How Children are Accompanied to School?

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1 Introduction

Policy-makers, throughout various disciplines, have focused on analyzing school trip behaviors. Public health officials, on one hand, look at the children school trips as an opportunity to embed a regular physical activity in their daily routine. City officials, on the other hand, are struggling to find policies that change the travel attitude of students and parents toward carpooling, walking, or biking. This is not only to decrease vehicle miles traveled (VMT) (especially, in the morning peak period), but to also diminish the externalities of a transportation system such as environmental impacts, traffic safety, and energy consumption. Although city planners strive to promote “green” modes of transportation and health officials advocate active modes of travel such as walking and biking, parents have understandable reservations regarding their children’s travel methods. Policies that aim at promoting non-motorized modes of transportation or at least admonishing auto driving solely for the purpose of picking up or dropping of the kids may not be successful in practice. Such policies could be promoted if the primary concerns of parents are regarded and addressed appropriately.

The way that students are accompanied on school trips has not been widely investigated, and only a few efforts are made to shed light on the subject. Vovsha and Petersen [1], for instance, considered three situations for escorting students to school: ridesharing with a household driver on a mandatory tour, escorting by a household driver on a non-mandatory tour, and having no escort. Quality and availability of transit service, distance to school, and car ownership, along with some household demographics such as gender, work status, and age turned out to be meaningful in the final model. From another point of view, Yarlagadda and Srinivasan [2] studied interdependencies among the travel patterns of parents and children in the San Francisco Bay Area. A multinominal logit (MNL) model was

introduced to simultaneously determine the choice of mode and the escorting behaviors on school trips. The explanatory variables include age, ethnicity, and gender of the students, employment status of mother and father, vehicle ownership, income, distance to school, along with some built environment characteristics such as length of bike lanes and road length. Nine choice situations were considered, namely: biking, driving, walking alone, walking with mother, riding a school bus, taking transit, driving with mother, driving with father, and driving with a non-parent driver.

This study is an effort to examine the behavioral aspects of escorting children to school, in Tehran, the capital of Iran. A quick overview of the data and the analysis method are provided in the next sections, and the paper concludes with an analysis of results.

2 Data

A data collection effort was undertaken in Tehran with a total of 7.5 million daily trips, 27% of which are estimated to be educational. A questionnaire was distributed among more than 4,700 middle and high school students in a randomly selected stratified sample. Since the schools are gender-segregated in Iran, a stratified sampling procedure was implemented to ensure male and female schools have the same proportion as they actually have in the population. The final questionnaires were distributed and completed by the students' parents, after a pilot study. A total of 3,441 forms were collected, making a response rate of 73%. A separate study on selectivity and response bias, along with the survey method and a descriptive analysis of the data is provided elsewhere [3].

The data revealed that parents play a dominant role regarding the transportation of their children. While only 10 percent of parents accompany their children to school on their way to work, 12 percent of parents travel solely for the purpose of taking their kids to school. This was, primarily, to ensure that their kids travel with the best care and minimum stress. Table 1 provides a summary of built-environment and socio-economic variables that are utilized to explain school trip escort patterns.

3 Model

A three-level nested logit (NL) model is formulated in this study to explore the motives behind different escort behaviors in school trips (Table 2). As illustrated in Figure 1, the model classifies students into those who travel alone and those who are accompanied on their way to school. The *escort* nest is further broken down into *school bus* and *no school bus* nests, and then the later is classified into escort by *parents* and escort by *others* including

siblings or friends. Contrary to some previous studies [2], children who are accompanied by a school official or friend are considered to be escorted in this study. No escort mode of travel, simply, corresponds to students who make the trip by themselves.

A nested formulation partially relaxes the property of independence from irrelevant alternatives (IIA) of MNL models [4]. MNL estimations on the choice situation are also provided in Table 2 for the comparison purposes. IIA of the MNL model indicates that if for some reason the parents cannot take their kid to school, the probabilities of taking a school bus and having the kid travel alone would increase proportionally. This is, intuitively, not true, as parents who want to take their kids to school are usually concerned about the safety and convenience of their children and taking a school bus seems more probable when they cannot drive them to school. From a theoretical perspective, however, a significant parameter for the inclusive value conveys IIA is not held. NL model not only has a higher explanatory power, but it also includes some key explanatory variables such as walk time to school with a more meaningful coefficient.

4 Results

This study found that the propensity of females be accompanied on their way to school is higher than that of males. In line with previous studies, socioeconomic factors such as car ownership and income turned out to have a significant positive impact on parental escort decisions. Furthermore, walk time from home to school is one of the most significant environmental factors positively affecting escorting propensities. Direct and cross elasticities for walk time to school, number of children between the age of 7 and 17, automobile ownership, and age of the students for the MNL and NL models are reported in Table 3. According to this table, model misspecification could be very misleading for policy assessment.

References

[1] Vovsha, P. and E. Petersen, “Escorting Children to School, Statistical Analysis and Applied Modeling Approach”, *Transportation Research Record* 1921, 131–140, 2005.

[2] Yarlagadda, A.K., and S. Srinivasan, “Modeling children’s school travel mode and parental escort decisions”, *Transportation* 35, 201–218, 2008.

[3] Samimi, A., and A. Ermagun, "Analysis of Response Behavior to a School Trip Survey", under review in the *Scientia Iranica*. Elsevier, 2011.

[4] Train, E. K., “Discrete choice methods with simulation”, 2nd Edition, Cambridge University Press, Cambridge, U.K., 2010.

TABLE 1 Description of explanatory variables used in the model

Variable	*Description*	*Average*	*Std. Dev.*
WALKTIM	1: less than 10 / 2: 10-20 / 3: 20-30 / 4: 30-40 / 5: 40-50 / 6:more than 50 minutes walk time to school	2.67	1.55
LOW_INC	1:If household income is less than 500,000 Rials* / 0: Otherwise	0.33	0.47
LEVEL	1:High school / 0:Middle school	0.41	0.49
AMT_TO	1:If students choose AMT to school / 0: Otherwise	0.43	0.49
LOW_EDU	1: Parents have less than a high school diploma / 0: Otherwise	0.33	0.47
GENDER	1:Male / 0:Female	0.40	0.49
CHILD_7	Number of school children in household(ages7-18)	1.57	0.67
AGE	Age of children between 12-17 years old	14.13	1.62
LIC_0	1: If no license in household / 0: Otherwise	0.71E-01	0.26
AUTO	Number of car in household	1.01	0.68
NON_WRK	1: If non worker parents are in household / 0: Otherwise	0.47E-01	0.21
INCOME	1: less than 500/ 2: 500-1000 / 3: 1000-1500 / 4: 1500-2000 / 5: 2000-2500 / 6:more than 2500 thousand Rials* household income	2.11	1.23
COST	1: If cost of trip is important for parents / 0: Otherwise	0.30	0.46
SAFE	1: If children safety is important for parents / 0: Otherwise	0.31	0.46
RELIABL	1: If reliability of trip is important for parents / 0: Otherwise	0.18	0.39
COMFRT	1: If comfort of trip is important for parents / 0: Otherwise	0.18	0.39
TRF_LIMIT	1: If traffic zone is limited / 0: Otherwise	0.11	0.31
D_WALKTIM	1: If walk time to school is less than 20 minutes / 0: Otherwise	0.60	0.50
D_GENSAFE	1: If safety is important for parent of male students / 0: Otherwise	0.12	0.32

Note: 11800 Rails was equivalent to 1 USD in May 2011.

TABLE 2 Summary of multinomial and nested logit models

Variables	*Alternatives*	*Multinomial logit*		*Nested logit*	
		Coefficient	t-statistic	Coefficient	t-statistic
AMT_TO	No escort	2.95***	21.66	2.79***	19.99
TRF_LIMIT		1.37***	6.39	1.22***	6.65
LOW_EDU		0.32***	2.71	0.33***	2.86
RELIABL		-0.47***	-3.17	-0.43***	-2.66
INCOME		-0.13***	-2.69	-0.16***	-2.87
COMFRT		-0.48***	-3.37	-0.50***	-3.26
Constant	Escort other	-1.17***	-3.49	0.19	0.25
GENDER		-2.40***	-8.4	-4.73***	-6.21
COST		-0.54**	-2.3	-1.88***	-3.36
TRF_LIMIT		0.49	1.33	0.55	1.43
CHILD_7		0.53***	4.08	0.62***	4.2
LEVEL		-0.59***	-2.79	-1.29***	-3.28
Constant	Escort parent	3.65***	4.2	4.73***	-3.28
GENDER		-1.35***	-10.47	-3.64***	-5.19
AUTO		0.27***	3.46	0.33***	2.73
LIC_0		-0.57**	-2.12	-0.87**	-2.47
COST		-0.68***	-5.32	-2.01***	-3.89
NON_WRK		0.49**	2.31	0.63**	2
Constant	School bus	4.95***	5.65	4.72***	3.2
GENDER		-2.28***	-13.1	-3.13***	-4.71
COST		-1.84***	-10.69	-2.43***	-5.27
D_WALKTIM		-1.39***	-11.65	-1.22***	-7.49
TRF_LIMIT		0.75***	3.41	0.70***	3.09
D_GENSAFE		1.34***	6.93	1.21***	5.13
LOW_INC		-0.93***	-6.25	-0.94***	-5.75
AGE	Escort parent	-0.19***	-3.06	-0.18*	-1.86
LEVEL	and	-0.31	-1.41	-0.96**	-2.33
SAFE	school bus	0.21*	1.81	0.66***	3.55
WALKTIM	All escort choices	-0.04	-0.96	0.24**	2.16
Inclusive value parameters:					
Escort				0.63***	4.01
No escort				1.0(fixed)	
A				1.0(fixed)	
B				0.62***	5.87
Log-likelihood at zero		-4176.91		-4176.91	
Log-likelihood at convergence		-2338.52		-2328.39	
McFadden Pseudo R-squared		0.31		0.36	
Sample size		3013		3013	

Note: ***, **, * means significance at 1%, 5%, 10% level.

TABLE 3 Elasticities for multinomial logit (MNL) and nested logit (NL) model structure

Attribute	Primary Alternative*	No escort		Escort parent		Escort other		School bus	
		MNL	NL	MNL	NL	MNL	NL	MNL	NL
WALKTIM	Escort other	0.00 (0.00)	-0.01 (0.01)	0.00 (0.00)	-0.06 (0.05)	-0.10 (0.06)	0.06 (0.36)	0.00 0.00	-0.02 (0.02)
	Escort parent	0.02 (0.02)	-0.06 (0.05)	-0.84 (0.05)	0.32 (0.20)	0.02 (0.02)	-0.35 (0.20)	0.02 (0.02)	-0.13 (0.08)
	School bus	0.03 (0.05)	-0.14 (0.19)	0.03 (0.05)	-0.24 (0.31)	0.03 (0.05)	-0.24 (0.31)	-0.07 (0.04)	0.42 (0.20)
CHILD_7	Escort other	-0.04 (0.06)	-0.02 (0.03)	-0.04 (0.06)	-0.11 (0.14)	0.81 (0.33)	0.87 (0.32)	-0.04 (0.06)	-0.05 (0.06)
AUTO	Escort parent	-0.07 (0.08)	-0.03 (0.04)	0.21 (0.14)	0.15 (0.10)	-0.07 (0.08)	-0.19 (0.14)	-0.07 (0.08)	-0.08 (0.07)
AGE	Escort parent	0.61 (0.46)	0.22 (0.17)	-2.21 (0.57)	-1.20 (0.30)	0.61 (0.46)	1.346 (0.31)	0.61 (0.46)	0.54 (0.22)
	School bus	0.64 (0.68)	0.37 (0.40)	0.64 (0.68)	0.69 (0.60)	0.64 (0.68)	0.69 (0.60)	-2.18 (0.73)	-1.86 (0.67)
INCOME	No escort	-0.16 (0.18)	-0.19 (0.21)	0.13 (0.11)	0.15 (0.13)	0.13 (0.11)	0.15 (0.13)	0.13 (0.11)	0.15 (0.13)

Note I: Standard deviation for each elasticity is reported in the parenthesis.

Note II: Elasticity value is the percentage of change in the choice probability of the decision variable in the first row, when the attribute in the utility function of the primary alternative increases by one percent.

FIGURE 1 Tree structure for the nested logit model