Children's travel behavior: a world of difference

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Total number of words: 3591 + 8*250 = 5591

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ABSTRACT

Children are not regarded as real actors in the domain of transportation. Most of the time when they appear in this domain they are talked about: their traffic safety, their health, … . That children's travel behavior could influence strongly their parents' travel behavior and future developments is something that is taken into account just recently.
In the first part of this paper we describe the differences between Flemish children's travel behavior, based on their attitudes towards transportation modes. Five different clusters of children are distinguished with a strong typology. In the second part we explain the use of three travel modes (public bus, bike and car) by means of logistic regression models. We show which variables have an effect in the use of one mode on the two reporting days.

1. INTRODUCTION

Children are mostly not regarded as actors in the domain of transportation. When they do 'act' in this domain, they are 'talked about': their traffic safety, their health, … (*1, 2*).
Most of the time children are considered to be fully dependent on their parents. That children's travel behavior could influence strongly their parents' travel behavior and future developments is something that is taken into account just recently. In this paper we take a look at the travel behavior of children aged 10 to 13 years old in the Flanders region, Belgium.

As children in this age are pushing very hard to be more autonomous, parents tend to be protective because of their perception of the risks and dangers in e.g., public space (social risks, safety risks) while children don't consider them to be real risks. In Belgium the children's situation is also influenced by their transit from the primary school, mostly situated in the quarter in which they live, to the secondary school, mostly not situated in the near environment. So at the age of 11, children are obliged to develop another transport behavior. The situation still becomes more complex while the authorities are stimulating children to use public transport by introducing special rates for them or to come to school by bike (they create cycle-paths, stimulate cycle-pooling, make school environments safer) which is not always compatible with the demands of the parents.

This text presents the first results of the quantitative part of the research, with an emphasis on the profiles of children in their travel behavior and on the factors influencing children's travel choice for bike, public bus and car.

2. RESEARCH APPROACH

The results from the quantitave analysis presented in this paper are just one part in a larger research project entitled 'Transportation dependence and the transportation autonomy of children in the age of 10 to 13 years old'. This project is made of four different stages: a study of the literature, a qualitative research, a quantitative research and an action research. The general objective was to direct transportation planning projects more child oriented. The (ongoing) action research emphasises on the development of participation methods for children on mobility projects at local level that can be implemented in the future. The goal of the qualitative phase was the collection of scientifically based knowledge on children's experiences and views on mobility. The quantitative study was set up to measure the weight of different factors found in the qualitative part in a representative sample of Flemish children (10-13 years old) and to collect information on children's travel behavior.

A number of critical factors was distilled from the qualitative study (*3,4*) and implemented in the quantitative study. Three different questionnaires were developped in close cooperation with the researchers of the qualitative study: a questionnaire for the children, one for the parents and a two-day diary for the child. A random sample of schools was composed based on the list of all (5^{th} and 6^{th} grade of) primary schools and (1^{st} and 2^{nd} grade of) the secondary schools in Flanders. 84 schools from all over Flanders participated in this project. We ended up with 2.546 children (and their parents) who filled out the questionnaires.

3. RESULTS

3.1. Overview

< INSERT TABLE 1 HERE>

Children travel in quite different ways and their travel behavior changes over time. In the Flemish Travel Behavior Study of 2000 (*5*) was found that 58 % of the trips made by six- to eleven-year-old children is made by car. Their average number of trips made during one day is 2.5, while traveling on average 26.2 km on one day. In the age group of twelve to fifteen years the percentage of car use during trips decreases to 36.2%. The average number of trips per day was 2.6 and the number of kilometers traveled on one day was 22.4 km. Compared to the Travel Behavior Study of 1994 we see for the youngest age group an increase in car use (especially for non-educational purposes) and an increase in distance traveled. For the twelve- to fifteen-year-old children the increase in car use between the two surveys is much stronger. Here too, the increase is more pronounced for the non-educational trip purposes. More remarkable in this age group is the decrease in distance traveled. From these figures we learn that children's travel behavior changes twice over time: by becoming older and over the years.

The children in the recent survey on transportation dependence and autonomy reported on average 2.8 trips on the first day and 2.6 trips on the second day, more trips than the figures we found in the travel behavior studies. Car use in trips ranges from 50.8% on the first day to 48.3% on the second day. These percentages are similar to the figures of the travel behavior study. In order to keep the diary form as simple as possible we did not ask for distances. The shift in number of trips between the first and second day we explain by report fatigue of the children, but this should be sorted out thoroughly.

3.2. Cluster analysis

No two children are equal and so is their travel behavior. A lot of questions in the child questionnaire dealt with attitudes to different modes. These attitudes were measured by 70 propositions, to which children could indicate if this item was important to them or not. On these 70 items we performed a cluster analysis to find some similarity between the 2.546 children in the survey. The result of this action was a division in 5 clusters with a strong similarity.

< INSERT TABLE 2 HERE>

The children in our sample are not equally spread over these five clusters. The cluster 2 is the largest one with 1.071 children. It becomes more interesting when other variables are crossed with these clusters. The mean values of age and of number of trips on the two days are presented in Table 2 and we already see differences between the five clusters. Below we present a typology of Flemish children in their travel behavior and give a description of each cluster.

Cluster 1: The no-alternatives

In the first cluster we find more boys than girls. In particular we have pupils of the 5^{th} and 6^{th} grade of primary school in this cluster. The mean age is the lowest of all clusters (see Table 2). The number of trips traveled per day is also the lowest. Most of the children in this cluster go to school by bike or on foot (65%). Partly this can be explained by the fact that they live the closest to school of all clusters. They live more in the country, outside the built-up area. As these areas have a low frequency bus it is also logical that this cluster contains a very small number of “buzzy-pass” - owners (a special rate pass for public bus and tramway in Flanders, only for persons younger than 26). The children do not find themselves old enough to go alone by bus or tramway.

The parents of these children are more than others prepared to bring and get their children by car. They hesitate to let their child go alone by bus, tramway or train. The families are situated in the middle-income group and have more than on average more than one child.

A description of this cluster: they live far away from everything except school; travel is mostly done by car because public transport is no alternative. And because this is no alternative, parents do not trust public transport. Fortunately school is very close to home and the children are allowed to go on foot or by bike.

Cluster 2: Mother's (and father's) boys and girls

The children in this cluster make the most trips by car on the reporting days. One reason for this behavior is the fact that their parents are the most of all clusters prepared to bring and get their children by car. This cluster has the highest proportion of kids that are brought to school by car (37%) and the lowest proportion of bikers and pedestrians to school. For school trips they also have the highest proportion of accompaniment by one of the parents. Home is not close to school, neither it is really far. Like the first cluster we find particularly 5^{th} and 6^{th} grade primary school pupils in this cluster.

There are more girls than boys in this cluster and also more firstborn kids than in other clusters. They do not find themselves old enough to go alone by bus or tramway, by bike, on foot or by train. Also their parents hesitate the most to let their child go on foot alone or by bike. In this cluster low-income households are overrepresented.

Children in this cluster are the most afraid of traffic: it is dangerous going out on the streets, because of busy roads and crossings, because of groups of teens that hang around, because of scary people and dangerous drivers.

On the other hand they seem to lack self-confidence: they are afraid to fall, to have technical problems with their bike. More striking is the fact that these children's and their parents' opinions on traffic and transportation autonomy are identical. These children do not search for adventures and they do not (want to?) disagree with their parents.

A description of this cluster: perfect agreement with the parents, a very negative view on traffic and on traveling alone because of the heavy traffic, traveling by car is the best solution to cope with this.

Cluster 3: the bikers

In this cluster we find the most children that make a trip by bike on the reporting days. The boys are overrepresented. 64% of the youngsters in this cluster come to school by bike or on foot. Noteworthy is the fact that the parents of this children are the least prepared to bring and get the child by car.
The proportion of unaccompanied to school is the highest of all clusters. Just like the preceding clusters we find here in particular 5th and 6th grade primary school. The families in this cluster are more situated in the middle-income group.

The children are aware of the dangers all around, and sometimes they are scared, but that does not mean that they take the car. Maybe their parents are more afraid than the kids, but the parents leave room for autonomy.

A description of this cluster: young children, bikers, an autonomous group, but they not overestimate themselves.

Cluster 4: the "buzzers"

The children in this cluster use the most of all clusters public bus on their reporting days. It is not surprising that we find here the highest number of "Buzzy-pass" owners, but also the highest number of season tickets for train.
In this cluster we find more boys than girls. Pupils of the 1st and 2nd grade of secondary school are overrepresented in this group. One reason for the high rate of public bus use is the great home-school distance. Remarkable, as these youngsters live more in towns in the built-up area. The social aspect of traveling is important to them: they report the highest proportion of going to school together with a friend and that is also their favorite way to come to school. The families in which these children live are situated in the high-income group. Further on it is notable that we have in this group a high amount of mobile phone owners; a typical present for the confirmation at the age of 11 – 12?

We have in this cluster the highest proportion of youngsters that do find themselves old enough to go alone by bus or tramway, by bike, on foot and by train, and their parents agree with this. From secondary school on, children are considered capable to travel alone?

A description of this cluster: public transport users, an autonomous group, the buzzy pass is their way to freedom.

Cluster5: cautious and wary

This cluster makes the most of all clusters a trip by foot on the reporting days and has the highest proportion of mobile phone owners. Also here we find more pupils from the 1st and 2nd grade of secondary school but these children live closer to the school than cluster 4. This cluster is the oldest of all clusters. Their parents leave room to travel alone, but only when they stay in the neighborhood. Children do agree with this and they do not overestimate themselves. In fact they are afraid of traveling alone and all the dangers that go together with it (and probably their parents think the same). The number of trips per day they make is low, given their age.
The income of these families is situated in the lowest classes.

A description of this cluster: more or less the same description as cluster 2, with this difference that their age leaves more room for the use of other modes.

Conclusion cluster analysis

We see a wide variety in the children's attitudes towards travel modes. This variety in attitudes hides sharper, underlying differences in their travel behavior. Children are not the same, and so is their travel behavior: a world of difference.

3.3 Logistic regression models

As stated above we performed logistic regressions on the data available. The probabilities we modeled were the use of public bus, bike use and car use during the two reporting days (all binary response variables, with Y=1 for the use of the mode concerned). A lot of explanatory variables were entered in the model, but the best model fits were simple.

Because of the high correlation between the variables AGE and GRADE (the grade pupils are in), different models were estimated for each mode, one with AGE and one with GRADE. For every mode, the models with GRADE outperfom the models with AGE.

Public bus use

< INSERT TABLE 3 HERE>

< INSERT TABLE 4 HERE>

Only three variables were taken in the model for this logistic regression model: GRADE, DISTANCE (home-school distance) and BUZZYPASS (buzzy pass ownership). The model output for public bus use is very clear. When the child owns a buzzy pass, his or her probability to use the public bus increases enormously. When a child uses public transport this mostly means that the child travels alone or with friends, without his or her parents. In this way a buzzy pass increases the autonomy of the child, and this not only for the home-school trips.

Home-school distance is another very influencing factor: the further a child lives from school the higher the probability that he or she uses the public bus. There seems to be a very strong distinction between primary and secondary school with regard to bus use. Compared to the reference situation of the sixth-grader in the primary school, first- and second-grader of secondary school have a higher chance to use the bus. We can explain this by the greater home-school distance for secondary school pupils. Sex has no influence on the use of public bus. Both boys and girls use the bus just as much.

Bike use

< INSERT TABLE 5 HERE>

< INSERT TABLE 6 HERE>

For bike use on the reporting days we find again the distinction between primary and secondary school. Pupils from the secondary school use more the bike than pupils from primary school, but there is a difference between buzzy pass–owners of secondary and primary school in bike use. Buzzy pass owners from secondary school tend to use less the bike than buzzy pass owners from primary school. The buzzy pass seems to be a very efficacious instrument for increasing bus use, but we see here that it decreases bike use Here again, the model with the GRADE is preferred above the model with AGE.

Compared to the reference situation (a home location in a town outside the built-up area) pupils who live in the built-up area of a town have a smaller chance to use the bike on the reporting days. Children who live in the country use more the bike and even more when they live outside the built-up area.

Also distance plays a role: children use the bike up to 2 km. For distances over 2 km the use of the bike decreases. Remarkable, the odds for boys versus girls is 1.369. Boys cycle a lot more than girls on the reporting days. Of course bike ownership is a very strong variable, but just for the children who have no bike (3% in our sample). Also biking is an autonomous transport mode for children: mostly they use the bike alone or with friends.

Car use

< INSERT TABLE 7 HERE>

< INSERT TABLE 8 HERE>

The use of a car for a trip on the reporting days can be modeled and explained by the variables GRADE, DISTANCE, SEX, BUZZYPASS, INCOME, the NUMBER of CHILDREN in the household and the NUMBER of CARS in the household. In this model again we find the distinction between secondary and primary school. Compared to the reference situation of less than 1 km, for all distances over 1 km we find odds ratios higher than 1. Interesting is to see how girls travel more by car then boys, while boys travel more by bike. Children with a buzzy pass make fewer trips by car. Income has different effects. Low income households tend to bring their kids more by car than middle income households, but less the highest income class (reference group).

Also the number of children in the household has an influence: the more children, the less the car is used to bring and get these children. Finally the number of cars in the household has an influence: when there is no car available, children travel the least by car. But compared to the reference situation when a family owns more than 2 cars, children in families with two cars have a higher probability to travel more by car.

Conclusion logistic regression

Just like the results of the cluster analysis we find in the logistic regression analyses again the strong difference between primary and secondary school. In fact, the variable GRADE is stronger than AGE, so that we can say that not age matters, but the grade the child is in. The buzzy pass seems to be a very efficacious instrument for increasing bus and car use, but we also see that it decreases bike use. The effect of distance was an effect we expected to find (and found), for all mode uses modeled.

CONCLUSIONS AND FURTHER RESEARCH

Children differ in their attitudes towards travel modes, but these attitudes are so strong that they show differences in travel behavior. A cluster analysis performed on these attitudes showed five different types of children. The difference between primary and secondary school was very strong in this analysis.

We also modeled the use of three travel modes during the two reporting days: public bus use, bike use and car use. The same difference between primary and secondary school was visible in the models. Also the ownership of a buzzy pas was an important factor in explaining the use of public bus, bike and car.

The analyses presented in this paper are just a first step in the analyses. Further research and more analyses has to be performed on this data in order to find more and other effects that give us a better insight in children's travel behavior. Because children's travel behavior, it is a world of difference.

ACKNOWLEDGEMENTS

This research is performed in execution of the project ‘Transportation dependence and the transportation autonomy of children in the age of 10 to 13 years old’, part of the Second Scientific Support Plan for a sustainable Development Policy (SPSD II), for the account of the Belgian State, Belgian Science Policy.

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LIST OF TABLES AND FIGURES

TABLE 1 Children's' travel behavior: comparison of two Flemish Travel Behavior Studies (1994 and 2000)

	Children aged 6-11		Children aged 12-15		Whole population (all ages)	
	1994	**2000**	**1994**	**2000**	**1994**	**2000**
% trips by car (all trip purposes)	55.29%	58.00%	29.95%	36.14%	63.32%	61.82%
% school trips by car	38.84%	39.20%	17.09%	19.83%	-	-
Average number of trips per day per person	2.5	3.6	2.5	2.6	2.7	2.8
Average distance traveled per day per person	15.4 km	26.2 km	29.7 km	22.4 km	35.5 km	32.7 km

TABLE 2 Cluster means and frequencies

	Cluster 1	**Cluster 2**	**Cluster 3**	**Cluster 4**	**Cluster 5**
N=	294	1071	443	328	410
% of total	11,5%	42,1%	17,4%	12,9%	16,1%
Average age	11 y 3 m	11 y 5 m	11 y 4 m	11 y 10 m	11 y 11 m
Average number of trips per day per person day 1	2.53	2.82	3.02	2.95	2.76
Average number of trips per day per person day 2	2.43	2.56	2.66	2.68	2.52

TABLE 3 Logistic regression model for public bus use

Model PUBLIC BUS (effect coding)	**parameters**	**SE**	**P**
Intercept	- 2.7565	0.1557	<.001
1st grade of secondary school	0.6339	0.1848	0.0006
2nd grade of secondary school	0.6726	0.1905	0.0004
5th grade of primary school	- 0.2614	0.2553	0.3059
distance to school 1 - 1.9 km	- 0.4956	0.3412	0.1464
distance to school 2 - 2.9 km	- 0.6943	0.4021	0.0842
distance to school 3 - 3.9 km	0.5145	0.2866	0.0726
distance to school 4 - 4.9 km	- 0.3007	0.3392	0.3754
distance to school 5 - 10 km	0.4495	0.1980	0.0232
distance to school 10.1 - 20 km	0.9584	0.2520	0.0001
distance to school + 20 km	0.5625	0.4366	0.1976
buzzy pass owner	1.5554	0.1195	<.0001

TABLE 4 Odds ratio estimates for public bus use

Effect	**Point estimates**
1st grade secondary vs. 6th grade primary	5.360
2nd grade secondary vs. 6th grade primary	5.572
5th grade primary vs. 6th grade primary	2.190
distance to school 1 - 1.9 km vs. less than 1 km	1.647
distance to school 2 - 2.9 km vs. less than 1 km	1.350
distance to school 3 - 3.9 km vs. less than 1 km	4.522
distance to school 4 - 4.9 km vs. less than 1 km	2.001
distance to school 5 - 10 km vs. less than 1 km	4.237
distance to school 10.1 - 20 km vs. less than 1 km	7.048
distance to school + 20 km vs. less than 1 km	4.744
buzzy pas owner vs. no buzzy pas	22.438

TABLE 5 Logistic regression model for bike use

Model BIKE USE (effect coding)	**parameters**	**SE**	**P**
Intercept	-2.1711	0.3805	<.0001
1st grade of secondary school	0.2249	0.1375	0.1019
2nd grade of secondary school	0.2780	0.1441	0.0537
5th grade of primary school	-0.4658	0.1538	0.0025
home location in the country, in a built-up area	0.2735	0.0933	0.0034
home location in the country, outside the built-up area	0.4476	0.1001	<.0001
home location in a town, in a built-up area	-0.3370	0.1279	0.0084
distance to school 1 – 1.9 km	0.6619	0.1340	<.0001
distance to school 2 – 2.9 km	0.4091	0.1643	0.0128
distance to school 3 – 3.9 km	0.0294	0.1757	0.8671
distance to school 4 – 4.9 km	-0.2286	0.1929	0.2360
distance to school 5 – 10 km	-0.4096	0.1497	0.0062
distance to school 10.1 – 20 km	-0.5790	0.2431	0.0172
distance to school + 20 km	-0.4337	0.4404	0.3247
sex – male	0.1570	0.0551	0.0044
buzzy pass owner – yes	-0.3171	0.0829	0.0002
bike ownership - yes	1.0907	0.3709	0.0033
buzzy pass owner – yes * 1st grade of secondary school	-0.1984	0.1335	0.1375
buzzy pass owner – yes * 2nd grade of secondary school	-0.2258	0.1391	0.1045
buzzy pass owner – yes * 5th grade of primary school	0.3894	0.1486	0.0088

TABLE 6 Odds ratio estimates for bike use

Effect	**Point estimates**
location in the country, in a built-up area vs. location in a town, outside built-up area	1.930
location in the country, outside the built-up area vs. location in a town, outside built-up area	2.297
location in a town, in a built-up area vs. location in a town, outside built-up area	1.048
distance to school 1 - 1.9 km vs. less than 1 km	1.118
distance to school 2 - 2.9 km vs. less than 1 km	0.868
distance to school 3 - 3.9 km vs. less than 1 km	0.594
distance to school 4 - 4.9 km vs. less than 1 km	0.459
distance to school 5 - 10 km vs. less than 1 km	0.383
distance to school 10.1 - 20 km vs. less than 1 km	0.323
distance to school + 20 km vs. less than 1 km	0.374
sex male v female	1.369
bike ownership – yes vs. no	8.859

TABLE 7 Logistic regression model for car use

Model CAR USE (effect coding)	**parameters**	**SE**	**P**
Intercept	0.5297	0.2471	0.0321
1st grade of secondary school	-0.4538	0.0987	<.0001
2nd grade of secondary school	-0.6042	0.1075	<.0001
5th grade of primary school	0.6415	0.0992	<.0001
distance to school 1 – 1.9 km	-0.3935	0.1352	0.0036
distance to school 2 – 2.9 km	0.1885	0.1703	0.2683
distance to school 3 – 3.9 km	-0.00149	0.1738	0.9932
distance to school 4 – 4.9 km	-0.3998	0.1861	0.0317
distance to school 5 – 10 km	0.4104	0.1419	0.0038
distance to school 10.1 – 20 km	0.5116	0.2221	0.0212
distance to school + 20 km	0.5248	0.4014	0.1911
sex – male	-0.2113	0.0559	0.0002
buzzy pass owner -yes	-0.2045	0.0761	0.0071
income class 0 – 750 €	-0.2694	0.2977	0.3555
income class 751 – 1875 €	-0.2473	0.1374	0.0718
income class 1876 – 3125 €	0.1669	0.1190	0.1608
income class 3126 – 5000 €	-0.1103	0.1344	0.4115
number children	-0.2845	0.0526	<.0001
number of cars = 0	-1.4979	0.4868	0.0021
number of cars = 1	-0.0383	0.2908	0.8953
number of cars = 2	0.7245	0.1972	0.0002

TABLE 8 Odds ratio estimates for car use

Effect	**Point estimates**
1st grade of secondary school vs. 6th grade of primary school	0.419
2nd grade of secondary school vs. 6th grade of primary school	0.360
5th grade of primary school vs. 6th grade of primary school	1.252
distance to school 1 – 1.9 km vs. less than 1 km	1.564
distance to school 2 – 2.9 km vs. less than 1 km	2.798
distance to school 3 – 3.9 km vs. less than 1 km	2.314
distance to school 4 – 4.9 km vs. less than 1 km	1.554
distance to school 5 – 10 km vs. less than 1 km	3.493
distance to school 10.1 – 20 km vs. less than 1 km	3.865
distance to school + 20 km vs. less than 1 km	3.917
sex – male vs. female	0.655
buzzy pass owner vs. no buzzy pass	0.664
income class 0 – 750 € vs. more than 5000 €	0.482
income class 751 – 1875 € vs. more than 5000 €	0.493
income class 1876 – 3125 € vs. more than 5000 €	0.746
income class 3126 – 5000 € vs. more than 5000 €	0.565
number of children	0.752
number of cars = 0 vs. number of cars = 3 and more	0.129
number of cars = 1 vs. more than 3 cars	0.721
number of cars = 2 vs. more than 3 cars	1.191