Promoting Sustainable Mobility in Home to School Journeys in Small and Medium Sized Cities. Case study of Castelo Branco

Rui Alves, Sérgio Bispo and Maria Inês Calcinha

Abstract — To promote sustainable to school journeys it's a permanent challenge for the contemporary societies by three reasons: High importance in urban commuting; relevant impact in urban environment; and the higher number of citizens involved such as students, parents, relatives, friends and other persons.

The way that this thematic is being developed at the international context is very diverse in answers, involved ways, organization and management and in political agenda. In some of the countries is very developed, involving partners network between national and regional governments, local authorities, NGO, schools and scholar community. In Portugal, this thematic is practically missing being in an early stage.

This paper reports a case of study being developed in a small Portuguese city where the research is being done. By aggregated way are analyzed the mobility patterns of the students by school and by grade in 18 schools in a group age of 6 until 14 years old in the total of a scholar population of 3554 students. The mobility patterns of each school are very different. For younger students motorized travel mode choices are lower, especially private car, in the opposite of older students that have more sustainable travel mode choices, especially walking. Journeys by bicycle are not significant as well in public transportation. Furthermore, it will be present some developed activities in the scope of the project in the way to aware scholar community and the different stakeholders for the necessity of promote mobility patterns more sustainable in home to school journeys.

Keywords—sustainable mobility, home to school journeys, scholar mobility patterns, small and medium sized cities, children and adolescents, awareness.

I. INTRODUCTION

To promote more sustainable journeys to/from school is a permanent challenge within societies for two main reasons. Firstly, because it's an opportunity to change actual urban mobility patterns into more sustainable patterns, and secondly, because it's an opportunity to instill sustainable and healthier mobility patterns into young generations.

The international context is very rich, experiences such as those in Europe, America and Australia where projects and good practices to promote more sustainable journeys to/from school have been employed. On the other hand, this is not a concern for central government, for the municipalities and school communities in Portugal.

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Financial Support of Fundação Calouste Gulbenkian.

This paper presents a research project, in an ongoing stage, in a small sized Portuguese city, that is intended to promote sustainable journeys to/from school. This project is being developed by a research group of Polytechnic Institute of Castelo Branco, the municipality, the local transports operator TRANSDEV and with the financial support of Fundação Calouste Gulbenkian.

II. SUSTAINABLE MOBILITY IN HOME TO SCHOOL JOURNEYS

Promoting sustainable mobility patterns is a challenge in contemporary societies. Hard material such as infrastructures, technology and economic interventions are needed as well behavioral changes and changes in attitudes in order to achieve the objectives of sustainable mobility planning [1].

TABLE I
URBAN SUSTAINABLE MOBILITY: MAJOR GUIDELINES

Reduce travel needs
Reduce private car use
Increase of sustainable travel mode choices (walking and bicycling)
Increase public transportation use
Improve air and urban environment quality
Reduce the levels of pollutants emissions with greenhouse effects
Reduce noise emissions of transports
Reduce the consumption of fossil fuels
Reduce traffic congestion and time delay
Reduce traffic accidents and severities
Reduce economic and social costs of journeys
Increase mobility equity

Regarding the above, these changes are a part of building social and environmental ethics and responsibility. The intervention in to/from school journeys may represent an important step towards achieving these guidelines, for two important reasons. First, because these journeys have an important share in all urban commuting, especially during the peak hour, thus through targeting to/from school journeys, it is an opportunity to change the actual urban mobility patterns. Secondly, it's an opportunity to instill in the younger generation more sustainable and healthy travel mode choices ("sow now to reap later").

III. HOME TO SCHOOL JOURNEYS IN SUSTAINABLE MOBILITY POLICIES

The policies to promote sustainable urban mobility give a relevant importance in to/from school journeys to security and road accidents in which children are involved, decreasing congestion. Not only European Union and Member States but also in other countries and continents, there were projects, awareness and information campaigns, targeted at students and

families, encouraging sustainable travel mode choices were established. Some of these national strategies focus specifically on the role of school mobility choices, promoting positive changes in mobility patterns [2, 3].

The Green Paper: Towards a new culture for urban mobility and the Action Plan on Urban Mobility by European Union stand the relevance of scholar mobility [4].

A. International Context

Projects in development, or in operation, in the international context are different regarding each conception, organization, management, duration and success. These projects were founded in different bases such as central and regional governments, local authorities, NGO's, schools, or partnerships between them. Each successful initiative was influenced by civil society, schools and the school community and by the organizers of the project and by financial, public support.

The concerns of to/from school journeys were associated with road safety at the beginning of 90's, such as Active & Safe Routes to School Program in Canada, EUA, Australia and United Kingdom, all with government support [5,6,7,8]. Furthermore, these programs were consolidated through the connection of promotion strategies of travel sustainable modes choices (walking and bicycling) and the creation of partnerships between government bodies and NGO's.

In Europe, the concern with to/from school journeys appeared some years after, with the exception of the program of Safe Routes to School in Denmark in the 70's. Only in the XXI century, other countries such as Italy, France and Belgium, started to develop their own initiatives that were not always supported by specific programs and public funding. Many of these initiatives were developed in isolation by schools and local authorities with financial support from European Funds, but were not included in national strategies of intervention. Furthermore, the central and regional government started to support them. Mobility Plans to University and School are common in several countries.

B. Typology of Developed Activities

The actions that were or are being developed in different countries may be distinguished in two types. Sectorial and infrastructures interventions, (streets geometry, road signs, transportation system, etc.) have been made by local authorities and represent the first category of established projects. The second are sustainable and immaterial actions such as:
a) Methodological guidelines for the elaboration of scholar mobility plans;
b) Scholar mobility plans;
c) Guidelines to implement Pedibus and Ciclobus;
d) Good practice guidelines for home to/from school journeys;
e) Institutional and social networks in this thematic (blogs);
f) Permanent Forums;

g) Awareness and learning actions of road safety, walk and bicycle in urban environment;
h) Promotion of regular events about scholar mobility;
i) Regular awareness campaigns;
j) Methodological guidelines about the design of urban streets and road safety solutions;
k) Introduction of road safety and sustainable mobility in scholar programs for different education levels;
l) Legislatives and regulations changes connected to the thematic;
m) Development of bikesharing and carpooling systems.

IV. MOBILITY PATTERNS IN SMALL AND MEDIUM SIZED CITIES

The number of studies about mobility in small and medium sized cities is minor, however it is expected that the mobility patterns of these cities are more sustainable than the mobility patterns of big urban areas and metropolitan areas regarding its physical and functional dimension. The distance of the journeys are shorter, considering the proximity between residence, job, school, community infrastructures, commerce and services. The indicators of journeys/person/day and km journeys/person/day are lower than in big urban areas. On the other hand, there is often a facility to plan daily journeys. The lower number of motorized traffic strengthens community and neighborhood relations. This results in feelings of greater security and stimulates sustainable travel modes choices, especially walking and cycling [9].

V. THE CASE OF PORTUGAL

In Portugal home to school journeys have no relevance in the Political Agenda of the Central Government or in the Local Authorities. However, they recognize the importance of this subject but there is a lack of established initiatives.

In the strategic guidelines and political agenda, Portugal is behind compared with other countries, despite the fact that the international strategic guidelines are the same for all European State Members. This delay has impacted the way that the government and Public Administration look to promote sustainable mobility and initiatives are frustrated by numerous factors: (i) the passivity of the administration of the government; (ii) the competition of the different Public Administration Bodies, (iii) and from the difficulty to approach this transverse subject as it is the sustainable mobility.

For the Sustainable Development National Strategy – 2015 [10] and for the National Program of Climate Changes [11], the promotion of sustainable urban mobility appears as a principal issue in the discussion over environment issues.

The National Action Plan for Energetic Efficiency – Portugal Eficiência, 2015, [12] establishes the mandatory elaboration of Mobility Plans for Enterprises / Office Parks or Industrial Parks with more than 500 employers, in which should be included schools with more than 500 students.

Journeys to/from school are not relevant in the aims of The Strategic Plan of Transportation 2020 [13]. The "3rd Specific

Objective – Compatible urban mobility with higher quality of life", passing by operational objectives, and results indicators, etc., do not discuss scholar mobility as an issue.

In 2009 the Portuguese Parliament mandated to the government that they elaborate the "National Plan of promotion of the bike and other sustainable travel modes "and recommends the development of learning and awareness campaigns in schools. This is an opportunity to reinforce and give more importance to sustainable school mobility.

The financial support of these projects may be done by the QREN 2007-13 and that offers different possibilities of financial support from central government initiatives or local authorities.

A. Initiatives Examples

Portugal has a low number of projects focusing on scholar mobility. In the academic world, there have been some studies about travel to universities such in Coimbra [14], UTAD [15] and Leiria [16]. The research of Leiria was integrated by a European project - "T.aT - Studens Today, Citizens Tomorrow, with financial support of Intelligent Energy – Europe.

Some developed projects or in an ongoing stage in the context of mobility to universities have been established, such as in Minho University, Porto and Lisbon with a bikesharing program (Bicicleta de Utilização Estudantil "Bike for Students" – BUTE) [17], and actions developed in "TaT" [18] Project to the promotion of carpooling and bikesharing system.

For other school education levels, the initiatives pass by the organization of a PEDIBUS with pilot initiatives in Lisbon [19], TocaPé [20] project included in iwalk, initiatives developed by the Municipality of Aveiro included in Active Acess[21] and the Lifecycle[22]; the project "Walk to School" in Barreiro and Loures Municipality[23]; as well the EcoMobiReal project in the Municipality of Vila Real[24].

VI. CASE STUDY OF CASTELO BRANCO

Castelo Branco is a city with 30 000 inhabitants, with 45 schools of different education levels, including university, where there 12 000 students attending. In the total of the city, 16 000 of persons, more than half of the population, are daily involved in to/from school journeys.

A. Mobility Patterns of the City

Castelo Branco, in the interior of Portugal in the border with Spain, is one of the 18 administrative capitals, of the country (Fig.1). According with the Sustainable Mobility Plan of the city [25], the urban area presents a surface area of 12, 8 km², a population density of 2550 inhabit. /km² and 12, 4 dwellings/hectare.

The population of the city is significantly young; 30, 2 % of the resident population was under 25 years old according with the data of 2001 Census. More than 56% of the families had, at least, two cars. The use of motorized cars in the area has increased 44% between 1994 and 2004. In 2008 it was estimated that the motorized car area rate of the city exceed the 700 cars/1000 inhabit. 53% of the families had, at least, 1 bicycle at home, although there's limited bicycle culture in/to work and school journeys.

The city has a public transports system with 7 daily lines. Some of the private schools, especially in kindergarten, have their own private student's buses of small dimensions. The municipality daily ensures the transport for gypsy children, from the periphery of the city, to schools. Although there doesn't exist a transport service to schools of public education and the lines are not articulated with schools location and timetables. The urban buses carry less than 2000 passengers/day during the year.

In the city there are no measures for the restriction of private car and there's no promotion for the use of public transportation and the travel sustainable mode choices and the use of multiple different modes are not actively promoted, continuous and coherent way. The parking in public space is free; bike lines are on the periphery of the city and are not connected to attractiveness areas and traffic. These bike lines are mainly used for free time and leisure purposes. Walking infrastructure interventions are not common in the global strategies of promotion of sustainable travel mode choices without the development of a project in recent years.

Private cars are the main travel mode choice for urban travellers. According with the Plan of Sustainable Mobility, in 2008 urban travel during week days were made by private car (52%) and walking (42%). However, the use of bus was registered only with 5, 5%. The journeys to/from work and school were made by private car (73, 4%), walking (18, 9%) and bus (4, 7%).

For the journey habits, 25 % of the respondents don't use urban public transports due to the infrequency of bus lines and inadequate bus lines; 14% don't use the bicycle due to the lack of bike lines, 9% because of the lack of parking areas and 9% lack of security. 70% of the respondents admit that may change car travel mode choice for walking (59%), 25% for public transports and 13% for bicycle.

B. The Project Home to School Journeys

The idea to develop this project started with the Sustainable Mobility Plan for the city promoted by National Environmental Agencie. This plan highlights the necessity of to/from school journeys be analyzed by responsible institutions considering its different impacts in the urban environment (pollutants emissions, noise, accident, congestion, delays, etc.). The project aims to promote sustainable mobility in to/from school journeys having as partners the municipality, the local transports operator (TRANSDEV) and financially supported by Fundação Calouste Gulbenkian [26,27].

C. Ongoing and planned Activities

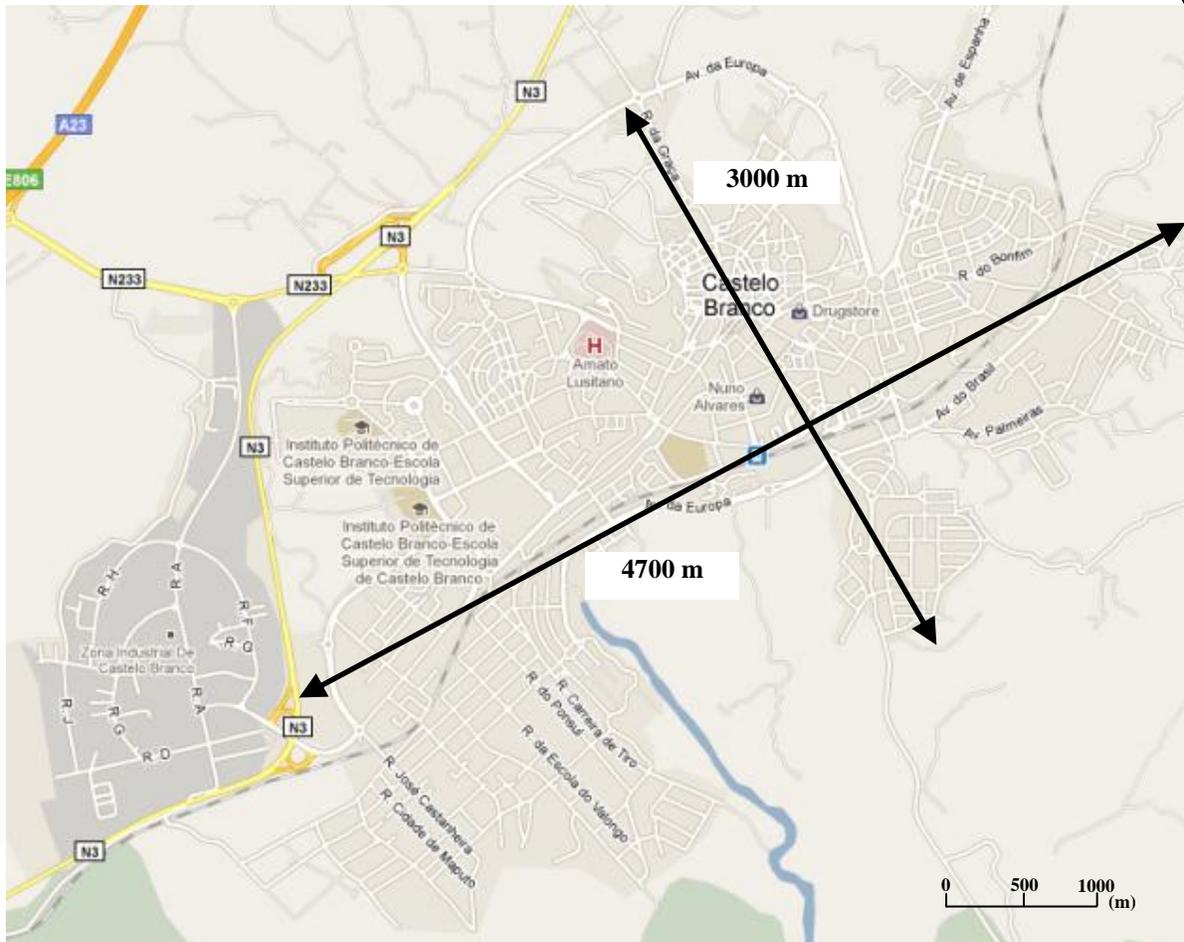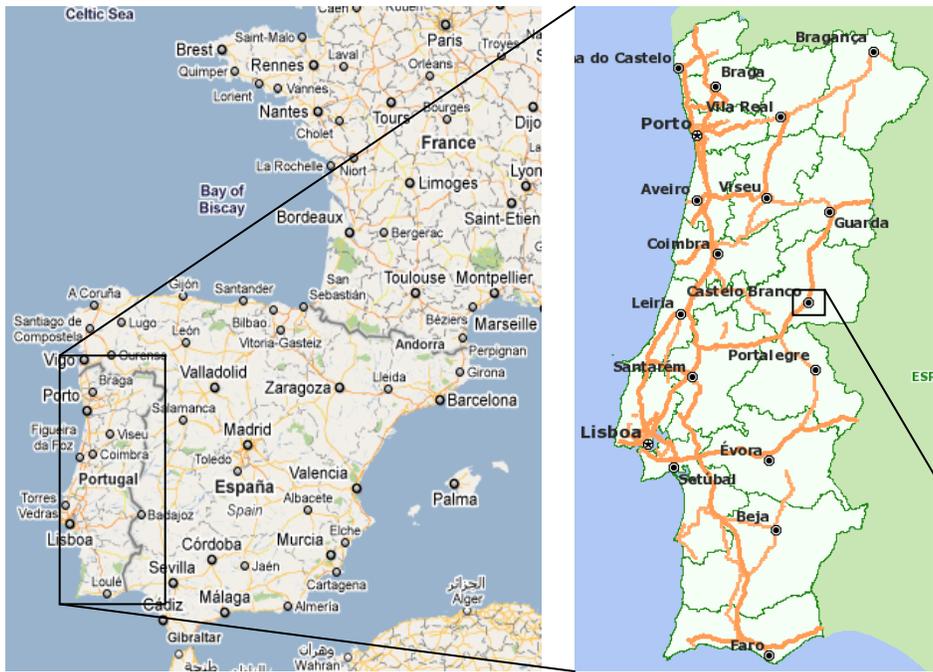The provided activities or those being developed vary greatly. Thus, they are grouped in 4 typologies (table II).

Fig. 1 Case Study of Castelo Branco

TABLE II
PROVIDED ACTIVITIES/ONGOING ACTIVITES

Typologie	Activities
Awareness material and events	Media – Articles Radio Programs Website and Blog Website and schools involved Awareness material Participation in events, workshops and local and national conferences Walk to school soundtrack and video
Events	Mobility Contest (Mental Map to school, cartoons and flyers drawings) Mobility Games Mobility Dar for school (Walk to school / Car Free Day) Mobility Week of scholar community (Walk to school/ Car Free Day in the same day)
Learning	Workshops and Conferences with scholar community (parents, students and teachers) about sustainable mobility Develop projects with students about sustainable mobility in urban environment (noise, air pollution and road safety)
Scientific and technical	Diagnostic Study of mobility alternatives (Conception, test and evaluation) Study of the solutions that improve the conditions of utilization and function of sustainable travel mode choices and public transportation penalizing travel individual mode choice (geometry, pavements, traffic control and traffic devices, road safety, etc.) National Seminar about the project National and international technical scientific events (congress, seminars and workshops) Papers submissions to tecnical and scientific national and international Reviews Guidelines and technical recommendations Project Reports

TABLE III
STUDENTS BY SCHOOL AND GRADE

Schools	1st to 4th grade	5th to 6th grade	7th to 9th grade	Total
CSPR	153	-	-	153
EBBE	70	-	-	70
EBCS	90	-	-	90
EBCT	42	-	-	42
EBGR	160	-	-	160
EBHA	23	-	-	23
EBMN	76	-	-	76
EBMT	42	-	-	42
EBNP	130	-	-	130
EBST	156	-	-	156
EBVL	68	-	-	68
JJD	81	-	-	81
EBAP	83	198	207	488
EBCCB	181	240	273	694
EBFV	90	181	184	455
EBJR	68	219	283	570
ESAL	-	-	96	96
ESNA	-	-	160	160
Total	1513	838	1203	3554

with the first education level and two of them with the third education level and high school (Table III).

E. Methodology

For the study of mobility patterns and similarly with other researches was used GIS trough it was possible to geocoded the urban streets, the schools and the students [34].

In this research were geocoded the urban streets, the schools and the students. From 3554 students that attend the 18 schools from the 1st grade until the 9th were geocoded 3320 students (93, 4%). At the same time we applied a survey for students and their parents about mobility habits in to/from school journeys, with the result of 2587 answers and 1732 respectively. From each school there were defined 2 buffers of 500 and 1000 meters, by street (Fig. 2).

For each school, a buffer identified and within it the number of student for each one, the school that each student attends and the aggregate student distance between their home and school were obtained. This information was sorted by school and school education level. With the information of the surveys, it was possible to know the journeys to/from school habits of the students by school and education level, journeys times of students and in adults company, for home to school journeys and additional times on home to school journeys expended to take/pick up their children from school when it is made by car in the city for additional reasons.

F. Results

In the 500 buffer, next to schools, 27% of the students live. In 3 schools, this proportion does not exceed the 10% and only 1 school exceeded 68%. Within the 1000 buffer, 52% of the students that attend the schools live.

Only in 1 school this proportion does not exceed the 25% and in 5 schools exceeds 70%. The average distance per student between their home and the school varies between the minim of 588 meters and the maximum of 2709 meters (Fig. 3 and 4).

D. Study of Mobility Patterns of Students

The study of mobility patterns as well the barriers needed to be overcome to change mobility patterns are part of the objectives of this project by the promotion of information activities, awareness and learning campaigns for scholar mobility, of the municipality and the local transport operator.

The study of mobility patterns in to/from school journeys have been a goal in the scope of medical/promotion of physical activity, road safety and urban planning and transports. Most of the researches give special attention between the relation of urban structure and travel modes regarding the models of logistic regression [28, 29, 30, 31, 32 and 33].

The subjects of this study come from 18 different schools in the city, from the 1st grade until the 9th grade, in an age group from 6 to 14 years old. Thus, the scholar population of 3554 students, includes 1513 from the 1st until 4th grade (6-9 years old; 42,5%), 838 from the 5th and 6th grade (10-11 years old; 23,6%) and 1277 from the 7th until 9th grade (12-14 years old; 36,9%).

The number of the students varies from 42 to 694 students in each category. Four schools with all education levels, twelve
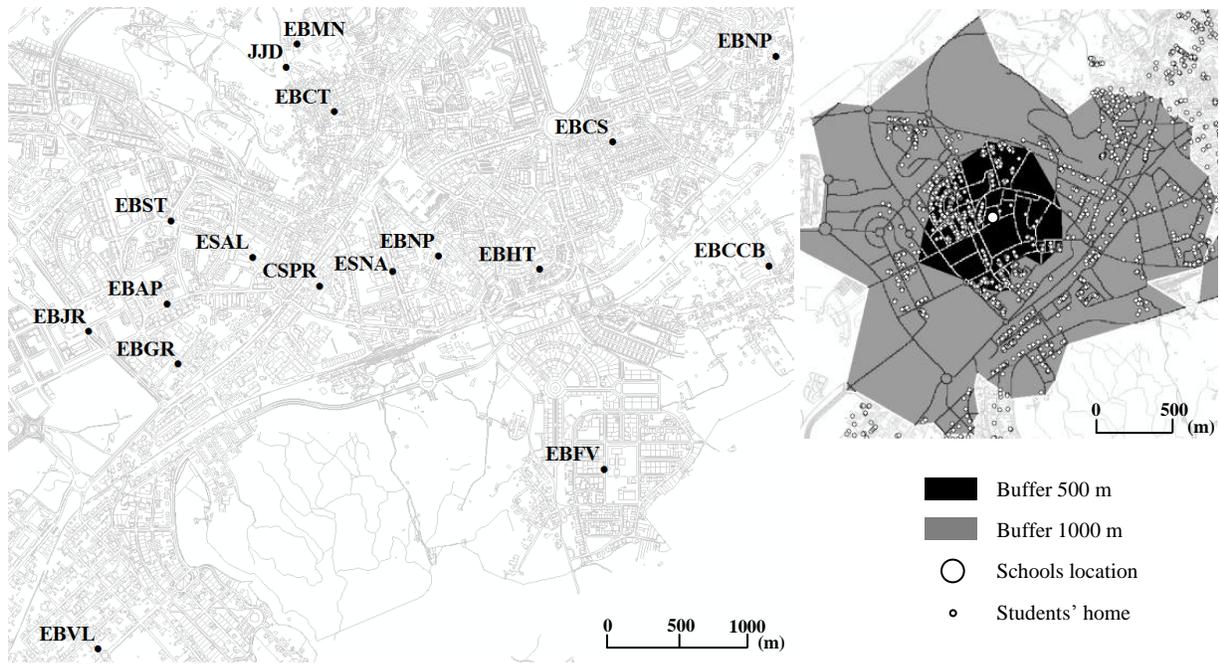
Fig. 2 Schools location in the city of Castelo Branco. Example of the buffers for each school.
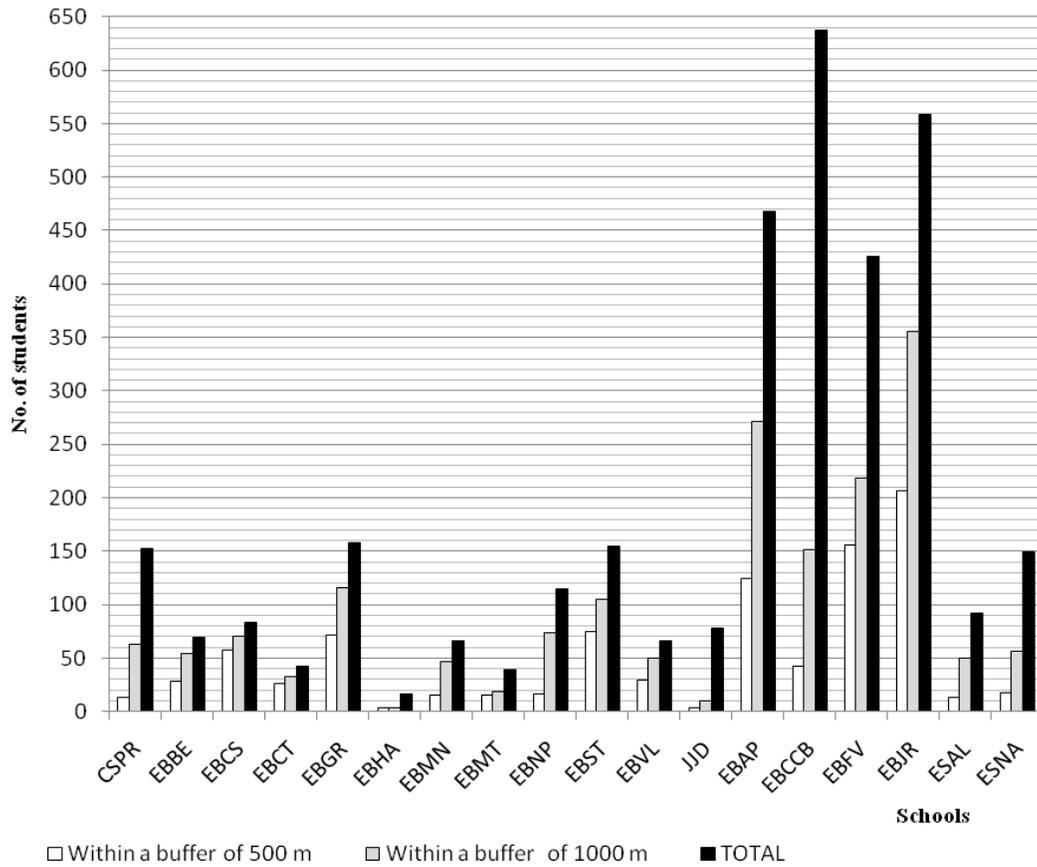

Fig. 3 Number of students within the buffer of 500 and 1000 meters and the total by school.
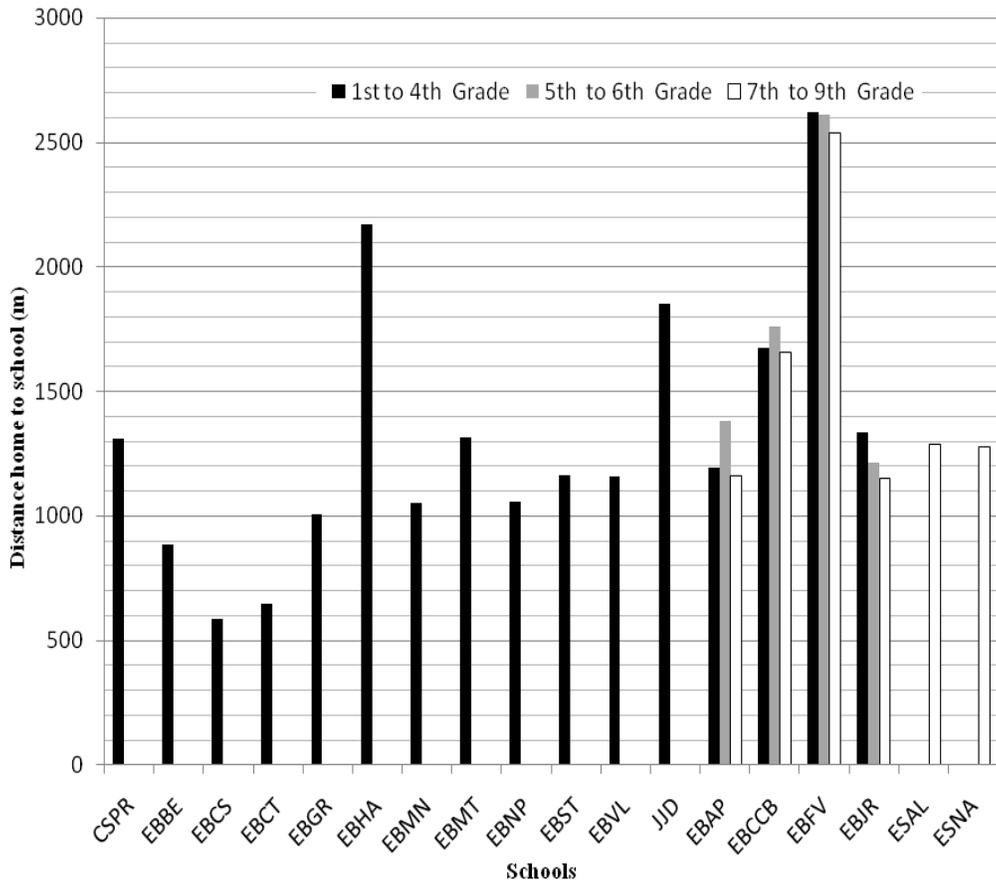
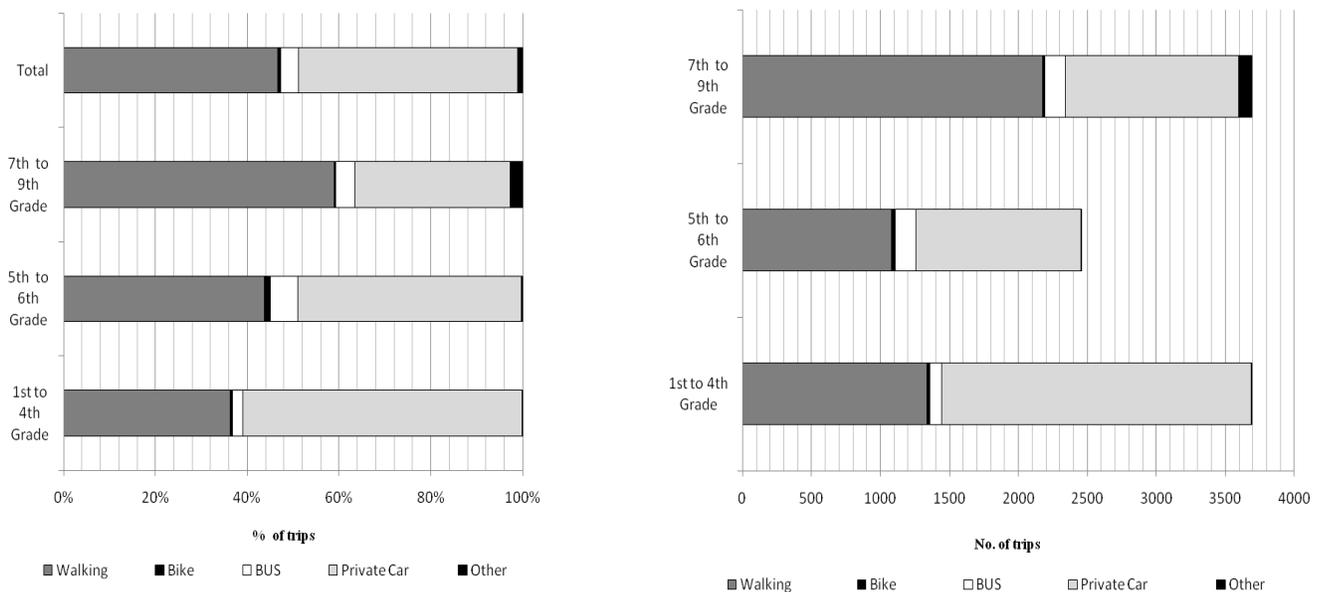Fig. 4 Average distance of home to school by school and school grade

Fig.5 Home to school journeys by school grade

Most of the journeys are made by private car (47, 7%) and walking (46, 6%). About 4% of the journeys are made by bus and the other travel modes are not significant. From all 9853 daily journeys, 37% are from the students from the 1st until the 4th grade, 25% from the students from the 5th and 6th grade and 38% from the students of the 7th until 9th. The journeys made by car decrease according with higher age groups, considering that from the 1st until 4th are 60,9%, decreasing to 48,5% for the 5th and 6th grade and 33,9% for the 7th until 9th grade (see Fig.5).

On the other hand, walking journeys increase in higher age groups (58, 8% for the 7th until 9th, 43, 7% for the 5th and 6th grade and 36, 3% for the 1st until 4th grade) (see Fig.5).

Mobility patterns by school are diverse and are connected with student's age group. For schools that offer the 1st until the 4th grade most of the journeys are made by private car, being registered the maximum value for EBVL (84,2%) and JJD (83%), to the opposite of journeys made by walking are particularly higher, EBCT(86,9%) and EBCS (62,6%). For the other schools, with higher student's age group (5th and 6th grade; 7th to 9th grade) journeys taken walking are the main travel mode choice varying from 46,7% to 63,9%, except EBCCB where private car travel mode choice is (58,1%). Public Transportation is only used in 16, 8% of the journeys of ESAL and 12, 3% in JJD (Fig. 6 and 7).
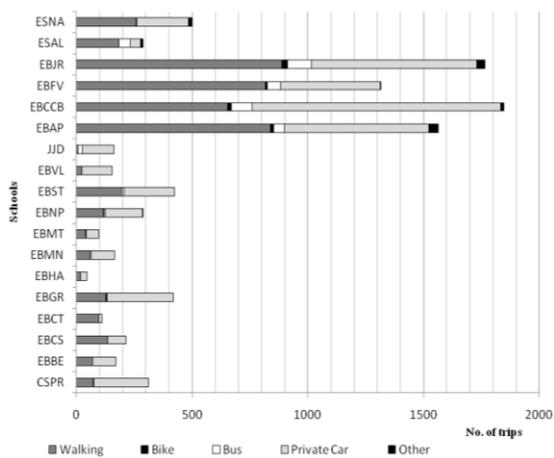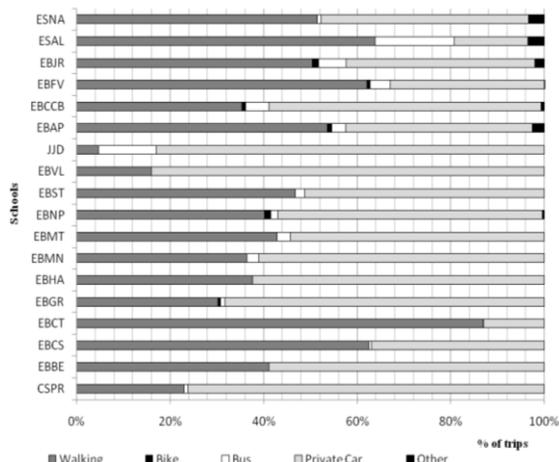

Fig. 6 Number of trips by school

Fig.7 Percentage of trips by school

1. Adults accompanying children to school

In any city, especially in small sized cities, it is usual that parents or other family adults take or pick up children and adolescents from school. That company decreases within the higher age groups.

For the 1st until 4th and 5th until 6th, 80% of student's journeys to/from school are made in the company of adults, 19% walking and 61% by private car. For the 7th until 9th this reality decreases to 38%, 4% walking and 34% by private car. This accompaniment is higher in journeys to school (87, 4% for the 1st until 4th and for the 5th and 6th grade and 45, 4% for the 7th until 9th grade) than from school (73% for the 1st until 4th grade and 5th and 6th grade and 31, 3% for the 7th until 9th grade). A journey to/from school in Castelo Branco for the 1st Until 6th involves 1, 8 persons/journeys meanwhile is only 1,4 persons/journeys for the 7th until 9th grade.

2. Journeys time

The average time of daily journeys is 7, 5 minutes for students and 7, 9 minutes with parents. Over all the different schools and age groups, 37, 5% of journeys are 5 minutes or under and 89,6 % of to/from school journeys are 15 minutes or under (Fig. 8).
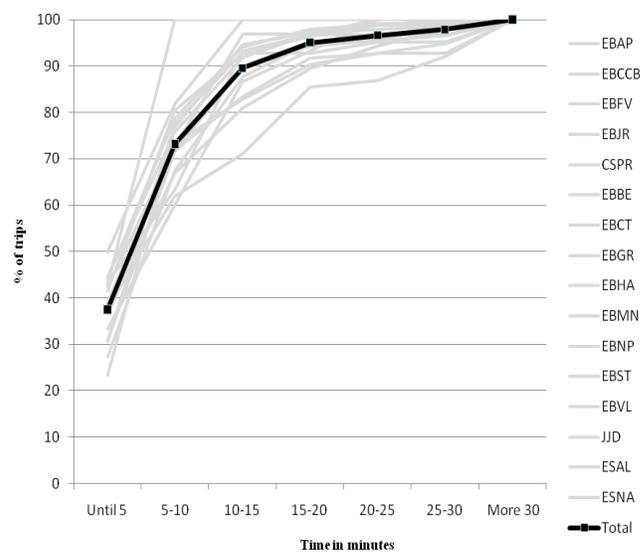

Fig. 8 Average of parent's journeys time

3. Parents additional journeys time

Some parents need to take and pick up their children from school in private car in order to do additional journeys in their daily travel which is often in their daily journeys between home and job. That corresponds to longer journeys and additional times spent in daily journeys. In the morning the journeys to take their children to school are normally done from their home being easy for parents to plan these journeys because they match in time with their job journeys. Thus, the journeys are normally shorter with fixed itineraries over the year. In the afternoon the parents' itineraries to pick up their children to school in private car are normally longer and more flexible.

According with the information of parents' surveys, 78% of the ones who said that they take their children to school in a private car continue the journey onwards afterwards. To pick up children in school, 34% said they go out from home, 60%, from job and 6 % from other places.

On average, parents spend additionally about 8 min/day/student to take and pick up their children to school and they make an average distance of 4 Km/day/student. At the morning, the expended times and distances (7 min./day/student and 3, 5 Km/day/student) are lower than the afternoon (8, 6 min./day/student and 4, 3 Km/day/student).

4. Carpooling in home to school journeys

According with parents surveys, carpooling to/from school journeys is usual for all education levels. Carpooling represents 58% of the journeys to school and 54% of the journeys back home; Rate occupancy of vehicles is 1,7 students/vehicle to school and 1,9 students/vehicle back home.

Nevertheless, according with parents surveys only 13% of them affirm that share their cars with other families that indicates that car occupancy is made by their children. Carpooling in a combined system is mainly made with the other students (60%), and in lower number in an alternate system (24%), offering or taking the ride.

5. Sensibility to change travel mode choices

The change of travel mode choice is expressed by students that make theirs journeys to school by private car, mainly for the 1st until 4th grade which are the ones that use more this travel mode. 70% of them would like to use other travel mode. In all school education levels 1452 students (55, 4%) would like to make their journeys in other travel modes than the car. The bicycle appears as the higher alternative travel mode choice to the car in all age groups.

50% of the parents that take their children to school by private car, in all education levels, affirm that "if they lived in less than 500 meters of the school", they would not let their children walk to school. This reality increases for lower age groups, for the 1st until 4th grade it is 68%. This is explained by the feeling of insecurity of the parents, which 85% of them reported safety concerns as a significant factor (Fig.9).
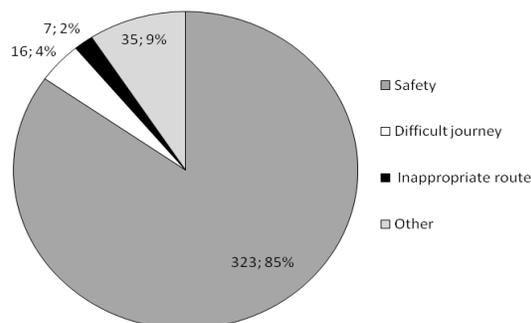
Fig.9 Reasons of the parents to prevent that their children walk to school.

On the other hand, 67% of the parents affirm that they would let their children make journeys to/from school by bus if only the service was improved. The lack of buses in the neighborhood area, the security and bus timetables are the main reasons for why their children do not use public transports (Fig.10).
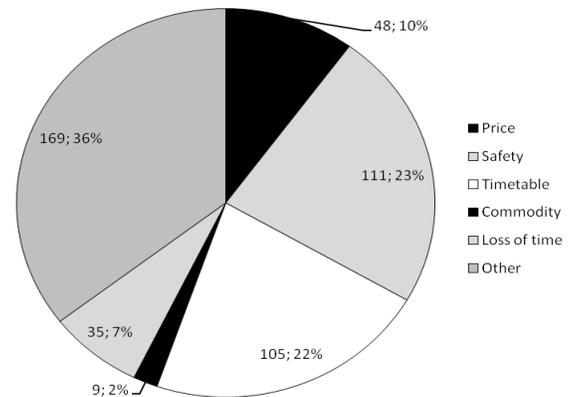
Fig 10 Reasons of the parents to prevent that their children use the bus

VII. CONCLUSIONS

The intervention in to/from school journeys is an attempt to promote urban mobility patterns that are more sustainable for the future. The interest in this subject is growing in the international context. Although, in Portugal, only the first steps are being taken without political and social recognition. The campaigns of information/awareness/learning in scholar community are principal to promote the change of habits in travel mode choices of the students. However, this assumes a complementary character comparatively to stronger one.

In small and medium sized cities like Castelo Branco with a young population, where the distance of the journeys to/from school is short, it is expectable that students would make sustainable travel modes choices. Although motorized travel mode choices are predominantly used, such as the private car. The lack of local active policies that restrict the private car in the city (measures pulls), and policies of promotion of sustainable travel modes (measures push) articulated and integrated in the space and time is the main cause of this status quo. If these measures would be well articulated and integrated scholar community is be able to change the use of private car by more sustainable travel modes [35].

In this context, the success of the activities of information/learning/awareness being developed in the research context is strongly conditioned if there's no unbreakable measures towards infrastructures and the restriction of private car travel mode in the city.

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