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Matching users´ expectations in school public behavior: where are we in public transport?

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Abstract

Sustainable transport contributes to sustainable development, enabling people to meet their needs and to respect future generations´ while minimizing environmental impacts. Targeting particular and more vulnerable segments of the society, our goal is to influence younger generations by creating an impact on their school commuting decisions or their parents' decisions. Based on a survey in 10 schools of the Lisbon Metropolitan area, this paper addresses the schoolers' decisions and trade-offs between car and bus through a discrete choice model. The results (1640 households) suggest that in order to achieve a modal shift towards public transportation, we should focus on improving *flexibility*, *tracking* and *trip time*. Transport operators can use this study to better understand school commuters' perceptions and leverage the role of public transportation to access school. Policies aiming to promote new mobility habits should involve the youth in the planning of school commuting, since they are the end-users.

Keywords: Public transport to school; Trade-off; Marketing; Discrete Choice Model; Lisbon Metropolitan Area

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1. Introduction

There is a worldwide consensus on the unsustainable mobility patterns and the need for paradigm shifts for smart and sustainable solutions to respond to and anticipate the current and future challenges of mobility in cities (Collins and Chambers, 2005; Gerald et al., 2008; Stern, 2011). Somehow, mobility is facing new challenges, needing to push the boundaries of the sector and redefine the approach to the market. With the increasing urbanization of the metropolitan areas and, simultaneously, lifestyle changes, transport players have to innovate and discuss the concept of latent demand. As investigated by the authors Clifton and Moura (2017), it is necessary to develop a theory of latent demand that assumes a more correct picture of demand for unimagined activities in order to attract new passengers. Considering the accelerated trend towards a sharing economy and where a range of transport options are available, we need to innovate in offering mobility packages that can fulfill the expectations of an existing latent demand.

In a society where experiences are key ingredients to mobility success (Lemon, 2016; Prahalad, 2004), transport actors are compelled to be more pro-active and to develop partnerships with new actors from different sectors: IT, media, retailing, etc. However, there is a challenge to maintain the mission of serving the public good with the orientation towards a business approach and with a multiplicity of solutions as researched by Poliak et al. (2017) and by Kamargianni (2016). In spite of this, and contrary to the foreseeable future, younger people, who are expectably more prepared for the digital era, have been losing their mobility autonomy. The study by Shaw et al. (2015) for the period 1971 to 2010, ranks Portugal in the 10th position amidst 16 countries involved and establishes recommendations for the future. Among others, it specifically suggests investing more in research to consolidate and develop knowledge of the independent mobility of children and on the other hand to incorporate youth mobility into the public policies of the countries. On the other hand, younger generations are increasing their digitalisation (Kilian et al., 2012, among others). Considering the importance of digitization in the new paradigm of the mobility sector, there are some studies that prove this theory namely from the authors Canzler & Knie (2016). As far as we know there is no research relating the growing digitalization in younger generations and their decreasing independent mobility.

It is on the basis of this social dynamics that the research topic arises to understand the reasons for choosing car as the main means of transportation to schools disregarding existing public transportation. Though children are not often considered the primary actor for transportation planning and management, a better understanding of their travel behavior provides important answers for future solutions in transportation (Zwerts et al., 2010). Long-term travel behavior of a citizen over his lifetime can be significantly influenced by the travel habits during childhood. To our knowledge though, there is no literature sustaining such theory. This postulate will be analyzed with the literature review due to its important potential impact on urban mobility planning.

In this competing scenario it is essential to develop capabilities for identifying latent needs, i.e., needs, desires, dreams, and solutions which commuters do not yet know they want. So, we believe that the development of future solutions will have to be based on the identification of commuters' minimum requirements that drive their mobility habits. For that, the aim of the study is to analyze the factors that influence the decision to commute to an from school by car or bus, and the corresponding trade-offs, in order to pro-actively building future scenarios and necessary solutions. The factors included were "Travel Cost", "Travel time", "Bus following system for parents" and "Bus Timetable Flexibility", and "Socio-demographic variables of the households".

The remainder of the paper is organized as follows. Section 2 reports an overview of the existing literature. Section 3 describes the methodology proposed while aiming to analyze the school commuting decisions and trade-offs. Section 4 describes the data collection, discusses the model results and finally Section 5 reports the conclusions and further research.

2. Literature review

Many studies on children's commuting to school have hypothesized that the characteristics of children, households, schools, and neighborhoods exogenously affect their travel mode to school as studied by Heath and Gifford (2006), Schlossberg et al. (2006), Wong et al. (2011), among others. Other studies discuss if it is children's school commuting that determines the household overall modal options or the other way around, i.e., parents' mobility planning and modal options that determine the way children commute to school by Deka (2013). Also, it is important to highlight that increased car use is having significant effects on the urban commuters´ health (Karanasiou et al., 2014) and particularly on children´s health (Unicef, 2016, Buka et al., 2006).

On the other hand, reducing car use and dependence presents potentially positive opportunities to enhance environmental quality and children's well-being (Gan et al., 2018) Potentially, this will decrease energy consumption, pollution and more importantly improve children's health, which is achieved through more outdoor activities and by providing healthy environments (Freeman & Quigg, 2009). These reasons justify the involvement of youth and children in policy decisions. In fact, up to a certain age, the final decision about the mode choice of the trip to school is made by the parents or caregivers in the household. The decision is not limited to children's constraints and preferences but also considerably by the parents or caregivers. Parental decision making can be seen as an intervening causal variable or mediator of a child's commute behavior; that is, it is a variable on the theorized causal way between urban landscape and a child's trip to school (Baron & Kenny, 1986) (Bauman et al., 2002).

Somehow, the involvement of children in public policies was referred in several studies and pointed in different perspectives to new types of citizenship in which children should be included to participate (Tisdall, 2008). Additionally, mechanisms were examined to incorporate the views and mobility needs of children into transport policy, considering them as political citizens (Barker, 2003). As mentioned by the researchers, one of the key features of current research with children is the adoption of the children's participation principle, putting their voices in the center of the research. This study argues that children's involvement in formal mechanisms of transport policy, by informing their family, can lead to reducing congestion when commuting to school (Barker & Weller, 2005).

From our review, we can conclude that there is room to explore hypothetical scenarios which can enhance proactive citizens' participation, namely younger generations in solving daily societal problems.

3. Methodology

3.1. Survey and experimental design

We conducted a survey on 10 elementary, middle and high schools (6-18 years) of three municipalities of the Lisbon Metropolitan Area, in Portugal. One of the goals of the survey was to gather high quality data and so the surveys were designed for paper-based use, following the schools' board of direction advise as it would be more effective, based on their past experiences. The dissemination and delivery of the questionnaires was carried out by the school´s boards of direction and teachers.

The 10-pages survey was divided in the following sections:

- Socio-demographic information (parents and children);
- Mobility routines (parents and children);
- Public transportation assessment (parents only);
- Choices between car and public transport (parents only);
- Personality type (parents only); and
- Environmental awareness and attitudes (parents only).

The National Data Protection Commission approved the present survey's contents, procedures and design.
The response rate was significant (57%; n=1640) and responses were collected over a rather short term (2 weeks in February 2018). After the data cleaning (digitalization of data and corresponding cleaning), we validated and used 1201 responses. 52% of the respondents of the present survey are aged between 35-44 years, while 34% range between 45 and 54 years. 68,5% of the respondents are women. The majority of respondents (70,9%) have a full-time job and 7,4% are unemployed. Concerning the level of education, 38,4% have a graduate level of education and 36,8% a secondary grade. From the sample of respondents, 55% parents escort their children by car, while 15% of the children walk to school.

In this study, parents/educators were asked to choose between hypothetical bus and car options from a binary choice set. This approach requires commuters to make trade-offs between the different attributes included in the utility functions of both modes (car and bus). In order to obtain effective responses for our modelling approach, we did an experimental design that aims to have a representative observation of the choices by parents regarding their children's commuting options to school, by manipulating the levels of a set of explanatory variables (Hensher et al, 2005). Before setting the possible levels of the attributes, we pre-tested several options with a smaller sample of respondents in a pilot survey.

The mode-choice attributes and their levels are defined in Table 1.

Table 1 Attributes, corresponding levels and values

Attributes	**Variables**	**Levels**	**Corresponding values**
CAR			
Morning duration trip	TMCAR	2	15 min;30 min
Afternoon duration trip	TTCAR	2	15 min ;30 min
Cost (month)	CCAR	2	25 euros; 60 euros
BUS			
Morning duration trip	TMBUS	2	20 min; 30 min
Afternoon duration trip	TTBUS	2	30 min; 60 min
Cost (month)	CBUS	2	20 euros; 40 euros
Tracking the trip	ACOMP	2	1: yes; 0: no
Flexible schedule	FLEX	2	1: yes; 0: no

Note: * Degrees of freedom= (2*3) + (2*5) + 1= 17

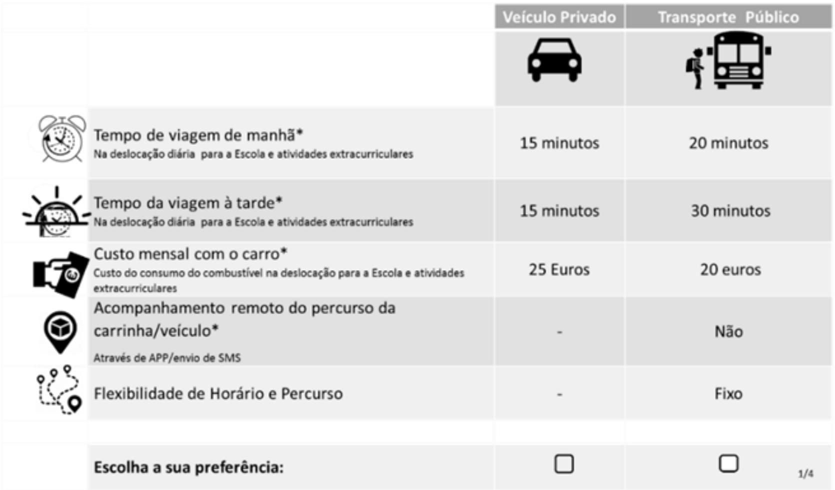
The next stage in the Discrete Choice Experiment (DCE) was to elicit the choice sets to be presented to the commuters as studied by Arentze et al. (2013), among others. For our experimental design, we used DCE macros in the statistical programme SPSS to generate optimal orthogonal design with nine profiles. This method considers orthogonality, level balance and minimal overlap (Kuhfeld, 2010). The profiles were combined to generate 27 choice sets, which is aligned with the literature and within an acceptable range for DCE studies.

In Table 2 a choice set of a the stated preference survey is portrayed.

Table 2 Choice set submitted to commuters

Block	Card	TMCAR	TTCAR	CCAR	TMBUS	TTBUS	CBUS	ACOMP	FLEX
1	4	15	15	25	20	30	20	0	0
1	12	30	30	60	30	60	40	0	1
1	18	30	30	60	30	60	40	1	0
2	7	15	15	25	30	60	40	0	1
2	15	30	30	60	20	30	40	0	0
2	16	30	30	60	30	60	20	0	0
3	3	30	30	60	30	60	20	1	1
3	10	30	30	60	20	30	40	0	0
3	24	15	15	25	30	60	40	0	0
4	9	15	15	60	30	60	20	1	0
4	23	30	30	60	20	60	40	0	1
4	26	30	30	25	30	30	40	0	0
5	5	15	15	60	20	60	40	1	1
5	8	30	30	60	30	30	20	0	0
5	14	30	30	25	30	60	40	0	0
6	1	15	15	60	30	30	40	1	0
6	11	30	30	25	20	60	20	0	1
6	22	30	30	60	30	60	40	0	0
7	13	30	30	25	30	30	40	1	1
7	25	15	15	60	30	60	20	0	0
7	27	30	30	60	20	60	40	0	0
8	19	30	30	60	30	60	40	0	0
8	20	15	15	60	30	30	40	0	1
8	21	30	30	25	20	60	20	1	0
9	2	15	15	60	20	60	40	0	0
9	6	30	30	60	30	30	20	0	1
9	17	30	30	25	30	60	40	1	0

The layout of this question: *Which of two options (Car/Bus) will you choose to take your children to school,* included in the questionnaire, is illustrated in Fig. 1.



	Veículo Privado	Transporte Público
Tempo de viagem de manhã* Na deslocação diária para a Escola e atividades extracurriculares	15 minutos	20 minutos
Tempo da viagem à tarde* Na deslocação diária para a Escola e atividades extracurriculares	15 minutos	30 minutos
Custo mensal com o carro* Custo do consumo do combustível na deslocação para a Escola e atividades extracurriculares	25 Euros	20 euros
Acompanhamento remoto do percurso da carrinha/veículo* Através de APP/envio de SMS	-	Não
Flexibilidade de Horário e Percurso	-	Fixo
Escolha a sua preferência:	☐	☐ 1/4

Fig. 1 Example of stated preference question to respondents (1 out of 3 choices for each respondent)

3.2. Modeling

The response variable (mode choice) is assigned 1 if car is chosen and 0 if bus is chosen. The independent variables were divided in 2 categories: attributes of the mode of transport; and sociodemographic characteristics as presented in Table 3.

Table 3 Summary of the variables descriptive statistics

Variable	Classes/Options	Description	Freq (%) ("Yes" = 1 in binary variables)
Dependent variable			
CHOICE	CAR	Modal choice to go to school	64
	BUS		36
Independent variables			
Attributes (CAR/BUS)			
TMCAR	15 min	Travel time of the Morning trip	34
	30 min		66
TTCAR	15 min	Travel time of the Afternoon trip	34
	30 min		66
CCAR	25€	Private Car Travel Cost (€ per month)	34
	60€		66
TMBUS	20 min	Travel time of the Morning trip	34
	30 min		66
TTBUS	30 min	Travel time of the Afternoon trip	34
	60 min		66
CBUS	20€	Public Transport Travel Cost (€ per month)	34
	40€		66
ACOMP	0	Possibility of tracking the trip (PT) of the student by the parents	34
	1		66
FLEX	0	Flexible schedule of bus transportation	33
	1		67
Sociodemographics			
PARENT	Non Parents	Relationship with the students	9

	Parents		91
AGE	Class 1	≤ 20 years	1
	Class 2	20 – 24 years	0
	Class 3	25 – 34 years	8
	Class 4	35 – 44 years	53
	Class 5	45 – 54 years	36
	Class 6	55 – 64 years	2
	Class 7	≥ 65 years	0
FEM	No	Gender	30
	Yes		70
WRK (Work occupation)	No work	Employment	16
	Work		84
STUD (Level of education of the respondent – parents only)	Class 1	primary	22
	Class 2	secondary	34
	Class 3	grade level	44
INC (Income)	Class 0	Live without financial restrictions	22
	Class 1	live modestely	64
	Class 2	Live with financial restrictions	14
NCAR (number of cars)	None	0	9
	0	1	42
	1	2	44
	2	3	4
	3	>3	1
CHILD (Number of children in the family)	1	1	2
	2	2	25
	3	>=3	73
LEVEL (School level)	Class 1	Primary school	22
	Class 2	Intermediate school	34
	Class 3	Secondary school	44
MUN (Municipality of the school)	1	Cascais	23
	2	Oeiras	56
	3	Sintra	21

3.2.1 Principal Component Analysis (PCA)

PCA is a statistical procedure that reduces the dimensionality of the data while holding most of the variation in the data set. It undertakes this reduction by identifying directions, entitled principal components, along which the variation in the data is maximal. PCA identifies new variables, unobserved ones, i.e. the principal components, which are linear combinations of the original variables.

We used PCA here to reduce substantially the initial variables used, allowing also to unfold significant latent variables. Considering this tool, we aim to explore homogeneous groups based on likely people responded to a choice set. Afterwards, the authors believe this will facilitate to propose a marketing strategy to enable a modal shift from car to public transport.

3.2.2. Discrete Choice Experiment

Discrete choice models are used in transportation to simulate the selection of one among a finite and exhaustive set of mutually exclusive alternatives. These choice models are developed under the theoretical assumption of random utility maximization of consumers. It is assumed that an individual will derive utility from alternatives. An individual will choose the alternative that returns the highest utility. Utility is assumed to be composed of a deterministic component (V_{in}) and a random component (ε_{in}). The former can be measured through observables attributes related to the alternatives of the choice set, while the latter cannot. The utility perceived by a consumer for a specified product depends on the possible alternatives (choice sets), the attributes of alternatives (characteristics of the products) and the socio demographic characteristics (e.g. gender, income, etc.) of the decision maker.

Assuming the utility as considered by Hensher et al. (2005) for individual n and alternative i consists of the two parts:

$Uin = Vin + \varepsilon in$ ……………………………………………………………………………………...(1)

where, $\boldsymbol{Vin}$,is the systematic utility and is a function of AS (alternative-specific) and SD (socio-demographic characteristics) observable variables
$\boldsymbol{\varepsilon in}$**,** is the random component, corresponds to unobservable part of the utility function

All computations and analyses were performed using the statistical software SPSS version 25 and Biogeme vers.3.1.2.

4. Results and discussion

In order to answer the a priori questions, a PCA was started to reduce the number of variables. Then a Discrete Model Choice was made based on the utility functions. All results are shown below.

4.1 Principal Component Analysis (PCA)

The dimensionality of transport priorities was examined in previous works (Nordjaern et al, 2014, Simsekoglu et al., 2015, among others). This analysis used Principal Component Analysis (PCA) with iteration, Varimax Rotation and Kaiser Criterion. Six factors for transport segments were identified and are shown in Table 4:

- PC1 are afternoon commuters who typically value less commuting times, and value positively the possibility to track their children while in public transport.
- PC2 are afternoon commuters who value positively shorter commuting times and negatively longer commuting times.
- PC3 are morning commuters who value shorter commuting in the morning.
- PC4 relate to bus captive commuters who value lower commuting costs and value positively the flexibility of bus school transportation flexibility.
- PC 5 and PC6 comprises respondents who prefer car over other modes. PC5 values a monthly cost of 60 euros and PC6 appreciates 30 minutes of travel time by car. The negative scores of these factors do not make sense in the present context, suggesting future deep investigation.

Table 4 PCA Segment types

Variables \ Segment	Aftern_comutter_Acomp (PC1)	Aftern_comutter (PC2)	Morn_comutter (PC3)	Bus_Captive (PC4)	Car_lover (PC5)	Multi-task (PC6)
TTBUS_60	**0,393**	**-0,359**	0,122	0,006	-0,002	-0,001
ACOMP	**0,298**	-0,106	-0,070	-0,003	0,022	0,025
TTBUS_30	-0,233	**0,640**	-0,010	0,052	0,007	0,010
TMBUS_20	-0,126	-0,082	**0,636**	0,019	-0,021	-0,019
TMBUS_30	0,291	0,254	**-0,404**	0,034	0,021	0,024
CBUS_20	-0,035	-0,037	-0,029	**0,628**	-0,028	-0,026
CBUS_40	0,223	0,223	0,139	**-0,490**	0,027	0,031
FLEX	-0,091	-0,004	0,270	**0,326**	0,068	0,070
CCAR_25	-0,078	-0,073	-0,040	-0,015	**-0,613**	-0,018
CCAR_60	-0,093	-0,096	-0,060	-0,029	**0,550**	0,010
TMCAR_15	-0,075	-0,070	-0,039	-0,015	-0,017	**-0,623**
TMCAR_30	-0,096	-0,099	-0,062	-0,029	0,012	**0,542**
% of respondents	*23%*	*15%*	*14%*	*13%*	*12%*	*12%*

Notes: Variables include possible scenarios of time and euros units, e.g. *TTBUS_60* means 60 minutes for travel time in afternoon. For full understanding of these coding, please see table 3.

4.2 Discrete Choice Models

The first step was to run an unrestricted model with all the alternatives included. Second step was to run a model with more significant variables and finally with the significant variables, as we can confirm in Table 5.

The aim here is to understand the effects of the attributes of each alternative presented (Car or Bus) on the decision maker's choice. We included an alternative specific constant (ASC) to the reference alternative "Car" to try to capture the mean unknown component of utility (error term) which is not explained by the other variables. Utility in the model will be interpreted against the utility of choosing a private car.

As a result of this preliminary analysis and variable transformation, Table 5 presents the different models' specifications in our approach (variables acronyms are detailed in the previous Table 3).

Table 5 Alternatives' utility specifications

Models	Utility functions for the specification of model
Model 1 **Global**	U(CAR)= V1 = ASC_CAR + B_TIME1 * TMCAR + B_TIME2 * TTCAR + B_COST * CCAR + B_PARENT * PARENT + B_AGE * AGE + B_FEM * FEM + B_WRK * WRK + B_STUD * STUD + B_INC * INC + B_NCAR * NCAR + B_CHILD * CHILD + B_LEVEL * LEVEL + B_MUN * MUN **(REFERENCE ALTERNATIVE)** U(BUS)= ASC_BUS + B_TIME1 * TMBUS + B_TIME2 * TTBUS + B_COST * CBUS + B_ACOMP * ACOMP + B_FLEX * FLEX
Model 2 **Restricted**	U(CAR) = ASC_CAR + B_TIME1 * TMCAR + B_AGE * AGE + B_WRK * WRK + B_STUD * STUD + B_NCAR * NCAR + B_CHILD * CHILD **(REFERENCE ALTERNATIVE)** U(BUS) = ASC_BUS + B_TIME1 * TMBUS + B_ACOMP * ACOMP + B_FLEX * FLEX
Model 3 **Final**	U(CAR) = ASC_CAR + B_TIME1 * TMCAR + B_TIME2 * TTCAR + B_COST * CCAR + B_AGE * AGE + B_WRK * WRK + B_STUD * STUD + B_NCAR * NCAR + B_CHILD * CHILD **(REFERENCE ALTERNATIVE)** U(BUS) = ASC_BUS + B_TIME1 * TMBUS + B_TIME2 * TTBUS + B_COST * CBUS + B_ACOMP * ACOMP + B_FLEX * FLEX

The results in Table 6 show the results for the Model 3. In this model, *ASC_Bus* is positive, which suggests that Buses are intrinsically preferred against car by the respondents, if no other attributes are considered. This is against expectations as, usually, car is the preferred mode for all its normally perceived advantages over public transportation (i.e., flexibility, availability, etc.). Here, there might be two causes for such results. Firstly, the population that attends the surveyed schools are of lower income. As such, being bus captive users, potentially, they are more constrained in their options to choose car as the preferred option.

Table 6 Model calibration results

Name	**Value**	***Std err***	***t-test***	***p-value***
ASC_BUS	1,52	*0,31*	*4,97*	*0,000*
B_ACOMP	-0,26	*0,07*	*-3,44*	*0,001*
B_AGE	0,02	*0,04*	*0,51*	*0,608*
B_CHILD	-0,17	*0,07*	*-2,30*	*0,021*
B_COST	-0,03	*0,00*	*-14,80*	*0,000*
B_FLEX	-0,28	*0,08*	*-3,77*	*0,000*
B_NCAR	0,21	*0,05*	*4,58*	*0,000*
B_STUD	0,29	*0,05*	*5,73*	*0,000*
B_TIME1	-0,03	*0,00*	*-6,32*	*0,000*
B_TIME2	-0,02	*0,00*	*-8,43*	*0,000*
B_WRK	0,30	*0,10*	*2,95*	*0,003*
Number of estimated parameters*		11		
Sample size		3910		

Init log likelihood	-2710.205
Final log likelihood	-2304.011
Likelihood ratio test for the init. Model	812.3898
Rho-square (*McFadden*)	0.15

Note: * Coefficient with the same names were calibrated together for both alternatives.

The variables related to cost (B_COST) and travel time present negative signs which corroborate with the corresponding disutility expectations. Interestingly, travel times in the morning (B_TIME1) and afternoon peak hours (B_TIME2) present very similar values, indicating that the afternoon peak hour is only slightly less penalized (-0,03) than the morning peak hour (-0,02).

Awkwardly, the possibility of tracking their children (B_ACOMP) while commuting to and from school autonomously was valued negatively (-0, 26), meaning that respondents do not like the idea of their children being tracked or also because she may have misunderstood the question. In the same vein, the greater *flexibility* (B_FLEX) of the bus schedules the lower the utility of the Bus option. Concerning flexibility, the negative coefficient could indicate that respondents could not understand the question, considering that usually, flexibility is something not related with PT. This means that there is some future work to do in this area, such as changing the management approaches of operators and decision makers considering on-demand public transport. Additionally, the more children are present in a household ((B_CHILD), the less the car was preferred. This result is also surprising as we would expect that coordinating more children´s schedules would result in the disutility of the bus as a reference On the other hand, more children in the family might be understood as they group and support each other while commuting to school and up to 12 years they have free passes which enables families to save some money in their household budgets.

As expected, the *more cars that household owns* (B_NCAR), the more the household prefers cars over bus for the children's school commuting, reinforcing the idea that the availability of cars leads to more car usage. Moreover, *the higher ranks of work categories* (B_WRK) *or level of education* (B_STUD), the higher the income is expected in the family. Apparently, higher income in the family would favor the option for driving children to school. Strangely, we would expect a higher environmental awareness from more educated families, which is not confirmed in this survey.

The calibration results show a reasonable goodness-of-fit of the model. The likelihood ratio chi-square of 812 with a *p-value ~ 0.000* and a ρ^2 = 0, 15, tells us that the model can explain a significant portion of the variability of the choices made by respondents. All estimated coefficients significant at the 95% confidence level.

5. Conclusions and further research

Our findings suggest that, to lower people´s car use, the operators should lower travel time and cost, as expected. The new monthly tariff for public transport in the Lisbon Metropolitan Area (30€/month within the municipalities; and 40€/month between any municipality of the 18 existing in the metro area) would certainly have an impact on the households' commuting choices.

Regarding the options of providing more flexible time tables of the buses or allowing for tracking children while in the bus, where either misunderstood or consciously penalized. An understanding for the latter is that the simple idea of tracking children was badly perceived. People do not want their children to be tracked. To the increased flexibility, respondents might not believe in the feasibility of such possibility in public transport.

Also, the deep-rooted negative attitudes of non-bus users offer greater resistance to shift to buses. We believe that promoting school bus transportation might be effective if the service characteristics meet the customers´ needs. If not, the leverage effect will be short-lived and will only lead to new group of users, potentially, confirming the negative perceptions they had before.

This study provides new evidence of the typical choice between car and bus, for the case of 10 schools in the Lisbon Metropolitan Area peripheral municipalities. The focus was to test the potential attractiveness of new bus-related services to enable a further marketing mix to leverage PT. We believe that the benefit of using a segmentation model is that it assists tailored approaches for specific groups. With this methodology we can understand which groups are more skeptical about their behavior shift or whether people are already actively seeking to influence their friends and family to move to a more environmentally friendly mode of transportation as well as identifying opportunities issues and their implications, key factors, opportunities and risks.

We believe there is no single solution that will motivate a mainstream population to choose a greener mode of transport. It requires multiple, integrated interventions. These interventions should develop an intervention mix combining tools from policy and communications drives.

On the other hand, further developments of this study may be identified by considering the children´s participation in transport policy which has been neglected in the field of transport planning.

Availability of data and material

Data sharing: Participant level data are available from the corresponding author

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