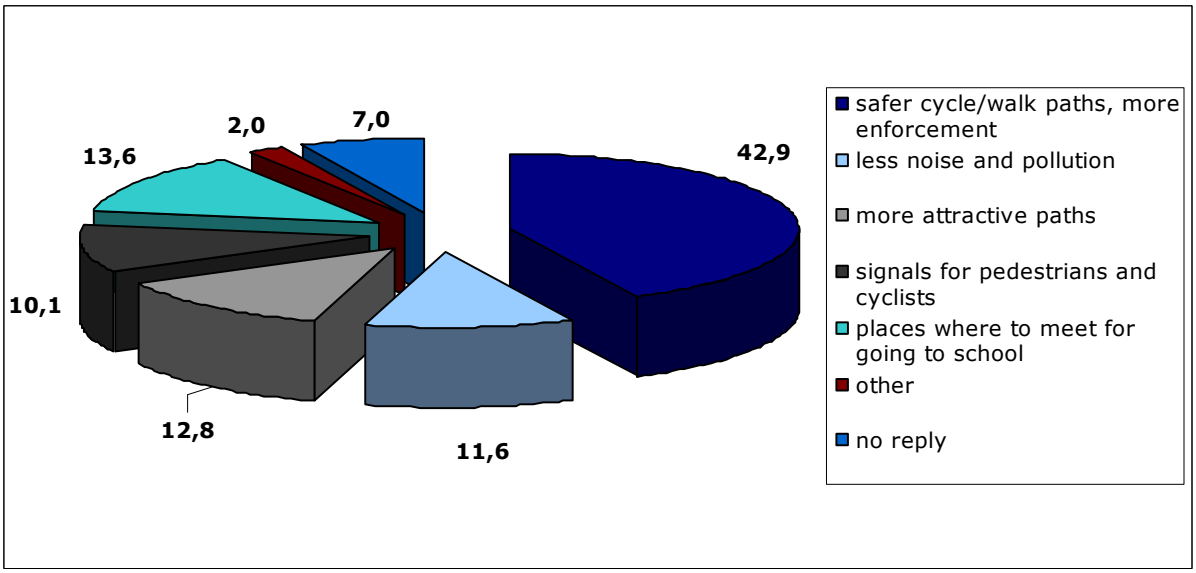
A final set of questions addressed, on the one hand, the issue of which elements could be perceived as major barriers to active commuting to school, and, on the other hand, whether *Shared Space*-related intervention schemes could be considered positively (or not) among parents.

The first item was treated in two questions, where children were asked to express their view about:

- what they would look for when going to school by walking or cycling;
- what bothers them at most.

To the first question (see Figure 5.9 in this respect), a large majority of children (42.9%, i.e. *n* = 148) declared the need to have: (i) safer cycle- and path ways, (ii) more parking lots for bicycles, and even more remarkably a greater level of enforcement by local police, so to prevent and fine unsafe or illegal behaviour. This was followed by considerations about the importance of suffering less noise and air pollution (11.6% of replies, i.e. *n* = 40), and disposing of more attractive paths (12.8%, i.e. *n* = 44), signals for pedestrians and cyclists (10.1% *n* = 35), and finally places where to meet for going together with their peers to school (13.6%, i.e. *n* = 47).

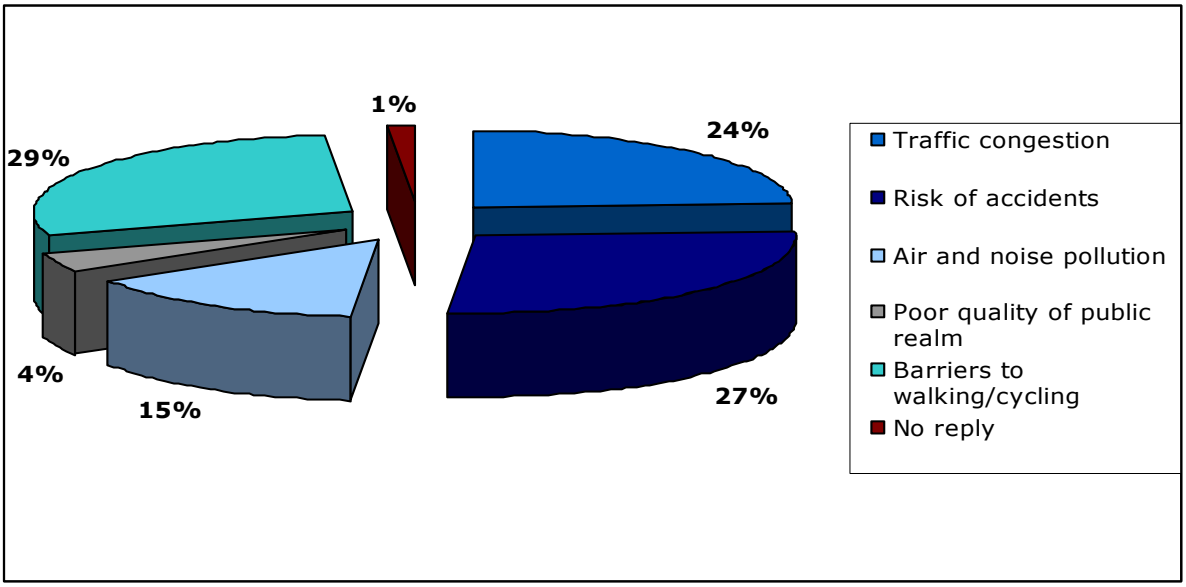
Figure 5.9: Main perceived barriers to ATS



Source: own elaboration based on collected data

Overall, children showed a significant awareness about the external traffic environment in which they move, as they appear to be conscious about the main barriers that may prevent ATS (Figure 5.10).

Figure 5.10: Main barriers preventing ATS



Source: own elaboration based on collected data

In particular, traffic congestion and risk of accidents is reported in more than half of children's responses (51.3%, i.e. *n* = 196) to have a key incidence in preventing ATS. This confirms previous findings about the importance road safety has in this respect, having the latter a role either of facilitating or hampering ATS depending on the local traffic conditions. Moreover, in children's perspective the quality of the environment is also important, accounting for a total of 18.6% of replies (*n* = 71).

The questionnaire ended with a final question addressed to parents and aimed at evaluate their degree of acceptance of likely interventions based on *Shared Space* principles.

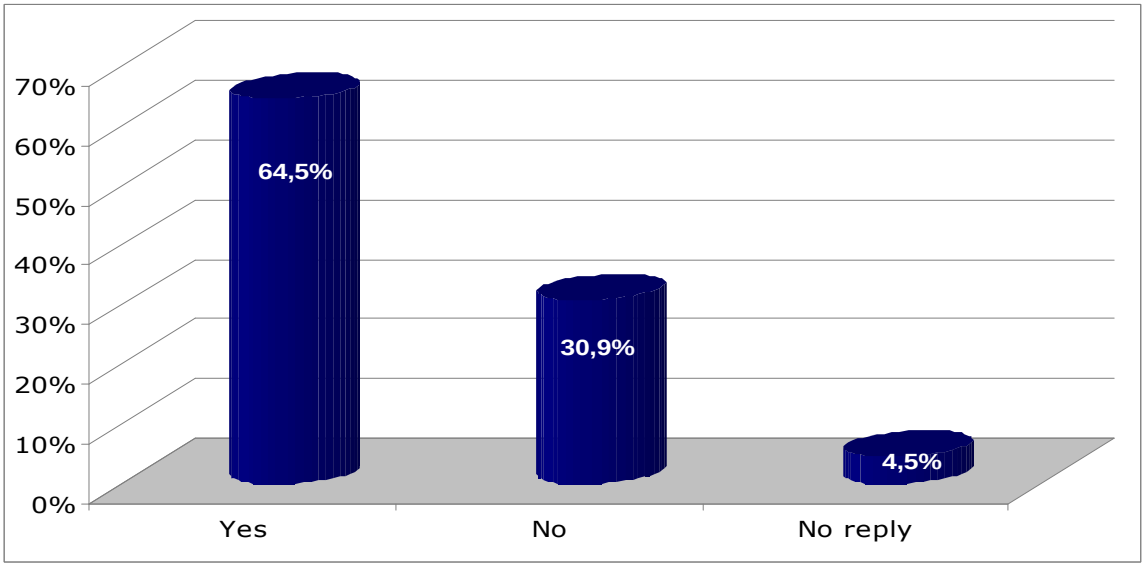
As indicated in Figure 5.11, a clear majority of parents (64.5%, i.e. *n* = 142) shows an overall appreciation of *Shared Space* schemes. They motivate such choice with the possibility, provided by a redesign of urban public realm according to a *Shared Space* concept, to enhance children's capacity to roam autonomously, which is regarded as a good opportunity for not only socialising with their peers, but also for learning how to safely behave in the traffic environments. As argued by some parents, children, as part of the traffic environment, may better know the traffic context and to recognise its signals (which is hardly possible by car). In other words, children are given the possibility for learning and increasing sensorial awareness in traffic situation so to either anticipate potential dangers or to avoid hazardous behaviours.

However, as reported by those parents that replied negatively, some specific issues are of major concerns. Firstly, safety is seen as the main barrier that prevent parents to let their children going to school independently. Here, safety should not only be intended as traffic-related, but also as part of the concept of *Stranger danger* that was analysed in Chapter Two of this thesis, and which make parents being scared of risks of violence or harassment against their children.

Secondly, the lack of adequate infrastructure is a further obstacle in this direction. Various parents claim that cycle or walk paths are missing, which does not allow their children to safely travel to school, namely when their place of residence is substantially far from the school.

Thirdly, among those parents that showed a negative opinion of *Shared Space*, there is the belief that educational actions are not enough to instil a cultural of shared responsibility among users, especially amongst car drivers.

Figure 5.11: Parents evaluation of *Shared Space*



Source: own elaboration based on collected data

5.3 Discussion

The primary focus of this survey was to collect observational data to determine the main patterns that characterised children's mobility in Castelfranco Veneto in relation to an important momentum of their daily life, i.e. school journeys.

Consistently with the analysis undertaken in the first two chapters of this thesis, investigation confirmed the key role played by car as preferred mode of transport for bringing pupils to school.

Compared to car use, the incidence of active commuting is not significant, especially when considering the choice for cycling. In a sense, the findings for cycling confirm the current gaps that feature the cycling network in Castelfranco Veneto, which, though investments that led to an overall length of 24 km, is still fragmented and mainly situated around the areas of most recent urbanisation. The downtown, where the primary school "A. Colombo" is located, is less served in this respect, which may explain why very few children travel to school by bike. No major differences were found in propensity to ATS between male and female children.

In line with previous research (Ewing et al., 2004; Timperio et al., 2006; Merom et al., 2006), the longer the distance to school, the lower the rate of ATS. With the exception of the shortest distance between home location and school, for which walking is the main mode, car is generally used as principal mode of transport. Interestingly, car was reported to be mainly used for a short/medium distance (500 metres - 2 km), which,

however, may be easily suitable for ATS. It is arguable that car is used in this situation because parents, after dropping their children at school, continue their journey to their respective workplaces.

Data gathered also suggest the low degree of independent mobility children may benefit from. As also mentioned in this thesis, pupils are fully embedded in their families' lifes and, though they strongly influence their parents' travel behaviour (Zwerts et al., 2007), they are also dependent upon their parents': (i) needs, (ii) perceptions, (iii) decisions, (iv) routines (Ziviani, et al., 2004). In this respect, variables like safety, perceptions of *Stranger danger* are determinant in the parents' decision to escort their pupils to school. Importantly this applied to boys and girls, irrespectively.

As expected, evidence was found about the role of mothers as "taxi drivers". While this role is fairly split between mothers and fathers as far as the journey to school is concerned, mothers mainly care for bringing their children back home. This may mirror specific both social and economic family conditions, like for example mothers working part-time.

Self-reported barriers to ATS were reported, as well. Children showed to be consciously aware of the main barriers that characterise the external traffic environment in which they move, and that prevent them from actively commuting. Safety, congestion, both air and noise pollution were identified as main obstacles

As a final note, it is worth commenting that the *Shared Space* concept received an overall appreciation among parents. Appreciation was expressed since it may enhance a greater rate of ATS or, as several parents pointed out, it may encourage children being more autonomous. However, safety concerns were again first and foremost pinpointed as main reasons for not accepting the introduction of *Shared Space* schemes.

5.4 Conclusions

This survey represents the first attempt to identify children's mobility patterns along school runs in the County of Treviso (to which Castelfranco Veneto belongs administratively). The main conclusions to be drawn from this survey may be summarised as follows.

- Car use is confirmed as predominant mode of transport for bringing children to school, while active commuting modes like walking and cycling have a limited incidence, namely cycling which overall is the less preferred mode of transport to travel to school.

- The overwhelmingly majority of children goes to school accompanied by parents and/or grandparents. This applied without distinction to boys and girls.
- Traffic congestion, safety, pollution are the most significant barriers to ATS that children self-report. Safety is of particular concern among parents.
- Overall, the *Shared Space* concept is welcome, though again safety concerns emerged to be the main reason for its negative evaluation among some parents.

CHAPTER VI: CONCLUSIONS

In general terms, it is acknowledged that children need and desire to freely move in the neighbourhood where they live, so to learn how to orient themselves and organise their space. In other words, they have a need to explore, socialise and move in the city where they live without dangers. This is especially evident when children go to school.

However, the traffic environment and the urban form often do not suit to them, and do not take into account their specific mobility needs. As explained in Chapter Two of this thesis, an increasingly problematic relationship between children and the urban environment where they live emerges, mainly because of the failure of modern cities in creating a suitable public realm for children.

The consequences are manifold, and do not only refer to fewer or missing social and attitudinal learning opportunities for children, but the impact is also evident as far as their mobility is concerned.

Children are, indeed, at high risk, due also to the fact that they still are not experienced to traffic flows and have a weak capability in judging potentially dangerous traffic situations and needs; often they also take grater risks without having a sufficient perception of the possible consequences. Additionally, there are also non urban form-related factors, such as for example the perceptions of non safety along school routes or the distance of schools from households.

All this may explain the overall drop in the number of children that opt for walking and cycling when travelling to schools. In fact, even more children go to school (or to other non-school activities) by car accompanied by their parents, even in the case of short trips. In a sense, this also mirrors the current role private car use has as predominant transport mode. Not surprisingly, the findings obtained by the survey carried out in Castelfranco Veneto and illustrated in Chapter V confirmed the predominant role of car use as the main mode of transport chosen by parents for bringing their pupils to school. In this respect, such findings position themselves in line with similar conclusions drawn by the various studies that were analysed in this thesis.

This raises, nonetheless, important concerns especially when observing the harmful effects on children's physical and psychological development. As Chapter Two described, besides the adverse effects produced by the soaring car usage in terms of: (i) road safety, (ii) air and noise pollution, (iii) GHGs emissions, there is evidence from a considerable body of research that children are more likely to suffer from an increasing

variety of diseases (cardio vascular diseases, anxiety, stress, depression, obesity) that until recent times where only associated to adulthood.

These elements determined the framework for the analysis of Active Commuting to School, which has been suggested as a tool that may likely enhance among children a greater use of walking and cycling as main mode of transport for their school journeys. Benefits would be, on the one side, higher physical activity rates and, on the other side, an opportunity for social interaction and maturation, and for independent mobility.

The showcases across Europe (namely in the United Kingdom, which is a frontrunner in this respect), Australia and the United States showed that ATS interventions (like School Travel Plans, Safe Routes to School Programmes and Walking School Buses) may successfully work and produce considerable positive results.

Nevertheless, the shift from car use to active commuting for school runs is not straightforward, since a number of environmental factors (also called determinants) exist and must be taken into proper consideration when designing an ATS schemes. Such determinants have, indeed, the capability either to facilitate or inhibit ATS and are strongly associated with parents' characteristics: (i) resources, (ii) needs, and (iii) perceptions.

Again, the findings derived from the analysis of the case-study of the primary school located in Castelfranco Veneto further corroborate the complexity of treating the issue of school runs, where such complexity is ruled by a number of interlinking social, economic, behavioural factors, where elements like: social values, income, concerns about safety and security, reliability and availability of public transport services, educational level, school and residence location, are all key variables that may explain why parents opt to:

- escort their children to school either by car or by other means, or
- alternatively, to let a certain degree of freedom to their children who are allowed to travel to school independently.

In fact, it should be reminded that children are embedded in their family contexts, which means that they are significantly influenced in their choices by their parents': values, beliefs, behaviours, perceptions of the external environment, attitudes and needs, and based on which the latter take their decisions. Broadly speaking the way school runs are managed by parents may be interpreted as a *mirror* of our contemporary society as they, to a certain extent, reflect the changes that occurred in the last decades. This issue was already addressed in Chapter Two, but it is important to underline again how in modern society the presence of a child (or more) directly and deeply affect parents' routine and habits (Zwerts, et al. 2007). Besides the effects that the birth of a child has on his/her

parents in terms, for instance, of increased household tasks and their repartition (Heine et al., 2001), or social network size (Bott, 1971; Biddart and Lavenu, 2005) and time use, there is a clear impact on how adults change their travel habits as well.

Such change is particularly evident as far as school journeys are concerned, since they occur on a specific time of day where they should be combined with parents' need to reach their respective working places. This combination is critical, especially when it has to be weight alongside additional factors covering distance from and route to school, different working patterns between the parents, etc. Then, elements like: children's characteristics (age, gender), urban structure, available alternatives, perceptions, values, social norms, etc. have a role and their interaction in terms of: *opportunity*, *obligation*, and *inclination* (Stradling et al., 1999; Wardman et al., 2001; both studies cited in Rothengatter and Huguenin, 2004) contributes to establish a decision-making process that determines the choice for:

- the preferred mode of transport, and
- whether children are allowed or not to travel to school independently.

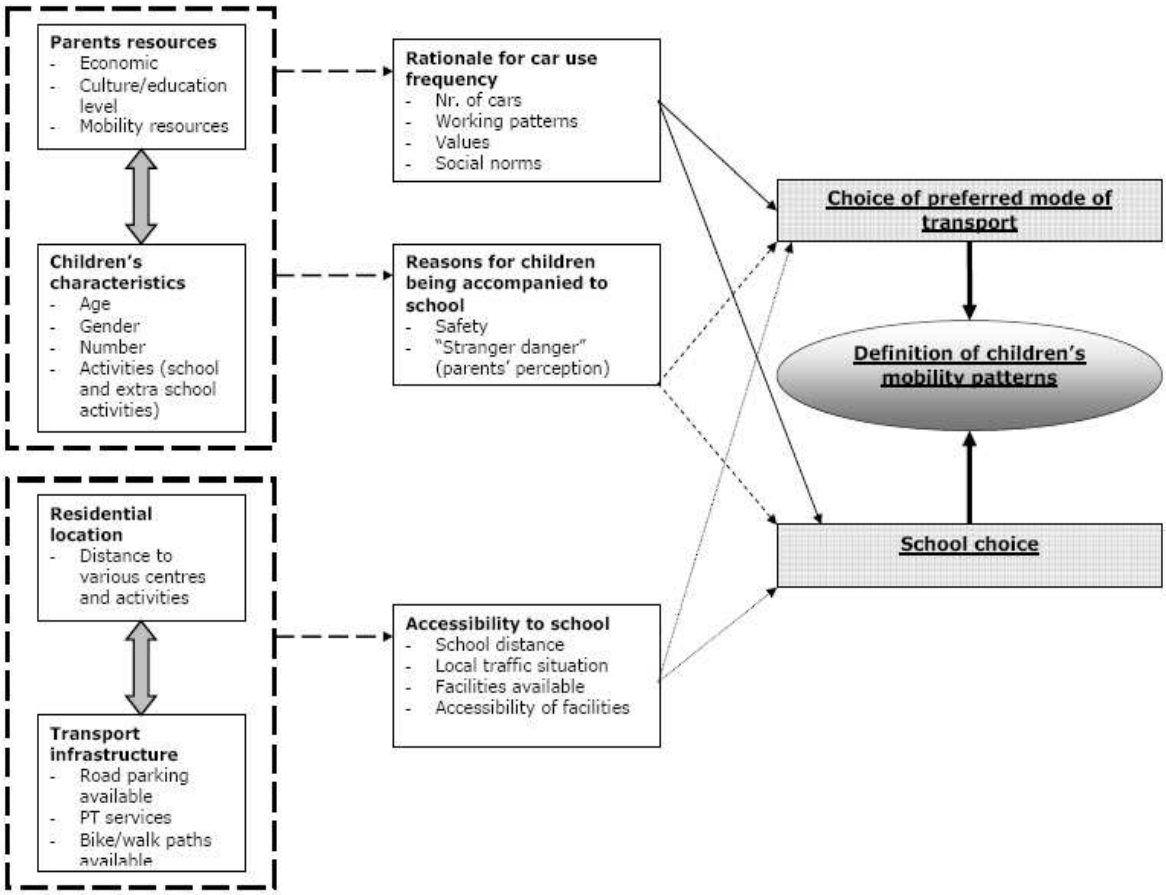
When this process is stabilised, i.e. the choice made is rewarding, this will end up in a feeling of control, and once control is established, the choice becomes a habit until new environmental or individual circumstances will lead parents to change (Küller, 1991, cited in Rothengatter and Huguenin, 2004).

This reasoning opens to an hypothesis for establishing a model to define children's mobility patterns, which is illustrated in Figure 6.1 on next page. From a general perspective, this model tries to propose a motivational model explaining the choice for a specific mode of transportation by incorporating a travel behaviour and the effects of urban structure in terms of accessibility. Specifically, this model may be regarded as an attempt to identify which determinants are key in coming to a specific decision about how children travel to school. Indeed, such decision may be considered as the final step or synthesis of a complex process that encompasses various variables, which weigh differently and, consequently, lead to different decisions.

The model recalls the role of those environmental correlates, that may facilitate or inhibit ATS and that are mostly associated with the tendency for children of using ATS, and takes into consideration three starting elements, which refer to:

- parents' resources;
- children's characteristics;
- residential location and transport infrastructure.

Figure 6.1: Model for defining children's mobility patterns



Source: own elaboration

The *first element* – parents' resources – is crucial, and to a certain extent may be looked at the *real* beginning of the process. Income, educational levels, mobility resources (which may be defined as *the limitations and possibilities regarding the modes of travel open for option*; Næss, 2006) are all pre-requisite that set attitudes, behaviour, perception in parents, and which are expected to also influence their children. In particular, in this model they are expected to set the frequency of car use, which is dependent upon parents' environmental or social values, social norms, working patterns.

The *second element* relates to children's characteristics (age, gender, number, activities), which identifies the reasons why they may be accompanied or not to school. Here, parents have again a crucial influence, since it is their perceptions about the external environment (safety, and *Stranger danger*) that leads to the possibility for children to

roam and travel to school autonomously or not. Safety appears then to be the strongest concern governing parental decisions regarding their children' transportation modes.

The *third element* is inherent to the urban structure and the transportation infrastructure. The former is strictly tied to the concept of **distance**, whilst the second is more linked to **accessibility**. Distance and accessibility are observed in their relation to school, and namely to what extent school is easily accessible. In particular, urban structure, though it is not the unique factor in determining ATS level, has an impact on to what extent parents take decisions about their children's trips to school. Here, travel distance (and the subsequent travel time) has a clear effect on modal choice, especially because travel choice is done according to parents' needs, for which minimising travel time to school often means minimising their travel time to work. Moreover, distance and accessibility are also linked to a further element: **school siting** and **school catchment area**. The closer the school to households, the higher the likelihood parents opt for active travel for bringing their pupils to school, or for even let them free to travel independently. This influences on safety parents' perceptions as well since, as some research has outlined (Tranter and Pawson, 2001), the location where parents live and where their children roam (including them school) is partly responsible for a higher traffic or crime-related feeling of fear.

School choice and choice of the preferred mode of transport are the result of the combination of these three elements, which, as last step, lead to the identification of the children's mobility patterns. It may be assumed that all components of this model have a relative *weight* and cooperate or conflict, though differently, to reach the end of the process, i.e. the decision to opt for ATS or for a more traditional transportation habit based on car use. They are also differently influenced according to family, personal, social and economic contexts where parents and their children live.

The relationships included into the model are dynamic, since they regularly evolve as (i) parents resources, (ii) children's characteristics or the (iii) urban structure change do as well. Such dynamic feature makes possible to intervene on one or more of the components of the model, and therefore it makes possible to orient parental decisions more in favour of ATS.

In particular, it makes possible to intervene on the parental perceptions about the dangers in the built environment. As already mentioned in this thesis, safety is a major concern for parents and a main determinant for their decision to bring children to school by car. Safety may be the field of action where the *Shared Space* concept may contribute the most. As argued by Methorst et al. (2007), *Shared Space* may lead to safer traffic

situation and this may favour a more positive attitude towards active travel, thanks to the fact that it creates a framework where users travel by the same speed and, therefore, may negotiate their traffic conflict by personal communication rather than traditional road signalling.

Given that active school journeys may be regarded not only as a good momentum for performing physical, but above all an excellent chance for providing children with a greater chance to familiarise with their surrounding community and environment, *Shared Space* may contribute in this respect by creating new opportunities for establishing human and social links, which enable children to learn autonomously both nature and dangers of the traffic environment.

Nevertheless, as reminded by Methorst et al. (2007) and Hamilton-Baillie (2008) a number of questions still exist, and one of them refer to fact that *normal* pedestrians and cyclists tend to run more risks than car drivers, which may, in turn, affect specific categories of VRUs with lower *power of traffic negotiation*, like first children and elderly or impaired people.

This explains why the solely application of *Shared Space* would, however, be not sufficiently effective in encouraging ATS. *Shared Space* should be, indeed, part of a more comprehensive package of measures where it could represent the long-term component of an integrated strategy that aims to achieve a more sustainable transportation for school trips, and where the concept of sustainability goes beyond the simple reduction of mobility-related environmental impacts for also embracing elements like safety and healthy benefits of active travel. In such strategy, the short-term component would be given by the ATS schemes (School Travel Plans, Safe Routes to School programmes, Walking School Buses) this thesis discussed about, but that are more likely to produce minor – even if important – changes if not complemented with urban planning improvements (both *soft* and *hard*) that create an incentive to children to autonomously roam and travel within their neighbourhood.

A further element is behavioural change. Any intervention on the infrastructure or the urban layout risk of not being successful if not adequately supported by a change in habits and especially in the way mobility is currently intended. It goes without saying that encouraging people to change their travel behaviour is certainly a key challenge itself. The difficulty mainly emerges from the fact that travel behaviour is often built upon habits (Triandis, 1977; 1980) which are a product of routine, and where routine of travel is often repetitive with respect to the travel mode that is chosen for the daily commuting activity (Lanzendorf, 2001). The direct consequence is that when a travel choice habit is

established, users hardly take into account alternative mode options, so that any new information referring to such options is likely to be ignored, and behaviour will not change. This would suggest that before travel behaviour change occurs, travel habits need to be broken.

Changing travel habits is undeniably not an easy task, also because behaviours are products of a variety of factors, which act at manifold levels: individual and societal, subjective and objective. Since these factors have to change before that behaviour is successfully influenced, their practical understanding is a precondition for properly design and implement measures that:

- offer an opportunity to change travel mode, i.e. an opportunity to shift from car to other transport modes;
- stimulate the perception that these alternatives are attractive;
- reinforce the motivation to behavioural change, i.e. increasing people's understanding that their car use is less convenient than the use of other transport means.

Often, parents show a positive attitude with regard to active commuting, but are constrained by social, policy and environmental factors that make active travel preferences difficult choices (Garrard et al., 2009). Thus, they need to be given with valuable alternatives that may facilitate choosing for a more sustainable mobility. Here, valuable alternatives does not only mean providing good-quality cycle and walk paths along the journey to school, but it also implies to offer, for example, the possibility to work from home or to benefit from flexible opening hours for school entrance or exit. In other words, parents need also a certain degree of flexibility for managing their activities and those of their pupils. Doing this means taking into consideration how parental daily social, working and family life is organised (the parents' resources element of the model illustrated in Figure 6.1), in order to create the conditions for shifting from car to active travel.

Behavioural change calls for another key element: community support and partnership.

Parental involvement in the change process is obviously crucial, because it represents the main determinant that may let or prevent any ATS intervention. However, school involvement and government support (at all governance levels) are also of paramount importance. Especially schools have a potential for establishing those social and environmental conditions under which ATS-oriented awareness and education may be encouraged. This may happen at two levels: children, which generally show a huge enthusiasm for this kind of initiatives, and their parents which may be convinced of the

opportunity and benefits of gradually shifting from car to active travel for school journeys.

That said, and as demonstrated by the major experiences presented in this thesis, government support is fundamental. This applies to both the financial side, and to a more strategic level where active commuting may be seen as an overall opportunity to reduce current level of motorisation.

To conclude, addressing the issue of school trips may enable to get a broader understanding of children's travel behaviour and to introduce proposals and recommendations for elaborating both educational plans and infrastructure improvements that encourage children's modal choices in favour of walking and cycling. This may also be crucial in helping children, as part of the traffic environment, to better know the traffic context and to recognise its signals (which is hardly possible by car). The final objective is to give children the possibility for learning and increasing sensorial awareness in traffic situation so to either anticipate potential dangers or to avoid hazardous behaviours. Walking and cycling to school may be a paramount opportunity for that.

Future research is then needed in a number of directions.

Firstly, there is a need to **further identify predictors and barriers to active commuting to school**. In this respect, research should investigate the interlink existing between school, parental, and community factors. This topic should be also integrated with an analysis of the effectiveness of the local, regional or even national policies and their effects on children's mobility and active commuting to school. This would allow to fine-tune programming strategies according to research findings.

Secondly, research may **focus on the design and implementation of standardised tools for comparative analysis**, which, in turn, may be also of help to policy-makers and planners when designing comprehensive planning programmes.

Thirdly, it would be important to **include in the analysis data collection and processing of information related to the public transportation system**, such as availability of school buses. Public transportation often misses in the analysis, though it may play a noticeable role in reducing car use for school journeys.

Fourthly, there is a need to **further investigate the impact of children on parental mobility needs**. The possibility to introduce flexible working timings or to work from home impact not only on their activity-travel behaviour, but also on the school travel of their children.

Finally, there is a need to **pay more care on children' perceptions and desire**. So far, research on children's mobility was based on adults' standpoint, as there was the belief that children's mobility is somehow either the product, or part of a more general parental mobility. Children should, instead, be more acknowledged as autonomous users. Listening more to their perceptions and needs would probably be helpful in setting up or improving ATS schemes and to investigate whether ATS tracks through adolescence and adulthood.

As pointed out in Chapter Two, children may be, indeed, a crucial measure and facilitator of sustainability. Making children familiar with sustainable transport modes and allowing them an increased mobility independence may pave the way for developing positive attitudes and behavioural patterns, which may be continued into their adulthood as well.

BIBLIOGRAPHY

Alton, D., Adab, P., Roberts, L., Barrett, T., 2007. Relationship between walking levels and perceptions of the local neighbourhood environment. *Archives of Disease in Childhood*, 92, pp. 29–33.

Andersen, L.B., Lawlor, D.A., Cooper, A.R., Froberg, K., Andersen, S.A., 2009. Physical fitness in relation to transport to school in adolescents: the Danish youth and sports study. *Scandinavian Journal of Medicine and Science in Sports*, 19, pp. 406–411.

Andersen, L.B., Harro, M., Sardinha, L.B., Froberg, K., Ekelund, U., Brage, S., Anderssen, S.A., 2006. Physical activity and clustered cardiovascular risk in children: a cross-sectional study (The European Youth Heart Study). *Lancet*, 368, pp. 299–304.

Anderson, P., Butcher, K.F., 2006. Childhood Obesity: Trends and Potential Causes. *The Future of Children*, 16 (1), pp. 19-45.

Arene and Ademe, 2008. *Fiche Eco-Mobilité Scholaire: Comment elaborer un plan de deplacements d'ecole?*. Arene and Ademe.

Baker, J., 2010. *Discussion on Shared Space*. [Email] (Personal communication, 3 and 4 March 2010).

Biddart, C., Lavenu, D., 2005. Evolutions of personal networks and life events. *Social networks*, 27, pp. 359-376.

Biddle, S.J., Gorely, T., Stensel, D.J., 2004. Health-enhancing physical activity and sedentary behavior in children and adolescents. *Journal of Sports Science and Medicine*, 22, pp. 79–701.

Boarnet, M.G., Day, K., Anderson, C., Mcmillan, T., Alfonzo, M., 2005. Evaluation of the California's Safe Routes to School program: impacts on walking, bicycling, and pedestrian safety. *Journal of the American Planning Association*, 71, pp. 301-317.

Booth, M.L., Chey, T., Wake, M., Norton, K., Hesketh, K., Dollman, J., Robertson I., 2003. Change in the prevalence of overweight and obesity among young Australians, 1969–1997. *American Journal of Clinical Nutrition*, 77, pp. 29-36.

Boreham, C., Riddoch, C., 2001. The physical activity, fitness and health of children. *Journal of Sports Science and Medicine*, 19, pp. 915–29.

Bott, E., 1971. *Family and social networks. Roles, Norms and External relationship in ordinary Urban Families*. New York: Free Press.

Bråbäck, L., Forsberg, B., 2009. Does traffic exhaust contribute to the development of asthma and allergic sensitization in children: findings from recent cohort studies. *Environmental Health*, 8 (17).

Bradshaw, R., 2001. School children's travel - The journey to school. *Geography*, 86, pp. 77–78.

Braza, M., Shoemaker, W., Seeley, A., 2004. Neighbourhood design and rates of walking and biking to elementary school in 34 California communities. *American Journal of Health Promotion*, 19, pp. 128-136.

Brighton-Hove County Council, 2007. *Sustainable Travel Strategy for Schools 2007/8*. Brighton: Brighton-Hove County Council.

Buchanan, C., 1963. *Traffic in Towns*. London: The Stationary Office.

Cairns, S., 2005. *Achieving Safer School Travel in the UK*. London: University College London, Centre for Transport Studies.

Cairns, S., Sloman, L., Newson, C., Anable, J., Kirkbride, A., Goodwin, P., 2004. *School Smarter Choices – Changing the Way We Travel*. London: DfT. Available at: http://www.dft.gov.uk/pgr/sustainable/smarterchoices/ctwwt/smarterchoiceschangingtheway5769 [Accessed: 30 January 2010].

Carlin, J., Stevenson, M., Roberts, I., Bennett, C., Gelman, A., Nolan, T., 1997. Walking to school and traffic exposure in Australian children. *Australian and New Zealand Journal of Public Health*, 21, pp. 286–292.

Cavill, N., Biddle, S., Sallis, J.F., 2001. Health enhancing physical activity for young people: statement of consensus of the United Kingdom expert consensus conference. *Pediatric Exercise Science*, 13, pp. 20–25.

Carver, A., Timperio, A., Crawford, D., 2008. Playing it safe: The influence of neighbourhood safety on children's physical activity: A review. *Health & Place*, 14.

Centers for Disease Control and Planning, 2005. Barriers to children walking to or from school—United States, 2004. *Morbidity & Mortality Weekly Report*, 54, pp. 949–952.

Centers for Disease Control and Prevention, 1999. Barriers to children walking and biking to school - United States. *Morbidity and Mortality Weekly Report*, 51 (32), pp. 701-4.

Christie, N., Towner, E., Cairns, S., Ward, H., 2004. *Children's Road Traffic Safety: An International Survey of Policy and Practice*. Road Safety Research Report No. 47. London: DfT.

City of Lund, 2007. *LundaMaTs II Strategy for a sustainable transport system for Lund 2030*. Lund: City of Lund. Available at: http://web.lund.se/upload/Tekniska%20f%C3%B6rvaltningen/Trafikmilj%C3%B6enheten/LundaMaTsII2009/VISA_LM_eng.pdf [Accessed: 18 January 2010].

City of York Council, 2000. *York School Travel Survey Report 2000*. York: City of York Council.

Clifton, K.J., 2003. Independent mobility among teenagers: an exploration of travel to after-school activities. *82nd Annual Meeting of the Transportation Research Board*. Washington, DC, the United States, 11-16 January 2003.

Cooper, A.R., Wedderkopp, N., Wang, H., Andersen, L.B., Froberg, K., Page, A.S., 2006. Active travel to school and cardiovascular fitness in Danish children and adolescents. *Medicine & Science in Sports Exercise*, 38 (10), pp. 1724-31.

Cooper, A.R., Page, A., Foster, L., Qahwaji, D., 2003. Commuting to School. Are Children Who Walk More Physically Active?. *American Journal of Preventive Medicine*, 25 (4).

Copperman, R., Bhat, C., 2007. An analysis of the determinants of children's weekend physical activity participation. *Transportation*, 34 (1), pp. 67–87.

Davison, K., Werder, J., Lawson, C., 2008. Children's Active Commuting to School: Current Knowledge and Future Directions, *Preventing chronic disease*, 5 (3).

Davison, K., Lawson, C., 2006. Do attributes in the physical environment influence children's physical activity? A review of the literature. *International Journal of Behavioral Nutrition and Physical Activity*, 3, p. 19.

De Haan, P., 2010. *The psychological basis of the Shared Space concept*.

Department for Transport, 2007. *DfT child road safety strategy 2007*. London: DfT. Available at: http://www.dft.gov.uk/pgr/roadsafety/child/childrdsafetystrategy2007 [Accessed: 4 January 2010].

Department for Transport, 1998. *A new deal for transport: better for everyone - white paper*. London: DfT. Available at: http://webarchive.nationalarchives.gov.uk/+/http://www.dft.gov.uk/about/strategy/whitepapers/previous/anewdealfortransportbetterfo5695 [Accessed: 4 January 2010].

Department for Transport and Department for Education and Skills, 2003. *Travelling to school: an action plan*. London: DfT and DfES. Available at: http://www.dft.gov.uk/pgr/sustainable/schooltravel/travelling/avellingtoschoolanactionplan.pdf [Accessed: 23 January 2010].

Dietz, W.H., 1998. Health consequences of obesity in youth: childhood predictors of adult disease. *Pediatrics*, 101 (3 Pt 2), pp. 518–25.

DiGuiseppi, C., Roberts, I., Li, L., Allen, D., 1998. Determinants of car travel on daily journeys to school: cross sectional survey of primary school children. *British Medical Journal*, 316 (7142), pp. 1426-8.

Di Peitro, G., Hughes, I., 2003. TravelSmart Schools – there really is a better way to go!. *In: 26th Australasian Transport Research Forum*. Wellington, New Zealand, 1-3 October 2003.

Ebbeling, C.B., Pawlak, D.B., Ludwig, D.S., 2002. Childhood obesity: public-health crisis, common sense cure. *Lancet*, 360 (9331), pp. 473–82.

Engwicht, D., 2007. *Mental Speed Bumps. The smarter way to tame traffic*. Brisbane: Creative Communities International.

European Commission, 2002. *Kids on the move* Brussels: EC. Available at: http://ec.europa.eu/environment/youth/original/air/kids_on_the_move_en.pdf [Accessed: 2 January 2010].

European Environment Agency, 2008. *Beyond transport policy — exploring and managing the external drivers of transport demand Illustrative case studies from Europe* Copenhagen: EEA. Available at: http://graphics8.nytimes.com/packages/pdf/world/Beyond_transport_policy.pdf [Accessed: 26 January 2010].

European Heart Network, 2001. *Children and Young People – the Importance of Physical Activity*. Brussels: EHN. Available at: http://www.ehnheart.org/files/phyactivity-084635A.pdf [Accessed: 31 December 2009].

Evenson, K.R., Birnbaum, A.S., Bedimo-Rung, A.L., Sallis, J.F., Voorhees, C.C., Ring, K., et al., 2006. Girls' perception of physical environmental factors and transportation: reliability and association with physical activity and active transport to school. *International Journal of Behavioral Nutrition and Physical Activity*, 3, p. 28.

Evenson, K.R., Huston, S., Mcmillen, B., Bors, P., Ward, D., 2003. Statewide prevalence and correlates of walking and bicycling to school. *Archives of Pediatrics & Adolescent Medicine*, 157, pp. 887–892.

Ewing, R., Schroeer, W., Greene W., 2004. *School location and student travel: analysis of factors affecting mode choice*. Washington D.C.: Transportation Planning and Analysis, Transportation Research Board, National Research Council. Available at: http://www.icfi.com/Markets/Transportation/doc_files/school-location.pdf [Accessed: 6 March 2010].

Fotel, T., 2007. *Mobilitet i børnehøjde. En mobilitetssociologisk analyse af praksis, velf_rd og ulighed i børns hverdagsliv*. Ph.D. Thesis No. 55/2007. Roskilde: Institut for samfund og globalisering. Roskilde Universitet.

Fox, K.R., 2004. Childhood obesity and the role of physical activity. *Journal of the Royal Society for the Promotion of Health*, 124 (1), pp. 34–39.

Frank, L., Kerr, J., Chapman, J., Sallis, J., 2007. Urban form relationships with walk trip frequency and distance among youth. *American Journal of Health Promotion*, 21 (4 suppl.), pp. 305-311.

Frank, L.D., Engelke, P, Schimd, T., 2003. *Health and Community Design: The Impact of the Built Environment on Physical Activity*. Washington D.C.: Island Press.

Freedman, D.S., Dietz, W.H., Srinivasan, S.R., Berenson, G.S., 1999. The relation of overweight to cardiovascular risk factors among children and adolescents: the Bogalusa Heart Study. *Pediatrics*, 103, pp. 1175–1182.

Freedman, D.S., Srinivasan, S.R., Valdez, R.A., Williamson, D.F., Berenson, G.S., 1997. Secular increases in relative weight and adiposity among children over two decades: the Bogalusa Heart Study. *Pediatrics*, 99, pp. 420-6.

French, L., 2008. School Travel Plans in Bromley. *In: 9th Walk International Conference: Walk with Barcelona - a moving city*. Barcelona, Spain, 8-10 October 2008. Available at: http://www.walk21.com/papers/French,%20Louise-%20School%20Travel%20Plans%20in%20Bromley.pdf [Accessed: 23 January 2010].

Frumkin, H., Frank, L., Jackson, R., 2004. *Urban Sprawl and Public Health: Designing. Planning and Building for Healthy Communities*. Washington D.C.: Island Press.

Fulton, J., Shisler, J., Yore, M., Caspersen, C., 2005. Active transportation to school: findings from a national survey. *Research Quarterly for Exercise and Sports*, 76, pp. 352-357.

Fyhri, A., Hjorthol, R., 2009. Children's independent mobility to school, friends and leisure activities. *Journal of Transport Geography*, 17, pp. 377–384.

Fyhri, A., 2005. Do they walk? Evaluation of the project Active way to school (2002–2006). *Institute of Transport Economics*, 814/2005.

Garrard, J. 2009. *Active transport: Children and young people. An overview of recent evidence*. Carlton South: VicHealth

Gehl, J., 2003. Winning Back the Public Spaces. *Conference lectured at the symposium "(In)visible Cities. Spaces of Hope, Spaces of Citizenship".* Barcelona, Spain, 25-27 July 2003. Available at: http://www.publicspace.org/en/text-library/eng/a006-winning-back-the-public-spaces [Accessed: 20 February 2010].

Gerlach, J., Methorst, R., Boenke, D., Leven, J., 2009. *Sense and nonsense about Shared Space - For an objective view of a popular planning concept*. Wuppertal: Bergische Universität Wuppertal. Available at: http://www.fietsberaad.nl/library/repository/bestanden/Shared%20Space_short_german-Eng.pdf [Accessed: 13 February 2010].

Gilhooly, P., D. Low, D., 2005. Primary school travel behaviour in Midlothian, UK. *Proceedings of the Institution of Civil Engineers, Municipal Engineer*, 58, pp. 129–136.

Gill, T., 2008. Space-oriented Children's Policy: Creating Child-friendly Communities to Improve Children's Well-being. *Children & Society*, 22 (2), pp. 136-142.

Gill, T., 2007. *No Fear: Growing up in a risk averse society*. London: Calouste Gulbenkian Foundation.

Green Communities, 2007. *Review of International School Travel Planning Best Practices*. Peterborough, ON: G.C. Available at: http://www.saferoutestoschool.ca/downloads/STP-Best-Practice-Final.pdf [Accessed: 28 January 2010].

Grunbaum, J.A., Kann, L., Kinchen, S., Ross, J., Hawkins, J., Lowry, R., et al., 2004. Youth risk behavior surveillance — United States. *Morbidity and Mortality Weekly Report*, 53 (2), pp. 1-96.

Ham, S., Martin, S., Kohl, I., 2008. Changes in the percentage of students who walk or bike to school—United States, 1969 and 2001. *Journal of Physical Activity & Health*, 5, pp. 205–215.

Hamilton-Baillie, B., 2008. Shared space: reconciling people, places and traffic. *Built Environment*, 34 (2), pp. 161-181.

Hamilton-Baillie, B., 2006. *What is Shared Space?*. Bristol: Hamilton-Baillie Associates. Available at: http://www.hamilton-baillie.co.uk/_files/_publications/6-1.pdf [Accessed: 15 February 2010].

Hamilton-Baillie, B., Jones, P., 2005. Improving traffic behaviour and safety through urban design. *Civil Engineering*, 158, pp. 39-47.

Harten, N., Olds, T., 2004. Patterns of active transport in 11-12 year old Australian children. *Australian and New Zealand Journal of Public Health*, 28 (2), pp. 167-72.

Hedley, A.A., Ogden, C.L., Johnson, C.L., Carroll, M.D., Curtin, L.R., Flegal, K.M., 2004. Prevalence of overweight and obesity among US children, adolescents and adults, 1999–2002. *Journal of the American Medical Association*, 291 (33), pp. 2847-50.

Heelan, K.A., Donnelly, J.E., Jacobsen, D.J., Mayo, M.S., Wasburn, R., Greene, L., 2005. Active commuting to and from school and BMI in elementary school children-preliminary data. *Child: Care, Health, and Development*, 31 (3), pp. 341-9.

Heine, H., Mautz, R., Rosenbaum, W., 2001. Mobilität im Alltag. Warum wir nicht vom Auto lassen. Frankfurt/M, New York: Campus Verlag.

Hillman, M., Adams, J., Whitelegg, J., 1990. *One false move: a study of children's independent mobility*. London: Policy Studies Institute.

Hjorthol, R., Fyhri, A., 2009. Do organized leisure activities for children encourage car-use?. *Transportation Research Part A*, 43 , p. 209.

Hjorthol, R., 2006. *Bilens betydning for barns og unges aktivitetsmønstre. (How the car affects the activity patterns of children and youth.). TØI report 834/2006*. Oslo: Institute of Transport Economics.

Hüttenmoser, M., 2004. *Scendi e vivi. L'importanza del percorso casa-scuola. Un'analisi basata sui disegni dei bambini* (*Get off and live. The importance of the school journey. An analysis based on children's drawings*). [in Italian]. Biaggio: Muri/AG.

Jensen, A.M., Ben-Arieh, A., Conti, C., Phádraig, M.N.G., Nielsen, H.W., 2004. *Children's Welfare in Aging Europe*. Trondheim: Norwegian Centre for Child Research.

Jensen S.U., 2008. How to obtain a healthy journey to school. *Transportation Research Part A*, 42, pp. 475–486

Joshi, M.S., Maclean, M., Carter, W., 1999. Children's journey to school: Spatial skills, knowledge and perceptions of the environment. *British Journal of Developmental Psychology*, 17, 125–139.

Joshi, M.S., Maclean, M., 1995. Parental attitudes to children's journeys to school. *World Transport Policy and Practice*, 1, pp. 29–36.

Kelly, S., 2010. *Request of information on the Brighton-Hove experience on ACS*. [Email] (Personal communication, 1 March 2010).

Kerr, J., Frank, L., Sallis, J., Chapman, J., 2007. Urban form correlates of pedestrian travel in youth: differences by gender, race-ethnicity and household attributes. *Transportation Research, Part D*, 12 (3), pp. 177–182.

Kerr, J., Rosenberg, D., Sallis, J.F., Saelens, B., Frank, L., Conway, T., 2006. Active commuting to school: associations with environment and parental concerns. *Medicine and Science in Sports and Exercise*, 38, pp. 787–794.

Keuning Instituut, 2008. *Final Evaluation and Results*. Groningen/Leeuwarden: Keuning Instituut. Available at: http://www.sharedspace.eu/en/publications/downloads/doc_download/21-shared-space-final-evaluation--summary [Accessed: 20 February 2010].

Keuning Instituut, 2005. *Shared Space: room for everyone A new vision for public spaces*. Groningen/Leeuwarden: Keuning Instituut. Available at: http://www.fryslan.nl/files/18445/SharedSpace_Eng.pdf [Accessed: 20 February 2010].

Kimm, S.Y., Obarzanek, E., 2002. Childhood obesity: a new pandemic of the new millennium. *Pediatrics*, 110 (5), pp. 1003–7.

Küller, R., 1991. Environmental assessment from a neuropsychological perspective. In T. Garling and G. Ewans (Eds), *Environment, cognition and action: An integrated approach, pp. 111-147*. Oxford: Oxford University Press.

Kyttä, M., 2003. *Children in outdoor contexts. Affordances and independent mobility in the assessment of environmental child friendliness*. Helsinki: University of Technology, Centre for Urban and Regional Studies. Available at: http://lib.tkk.fi/Diss/2003/isbn9512268736/isbn9512268736.pdf [Accessed: 6 March 2010].

Lanzendorf, M., 2001. *Freizeitmobilität. Unterwegs in Sachen sozial-ökologischer Mobilitätsforschung*. Materialien zur Freizeit- und Fremdenverkehrsgeographie 59. [in German]. Trier: Trierer Geographische Gesellschaft.

Larsen, K., Gillilanö, J., Hess, P., Tucker, P., Irwin, J., He, M., 2009. The Influence of the Physical Environment and Sociodemographic Characteristics on Children's Mode of Travel to and From School. *American Journal of Public Health*, 99 (3).

Lay, M.G., 1992. *Ways of the World*. New Jersey: Rutgers University.

Lennard, H.L., Crowhurst Lennard, S.H., 2008. *Cities for the Well-Being of Children*. Carmel, CA: Gondolier Press Book.

Loiseau, F., 1990. *Van Baerle: Better and safer streets through traffic calming*. Paris: Edition Amarcande.

Mackett, R.L., Lucas, L., Paskins, J., Turbin, J., 2005. The therapeutic value of children's everyday travel. *Transportation Research, Part A, Policy and Practice*, 39 (2–3), pp. 205–219.

Mackett, R., 2002. Increasing car dependency of children: should we be worried. *Proceedings of the Institution of Civil Engineers–Municipal Engineer*, 151 (1), pp. 29–38.

Mackett, R.L., 2001. *Are we making our children car dependent?* Paper written for a lecture given at Trinity College, Ireland.

Marchetti, L., Pullen, N., 2004. Growth of Walk to School in the USA: identifying trends and transitions. *In: 5th Walk21 International Conference: Cities for People*. Copenhagen, Denmark, 9-11 June 2004. Available at: http://www.walk21.com/papers/Copenhagen%2004%20Marchetti%20Growth%20of%20Walk%20to%20School%20in%20the%20USA.pdf [Accessed: 23 January 2010].

Marchetti, L., Smith, R., 2002. Children leading the way to safer, healthier communities. *In: 3rd Walk21 International Conference: Steps towards liveable cities*. Donostia-San Sebastian, Spain, 9-10 May 2002. Available at: http://www.walk21.com/papers/San%20Sebastian%2002%20Marchetti%20Children%20leading%20the%20way%20to%20safer.pdf [Accessed: 23 January 2010].

Marten, N., Olds, T., 2004. Patterns of active transport in 11-12 year old Australian children. *Australian and New Zealand Journal of Public Health*, 28 (2), pp. 167-72.

Martin, S., Lee, S., Lowry, R., 2007. National prevalence and correlates of walking and bicycling to school. *American Journal of Preventive Medicine*, 33, pp. 98–105.

Martin, S., Carlson, S., 2002. Barriers to children walking to or from school–United States. *Morbidity & Mortality Weekly Report*, 54, pp. 949–952.

Mattson, K.T., 2002. Children's (in)dependent mobility and parents' chauffeuring in the town and the countryside. *Tijdschrift voor Economische en Sociale Geografie*, 93 (4), pp. 443–453.

McDonald, N., 2008. Household interactions and children's school travel: the effect of parental work patterns on walking and biking to school. *Journal of Transport Geography*, 16, pp. 324–331.

McDonald, N.C., 2007. Active transportation to school: trends among U.S. schoolchildren, 1969–2001. *American Journal of Preventive Medicine*, 32, pp. 509–516.

McKenzie-Mohr, D. Smith, W., 1999. *Fostering Sustainable Behavior: An Introduction to Community-Based Social Marketing*. Canada: New Society Publishers.

McMillan T., 2007. The relative influence of urban form on a child's travel mode to school. *Transportation Research, Part A*, 41, pp. 69–79.

Merom, D., Tudor-Locke, C., Bauman, A., Rissel, C., 2006. Active commuting to school among NSW primary school children: implications for public health. *Health & Place*, 12 (4), pp. 678–687.

Metcalf, B., Voss, L., Jeffery, A., Perkins, J., Wilkin, T., 2004. Physical activity cost of the school run: impact on schoolchildren of being driven to school (EarlyBird 22). *British Medical Journal*, 329 (7470), pp. 832-3.

Methorst, R., Gerlach, J., Boenke, D., Leven, J., 2007. Shared Space: Safe or Dangerous? A contribution to objectification of a popular design philosophy. *In: 8th Walk21 International Conference: Putting pedestrians first*. Toronto, Canada, 1-4 October 2007. Available at: http://www.walk21.com/papers/Methorst%20Shared%20Space.pdf [Accessed: 13 February 2010].

Miller, J., Rosenbloom, A., Silverstein, J., 2004. Childhood obesity. *Journal of Clinical Endocrinology & Metabolism*, 89 (9), pp. 4211–8.

Ministère de l'Equipement et des Transports, 2003. *Experiences pilotes en Region wallonne*. MET.

Mota, J., Gomes, H., Almeida, M., Ribeiro, J., Carvalho, J., Santos, M., 2007. Active versus passive transportation to school-differences in screen time, socio-economic position and perceived environmental characteristics in adolescent girls. *Annals of Human Biology*, 34, pp. 273–282.

Næss, P., 2006. *Urban Structure Matters. Residential location, car dependence and travel behaviour*. London: Routledge.

National Center for Safe Routes to School, 2008. *A report on the first three years of the National Safe Routes to School Program*. Chapell Hill, NC: NCSRTS. Available at: http://www.saferoutesinfo.org/resources/collateral/status_report/SRTS_3-year_report.pdf [Accessed: 31 January 2010].

National Highway Traffic Safety Administration, 2004. *Safe Routes to School. Practice and Promise*. Washington D.C.: NHTSA. Available at: http://www.nhtsa.dot.gov/people/injury/pedbimot/bike/safe-routes-2004 [Accessed: 31 January 2010].

Nelson, N., Foley, E., O'Gorman, D., Moyna, N., Woods, C., 2008. Active commuting to school: how far is too far?. *International Journal of Behavioral Nutrition and Physical Activity*, 5 (1), p. 9.

Nowotny, H., 1994. *Time: The Modern and Postmodern Experience*. Cambridge, UK: Polity Press.

Oxley, J., Congiu, M., Whelan, M., D'elia, A., Charlton, J., 2007. *The impacts of functional performance, behaviour and traffic exposure on road-crossing judgement of young children*. Clayton: Accident Research Centre Monash University.

Pabayo, R., Gauvin, L., 2008. Proportions of students who use various modes of transportation to and from school in a representative population-based sample of children and adolescents, 1999. *Preventive Medicine*, 46, pp. 63–66.

Peddie, B., Somerville, C., June 2006. School Travel Planning: travel behaviour change and community engagement—results from Victoria. *Road & Transport Research*, 15 (2), p. 90.

Pont, K., Ziviani, J., Wadley, D., Bennet, S., Abbott, R., 2009. Environmental correlates of children's active transportation: A systematic literature review. *Health & Place*, 15, pp. 849–862.

Powers, C.M., Lake, J.K., Cole, T.J., 1997. Measurement and long term health risks of childhood and adolescent fatness. *International Journal of Obesity*, 21, pp. 507–526.

Preiss, D., 1989. *Frauen – Kinder – Auto – Träume, in: Paul, Beeckmans (Ed.), Welche Freiheit brauchen wie? Zur Psychologie der AutoMobilen Gesellschaft*. Berlin: VAS in der Elefanten Press.

Prezza, M., Romana Alparone, F., Cristallo, C., Luigi, S., 2006. Parental perception of social risk and of positive potentiality of outdoor autonomy for children: The development of two instruments. *Journal of Environmental Psychology*, 25.

Prezza, M., Pilloni, S., Morabito, C., Sersante, C., Alparone, F.R., Giuliani, M.V., 2001. The influence of psychosocial and environmental factors on children's independent mobility and relationship to peer frequentation. *Journal of Community and Applied Social Psychology*, 11 (6), pp. 435–450.

Pullen-Seufert, N., Marchetti, L., Brown, A., Barth, P., Seth, L., 2009. Walking and Bicycling to School in the USA: The Status and Future of Safe Routes to School in the USA. *In: 10th Walk21 International Conference: More footprints less carbon Walk21NYC*. New York City, the United Stated, 7-9 October 2009. Available at: http://www.walk21.com/papers/Nancy_PullenSiefert_et_al.pdf [Accessed: 23 January 2010].

Roberts, I., R. Norton, R., Taua, B., 1996. Child pedestrian injury rates: the importance of "exposure to risk" relating to socioeconomic and ethnic differences, in Auckland, New Zealand. *Journal of Epidemiology and Community Health*, 50, pp. 162–165.

Rosenberg, D.E., Sallis, J.F., Conway, T.L., Cain, K.L., Mckenzie, T.L., 2006. Active transportation to school over 2 years in relation to weight status and physical activity. *Obesity (Silver Spring)*, 14 (10), pp. 1771-6.

Rossi, G., Moretti, R., Pirone, M., Locatelli, W., 2004. Promoting physical activity: going to school by the Pedibus (walking school bus). *Epidemiol Prevention*. 28, pp. 346–349.

Rothengatter, T., Huguenin, D., 2004. *Traffic and Transport Psychology. Theory and Application*. Oxford: Elsevier Ltd.

Sallis, J., Owen, N., 1999. *Physical Activity and Behavioral Medicine*. Thousand Oaks: Sage Publications

Salmon, J., Salmon, L., Crawford, D., Hume, C., Timperio, A., 2007. Associations among individual, social, and environmental barriers and children's walking or cycling to school. *American Journal of Health Promotion*, 22, pp. 107–113.

Salmon, J., Timperio, A., Cleland, V., Venn, A., 2005. Trends in children's physical activity and weight status in high and low socio-economic status areas of Melbourne, Victoria, 1985–2001. *Australian and New Zealand Journal of Public Health*, 29 (4), pp. 337–342.

Schlossberg M, Greene J, Phillips PP, Johnson, B., Parker B., 2006. School trips: effects of urban form and distance on travel mode. *Journal of the American Planning*, 72, pp. 337-346.

Schofield, G., Schofield, L., Mummery, K., 2005. Active transportation: an important part of adolescent physical activity. *Youth Studies Australia*, 24 (1), pp 43-7.

Scott, J., 2000. Is it a different world to when you were growing up? Generational effects on social representations and child-rearing values. *British Journal of Sociology*, 51 (2), pp. 355-376.

Shi, Z., Lien, N., Kumar, B., Holmboe-Ottesen, G., 2006. Physical activity and associated socio-demographic factors among school adolescents in Jiangsu Province, China. *Preventive Medicine: An International Journal Devoted to Practice and Theory*, 43, pp. 218–221.

Sirard, J., Riner Jr., W., McIver, K., Pate, R., 2005. Physical activity and active commuting to elementary school. *Medicine and Science in Sports and Exercise*, 37, pp. 2062–2069.

Sitran, A., Bosetti, S., 2009. *Gli utenti deboli e la sicurezza stradale: analisi della sinistrosità e fattori di rischio* (*Vulnerable road users: analysis of accident-related risk factors*) [In Italian]. Milan: Quaderno Ricerche e Trasporti.

Sjolie, A.N., Thuen, F., 2002. School journeys and leisure activities in rural and urban adolescents in Norway. *Health Promotion International*, 17 (1), 21–30.

Spallek, M., Turner, C., Spinks, A., Bain, C., Mcclure, R., 2006. Walking to school: distribution by age, sex and socio-economic status. *Health Promotion Journal of Australia*, 17, pp. 134–138.

Speiser, P.W., Rudolf, M.C., Anhalt, H., et al., 2005. Childhood obesity. *Journal of Clinical Endocrinology & Metabolism*, 90 (3), pp. 1871–87.

Staunton, C.E., Hubsmith, D., Kallins, W., 2003. Promoting safe walking and biking to school: the Marin County success story. *American Journal of Public Health*, 93 (9), pp. 1431-1434.

Stradling, S.G., Meadows, M.L., Beatty, S., 1999. *Factors affecting car use choices*. Edinburgh: Transport Research Institute, Napier University.

Sustrans, 2000. *The health benefits of Safe Routes to Schools. Information sheet FS15*. Bristol: SUSTRANS. [Online]. Available at: http://www.sustrans.org.uk/assets/files/Safe%20Routes/resources/infosheets/SRS_Health_Benefits_FS15.pdf [Accessed: 7 March 2010].

Thomson, L., 2009. *How times have changed". Active transport literature review, Participation and equity for health*, VicHealth. [Online]. Available at: http://www.vichealth.vic.gov.au/~/media/ProgramsandProjects/PhysicalActivity/Attachments/Active%20Transport%20Literature%20Review%20Final%20March%202009_2.ashx [Accessed: 28 January 2010].

Tillberg, K., 2001, *Barnfamiljers dagliga fritidsresor I bilsamhället – ett tidspussel med geografiska och könsmessiga variationer (Daily leisure trips of families with children in a car-based society – a time puzzle involving geographical and gender differences)*. Uppsala: Uppsala University.

Timperio, A., Ball, K., Salmon, J., Roberts, R., Giles-Corti, B., Simmons, D., Baur, L., Crawford, D., 2006. Personal, family, social, and environmental correlates of active commuting to school. *American Journal of Preventive Medicine*, 30, pp. 45–51.

Timperio, A., Crawford, D., Telford, A., & Salmon., J., 2004. Perceptions about the local neighbourhood and walking and cycling among children. *Preventive Medicine*, 38 (1), pp. 39-47.

Torsheim, T., Samdal, O., Wold, B., Hetland, J., 2004. *Helse og trivsel blant barn og unge: norske resultater fra studien "Helsevaner blant skoleelever: en WHO studie i flere land*. Bergen: University of University of Bergen.

TRT Trasporti e Territorio, Arch. Francesco Magro, 2008. *Studio della viabilità per il centro di Castelfranco Veneto* (*Study of the mobility plan for the downtown of Castelfranco Veneto*). [In Italian]. Milan: TRT.

Transportation Alternatives, 2002. *The 2002 Summary of Safe Routes to School Programs in the United States*. New York: TA. [Online]. Available at: http://www.transact.org/report.asp?id=49 [Accessed: 6 March 2010].

Tranter, P., Pawson, E., 2001. Children's access to local environments: a case study of Christchurch, New Zealand. *Local Environment*, 6 (1), pp. 27-48.

Triandis, H. C., 1977. *Interpersonal Behavior*. Monterey: Books/Cole.

Triandis, H. C., 1980. *Values, attitudes and interpersonal behavior. M. M. Page, (Ed.), Nebraska symposium on motivation*. Lincoln: University of Nebraska Press.

Troiano, R.P., Flegal, K.M., 2004. Overweight children and adolescents: description, epidemiology and demographics. *Pediatrics* 1998, 101 (497), pp. 504.

Tudor-Locke, C., Ainsworth, B., Adair, L., Popkin, B., 2003. Objective physical activity of Filipino youth stratified for commuting mode to school. *Medicine and Science in Sports and Exercise*, 35, pp. 465–471.

Tudor-Locke, C., Neff, L. J., Ainsworth, B. E., Addy, C. L. & Popkin, B. M., 2002. Omission of active commuting to school and the prevalence of children's health-related physical activity levels: the Russian Longitudinal Monitoring Study. *Child: Care, Health and Development*, 29, pp. 507–513.

Valentine, G., 1997. "Oh yes I can." "Oh no you can't": Children and parents' understanding of kids' competence to negotiate public space safely. *Antipode*, 29 (1), pp. 65-89.

Valentine, G., Mckendrick, J., 1997. Children's outdoor play: exploring parental concerns about children's safety and the changing nature of childhood. *Geoforum*, 28 (2), pp. 219–235.

Vietch, J., Bagley, S., Ball, K., & Salmon, J., 2006. Where do children usually play? A qualitative study of parents' perceptions of influences on children's active free-play, *Health & Place*, 12.

Vittoria, S., 2010. *Active transportation to school in Monza*. [Interview] (8 February 2010).

Von Hagen, L.A., 2010. Request of information on the SRTS Program in New Jersey. [Email] (Personal communication, 25 January 2010).

Von Hagen, L.A., 2009. Safe Routes to New Jersey's Disadvantaged Urban Schools. *In: 10th Walk International Conference: More footprints less carbon.* New York, United States, 7-9 October 2009. [Online]. Available at: http://www.walk21.com/papers/Leigh_Ann_Von_Hagen_and_Alan_Voorhees.pdf [Accessed: 23 January 2010].

Wardman, M., Hine, J., Stradling, S.G., 2001. *Interchange and travel choice* (Vol. 1, 2). Edinburgh: Scotland Executive Central Research Unit.

Wedderkopp, N., Froberg, K., Hansen, H.S., Andersen, L.B., 2004. Secular trends in physical fitness and obesity in Danish 9-year-old girls and boys: Odense school child study and Danish substudy of the European Youth Heart Study. *Scandinavian Journal of Medicine and Science in Sports*, 14 (3), pp. 150-5.

Whitzman, C., 2007. *From battery-reared to free range children: Institutional barriers and enablers to children's independent mobility in Victoria, Australia*. Report for Australasian Centre for Governance and Management of Urban Transportation.

Wilkinson, R, Pickett, K, 2009. *The spirit level: why more equal societies almost always do better*. London: Allen Lane.

World Health Organisation, 2006. Some children have safer childhoods than others: what makes the difference? (WHO Fact sheet EURO/01/06). [Online]. Copenhagen, Oslo, Rome: WHO. Available at: http://www.euro.who.int/document/mediacentre/fs0106e.pdf [Accessed: 24 September 2008].

World Health Organisation, 2005. *Effects of Air Pollution on Children's Health and Development. A Review of the Evidence*. [Online]. Copenhagen: WHO. Available at: http://www.euro.who.int/document/E86575.pdf [Accessed: 9 February 2010].

World Health Organisation, 2004. *Road traffic injuries in the WHO European Region: the population groups and countries most affected* (WHO Fact Sheet EURO/03/04). [Online]. Copenhagen, Rome: WHO. Available at: http://www.euro.who.int/document/mediacentre/FS0304E.pdf [Accessed: 24 September 2008].

World Health Organization, 2000. *Obesity: Preventing and Managing the Global Epidemic. Report of a WHO Consultation* (WHO Technical Report Series no. 894). [Online]. Geneva: WHO. Available at: http://www.atividadefisica.pro.br/artigos/WHO%20obesity.pdf [Accessed: 6 March 2010].

World Health Organisation, 1999. *Charter on Transport, Environment and Health*. [Online]. Copenhagen: WHO. Available at: http://www.who.it/document/peh-ehp/charter_transporte.pdf [Last accessed: 4 January 2010].

Wyness, M., 2006. *Childhood and Society: An introduction to the sociology of childhood*. London: Palgrave Macmillan.

Yarlagadda, A., Srinivasan, S., 2008. Modeling children's school travel mode and parental escort decisions. *Transportation*, 35, pp. 201–218.

Yelavich, S., Towns, C., Burt, R., Chow, K., Donohue, R., Sani, H., Taylor, K., Gray, A., Eberhart-Phillips, J., Reeder, A.I., 2008. Walking to school: frequency and predictors among primary school children in Dunedin, New Zealand. *New Zealand Medical Journal*, 121, pp. 51–58.

Zeiher, H., 2001. *Children's Island in space and time: the impact of spatial differentiations on children's ways of shaping social life*. In: Bois-Reymond, M.S. et al. (red) *Childhood in Europe, Approaches-Trends-Findings*. New York: Peter Lang pp. 139–159.

Ziviani, J., Kopeshke, R., Wadley, D., 2006. Children walking to school: parent perceptions of environmental and psychosocial influences. *Australian Occupational Therapy Journal*, 53, pp. 27–34. [Accessed: 21 January 2010].

Ziviani, J., Scott, J., Wadley, D., 2004. Walking to school: incidental physical activity in the daily occupations of Australian children. *Occupational Therapy International*, 11 (1), pp.1-11.

Zwerts, E., Janssens, D., Wets, G., 2007. *How the presence of children affects parents' travel behaviour*. Hasselt: Hasselt University.

ANNEXES

ANNEX A: Supporting tables on ATS

Table A.1: UK STP essential and deliverable supporting evidence (*abstract*)

Key indicators	Supporting evidence	
	Essential	**Desirable**
Description of location, size and type of school	• Type. • Age range & number of pupils. • Written description of the locality of the school.	• Location map and site plan. • Facilities and transport links. • Details of school catchment area. • Opening times. • Current involvement of school in school travel activities and education.
Description of travel/transport problems/issues faced by a school/cluster of schools	• Written description of particular travel issues/problems at the school.	• Transport needs of all pupils. • Journeys made during the school day. • Pre- and after-school clubs/activities if in place at the school. • Travel needs of other users (staff, community) if relevant. • Current involvement of the school in school travel activities and education.
Survey results on how children: **- currently travel to/from school** **- would prefer to travel to/from school**	• Date survey undertaken. • Survey of how pupils *usually travel to school* and *prefer to travel to school*. • Survey data should be recent. • As school travel patterns may be influenced by age, socio-economic group.	• Survey of how pupils *usually travel to and from school*. • Detailed questionnaire for greater identification of issues, barriers, solutions for modal shift. • Parents surveyed and asked for their contribution/ideas. • Staff survey. • Use of historical data to show progress to date.
Details of proposed measures	• A clearly defined yearly action plan stating what will be done to meet the STPs' objectives and targets.	• Link actions to specific objectives and/or targets.

(Continued on next page)

Source: Green Communities, 2007

Table A.1: UK STP essential and deliverable supporting evidence (*abstract*)

*(**Continued from previous page**)*

Key indicators	Supporting evidence	
	Essential	**Desirable**
Clearly defined objectives and targets	• Clear objectives and targets. • Measurable. • Achievable. • Realistic and timed (by a set date).	• Encouraging for long-term objectives.
Detailed timetable for implementation	• Clearly state when the action/activity will be completed and/or undertaken. • Stating specific date.	• Identification of the risks which would prevent implementation.
Clearly defined responsibilities	• Specific role assigned to each action/task listed.	• Named individuals within a school. • Identification of a lead person within the school to take up any actions with external bodies.
Evidence that all parties have been consulted	• Consultation, exchange of opinions and ideas with all those directly affected by the action plan in the STP. • Who was consulted & how.	• Findings of detailed questionnaires with parents, pupils and staff. • School Council involvement and tasked with actions. • Letters sent home to parents.
Monitoring and reviewing proposals	• Indication of when the next survey(s) will be done. • Setting a date for review. • Stating who is responsible for ensuring both survey and review will be completed. • Including commitment for review that will consider pupil travel needs arising from new developments in education, and transport provision and that the STP will be revised as necessary to take account of these.	• Including *success criteria* or *monitoring indicators*. • Making links to the school development /improvement plan.

Source: Green Communities, 2007

Table A.2: TSG: summary of Year 1 results by country

Country	Nr. of pupils involved	Nr. of school engaged	Results
Austria	1,999	15	The schools experienced a shift from 78% eco-trips *before* the game to 92% *during*. "Car alone" journeys were reduced from 425 to 166 in the Austrian schools. The *after* evaluation suggests this has been sustained with 89% of the trips now sustainable.
Belgium	1,078	8	The results show a shift from 64% sustainable trips *before* the game to 85% *during* the game. The breakdown of transport modes show a good rise in walking and an additional 155 cycle trips made while the game was played. The *after* monitoring shows a good overall increase to 76%.
Bulgaria	2,024	9	The *before* results showed 78% of pupils arriving to school by a sustainable transport mode. *During* the game the schools saw a good increase to 93%, with this sustained at 86% once the game had finished. The results also include a high number of pupils choosing to skateboard to school.
Greece	424	5	The *before* data show 77% of journeys made by sustainable transport mode. Greece saw a good increase *during* the game to 86% with this level maintained at 84% once the game had been completed. The results show a good increase across all the sustainable modes of travel.
Hungary	2,086	6	From a previously high level of sustainable trips (96%), the Hungarian results show an increase to 97% with this maintained after the game. The results show an extra 128 pupils walking to school while the game was being played, showing a significant modal shift from public transport journeys.
Italy	1,748	10	The *before* data show 45% of journeys made to school made by sustainable modes of transport. During the game, the Italian schools significantly reduced the number of "car alone" journeys by 533, increasing the eco-trip percentage to 77%. The *after* evaluation shows that this has been sustained with 65% of trips to school being made by sustainable modes of travel.

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Source: Schoolway web site (www.schoolway.net)

Table A.2: TSG: summary of Year 1 results by country

(Continued from previous page)

Country	Nr. of pupils involved	Nr. of school engaged	Results
Slovenia	899	6	From a *before* percentage of 53%, the Slovenian schools saw an increase of 87% *during* the game, with this sustained at 75% once the post-game evaluation forms had been collected. The results show a good increase in walking and cycling.
The Netherlands	2,100	6	The *before* data show 73% of trips to schools being made by sustainable modes of travel with an increase of 13% *during* the game to 86%. The *after* results show this has been maintained after the game at 81%.
United Kingdom	3,533	12	The *before* data show 86% of school journeys being made by sustainable modes of transport. During the game this rose to 91% with 103 extra bike journeys. The results received as part of the *after* evaluation show that this has been sustained at 91%.

Source: Schoolway web site (www.schoolway.net)

Table A.3: Additional themes identified during the implementation of the *Shared Space* Project

Themes	Critical issues
Speed	• A critical qualitative change in the use and quality of public space at speeds around 30 km/h. • A link appears between this qualitative change and physical characteristics of the human body. • A further link appears between this qualitative change and people's ability to communicate through gestures and eye-contact at speeds below the maximum human running speed. • In streets designed with speeds of around 50 km/h, there would appear to be significant spatial and behavioural benefits from working to speeds closer to those within the evolutionary range of human abilities.
Influencing speeds	• Driving speeds are influenced by the interpretation of the street context by drivers. • Legislation and formal speed limits are a secondary constraint, and less effective than design and configuration of the built environment. • Some research (Engwicht, 2007) suggests that traffic speed is determined predominately by "*the degree of psychological retreat from the streetscape*".
Risk and the promotion of safety	• Risk is increasingly seen as relevant to the quality of public. • A paradox emerges since the safest places are those that appear the most dangerous. • Risk is also central to understanding the changes that take place in behaviour when spaces are shared, and some degree of uncertainty and unpredictability is introduced.
Integration of professional skills and expertise	• Realignment, combination and integration of the input provided by a range of professional expertise, by overcoming traditional roles and established boundaries of key professions. • Need for new organisational patterns within professions and local authorities.
Coping with change	• Streets are very permanent features of our built environment. Any changes require changes in mental maps and landmarks. • Street works are particularly disruptive and intrusive, generating noise, congestion and confusion. • Changes are difficult for people, especially for elderly and impaired people.

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Source: Table elaborated based on data taken from Keuning Instituut (2008)

Table A.3: Additional themes identified during the implementation of the *Shared Space* Project

(Continued from previous page)

Themes	Critical issues
Lower speeds and improved transport efficiency	• Apparent reduction in delays and congestion, and improvements in journey times are associated with lower speeds. • Reduction in dependency on signals and formal traffic controls is likely to improve capacity and movement for all modes, due to greater efficiencies at intersections. • Slower speeds, greater interaction and negotiations between drivers and other road users appear to minimise the interruptions and delays in movement and flows associated with conventional traffic flows.
Social interaction and liveability	• Need to develop new ways to re-enhance vital street functions (movement, space for human exchange, interaction, trade and social contact) and to increase the potential for human interaction and civility. • Facilities for encouraging informal, day-to-day social exchanges appear to be also critical for promoting safety and for social cohesion. • Issues of liveability and social interaction appear to be critical to encouraging economic investment and urban regeneration, as well.

Source: Table elaborated based on data taken from Keuning Instituut (2008)

ANNEX B: Survey Questionnaire on School Trips in Castelfranco Veneto

General information

1. Which classroom do you attend? __1 __2 __3 __4 __5

2. How old are you? _____

3. Male or female? __M __F

4. Which and how many transport means do you have in your family?

_____car _____bicycle _____moped

5. Where do you live?

___Castelfranco Veneto ___Other municipality (which one?)…….

"Going to school"

Timing

6. How far is your school from home?

___up to 500 m. ___between 500 m. and 2 km ___between 2 and 5 km ___more than 5 km

7. When the weather is fine, how long does it take to you to go to school?

___0' ___10' ___10'-30' ___30'-1h ___more than 1h

8. When the weather is bad, how long does it take to you to go to school?

___0' ___10' ___10'-30' ___30'-1h ___more than 1h

Modal choice

9. How do you usually go to school?

When the weather is nice

Only 1 response is possible	**Why (max 2 responses)**
___by walking (alone)	___is my choice
___by walking (with my friends)	___is more convenient to me
___by walking (taken to school by someone)	___from habit
___by cycling (alone)	___is less dangerous
___by cycling (with my friends)	___is my parents' choice
___by cycling (taken to school by someone)	___it takes less time to me to go to school
___by bus	___is cheaper
___by train	___no better alternatives are available
___by car (no more than two occupants)	___other (please specify)……..
___by car (more than two occupants)	
___other (please specify)……..	

When the weather is bad

Only 1 response is possible	**Why (max 2 responses)**
___by walking (alone)	___is my choice
___by walking (with my friends)	___is more convenient to me
___by walking (taking to school by someone)	___from habit
___by cycling (alone)	___is less dangerous
___by cycling (with my friends)	___is my parents' choice
___by cycling (taken to school by someone)	___it takes less time to me to go to school
___by bus	___is cheaper
___by train	___no better alternatives are available
___by car (no more than two occupants)	___other (please specify)……..
___by car (more than two occupants)	
___other (please specify)……..	

10. How do you usually come back home from school?

When the weather is nice

Only 1 response is possible	**Why (max 2 responses)**
___by walking (alone)	___is my choice
___by walking (with my friends)	___is more convenient to me
___by walking (taken back home by someone)	___from habit
___by cycling (alone)	___is less dangerous
___by cycling (with my friends)	___is my parents' choice
___by cycling (taken back home by someone)	___it takes less time to me to go back home
___by bus	___is cheaper
___by train	___no better alternatives are available
___by car (no more than two occupants)	___other (please specify)……..
___by car (more than two occupants)	
___other (please specify)……..	

When the weather is bad

Only 1 response is possible	**Why (max 2 responses)**
___by walking (alone)	___is my choice
___by walking (with my friends)	___is more convenient to me
___by walking (taken back home by someone)	___from habit
___by cycling (alone)	___is less dangerous
___by cycling (with my friends)	___is my parents' choice
___by cycling (taken back home by someone)	___it takes less time to me to go back home
___by bus	___is cheaper
___by train	___no better alternatives are available
___by car (no more than two occupants)	___other (please specify)……..
___by car (more than two occupants)	
___other (please specify)……..	

11. With whom do you usually go to school?

___with my mum

___with my dad

___with my grandparents

___alone

___with brother(s)/sister(s)

___with my friends

___other (please specify)

12. With whom do you usually come back home from school?

___with my mum

___with my dad

___with my grandparents

___alone

___with brother(s)/sister(s)

___with my friends

___other (please specify)

13. How often do you go to school taken by an adult? (mum/dad/grandparents/brother(s)/sister(s) of full age)?

___always

___often

___sometimes

___never

14. If you go to (come back from) school taken by an adult, why?.....(*more responses are possible*)

___My parents prefer I am taken by an adult

___I do not like travelling alone, I prefer being taken

___I am still a child

___We have few time at our disposal

___Traffic is dangerous

___We live far from school

___My brother(s)/sister(s) are taken to school/home together with me

___My parents travel along the same way to go to work

___There are no alternatives

___Other……

15. Along the way to/from school, how do you feel?

___I have fun

___I get tired

___I get bored

___I get nervous

___other……

16. What do you like/dislike of your school trip?

……..

……..

<u>Going to school by walking, cycling….</u>

17. What do (would) you like of going to school by walking or cycling?

___I have no problems with the traffic congestion and I can be at school on time

___I can stay my friends

___is funny

___I feel more independent

___is good for the environment

___I can tell what I see by going to school

___I learn more

___I learn by staying with other friends of the same age

___other……..……

18. What do (would) you not like of going to school by walking or cycling?

___It is dangerous: safe paths, bicycle lanes, etc. are missing or not adequate

___My parents feel not confident

___I do not like noise and smog

___I have to wake up very early

___Other……..……

19. What would you looking for going to school by walking or cycling?

___Safe paths, bicycle lanes, parking slots for bicycles, more safety, etc.

___Fewer air and noise pollution

___More friends to travel with

___More amazing paths

___More traffic signals for pedestrians and cyclists

___Places where meeting and going to school together is possible

___Other……..……

Opinions and proposals

20. Among the following items, which one(s) bother(s) you too much?

___Traffic congestion and jam

___Risk of being involved in an accident and low safety on the road

___Air and noise pollution

___Boring travel paths

___Difficulties in reaching the school by walking or cycling (high driving speed, cars parked on pavements, etc.)

For mum and dad

21. in your opinion, the concept of "*Shared Space*" may be a likely solution in order to make your son/daughter going to school alone (together with his/her friends, either by walking or by bicycle?

___Yes ___No

Why?

……

……

Many thanks for your help!!!

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Voor akkoord,

Sitran, Alessio

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