Role of children in parents' transit use behavior
- An Iranian sample

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Abstract— The aim of this paper is to show the influence of related variables of children's school trips on their parents' transit use behavior for commuting trips, as well as principle factors in theory of planned behavior and socio demographic factors.

An urban Iranian sample from Tehran, consisting of parents (men and women) with primary-school children was asked to fill in physical questionnaires. Sample characteristics next revealed by descriptive statistics. A block regression analysis was utilized to explore how children's transportation's related-variables increased the explained variance of parents' transit use behavior beyond demographic and TPB 1 's factors which includes attitude, norm, perceived behavioral control and intention.

Results show children's transportation block increased the explained variance of parents' transit use behavior beyond both demographic variables and TPB's factors. Finally results are discussed due to the hierarchy pattern in the models.

Keywords—Children's school trips, Commuting trips, Mode choice behavior, Theory of planned behavior, Transit

I. INTRODUCTION

To change the behavioral pattern of motorized trips, the first step would be a precise understanding of the existing pattern of travel mode choice decision making and how it is influenced by different factors.
Travel mode choice has been widely researched within sustainable behavior analysis. Herein exist two major perspectives. First, the traditional non-psychological perspective which principally focuses on socio-demographic factors, the specifications of the travel mode and decisional situations (e.g. weather, day of travel, purpose of trip) [1]. Second; the psychological perspective, which focuses on psychological person characteristics. Research clearly shows that psychological factors are performing better in predicting the travel mode choice than socio demographic and infrastructure differences [2] [3].

Two main trends can be perused in the psychological perspective. The First trend, based on a self-interest motive, is typically presented by the theory of planned behavior (TPB) [4]. Included variables in TPB models are attitude, subjective norm, perceived behavioral control and intention. The second trend based on pro-environmental motive is typically presented by norm-activation model (NAM) [5]. Included variables in the latter models are personal norm, environmental awareness of consequences and environmental awareness of need. A Comparison between the self-interest model and pro-environmental model indicates the self-interest models have a better predictive ability [6].

As transportation mode choice is a complicated multi-aspects behavior, researchers tried to combine factors from different aspects in order to enhance the predictor ability of the model. For example, "habit" was successfully introduced into the TPB [7] , and to the NAM [8], [9]. In a research, relation between situational features (mode cost, access to public transportation services, travel time) and psychological beliefs about environmental effects on car use is reported [10]. Situational, socio-demographical and psychological variables found to be significant simultaneously in another research [11]. A recent study, presented the Comprehensive Action Determination Model (CADM) integrates among intentional, situational, and habitual variables [12].

Besides other variables considered in previous researches, this paper investigates whether parent's mode choice is under the influence of primary-school children's trips. While parents are assumed to be the ultimate decision makers of their child's mode choice [13], they are daily facing with two types of commuting trips simultaneously: work and school trips. The aim of this paper is first to investigate how the variables related to children school trips (situational and psychological variables) would influence on parents commuting trip. This issue has not been studied yet previously. Second, we will examine how much psychological variables and children-school-trip variables would add to explained variance of parent's behavior in transit use for work trips, in consequential steps.

II. METHODOLOGY

A. Data collection

A survey was conducted in Tehran, Iran, from April 21st, 2015, through May 10th, 2015. The city was divided into six major zones. For each zone, four schools have been chosen (girls/ boys/ public/ private). A total number of 4000 questionnaires were distributed among students and filled by parents. The number of returned questionnaires was 1876, indicating a return rate of 47.39 percent.

B. Measures

The questionnaire consisted of different parts, some of which are used for the subsequent analysis. Three parts deal with TPB's factors (attitudes, subjective norms, perceived behavioral control and intentions) toward escorting children to school, transit usage for

work and school trips respectively. Next habit is measured and finally socio-demographic information was collected. The items are shown in Table 1.

different factors on the frequency of using public transport, and whether the children related dimensions added to the explained variance above or beyond other control variables, a hierarchical block regression

TABLE 1. ITEMS USED FOR MEASUREMENTS

Behavior	Variable	Item/question
Escorting child to school	Attitude	Q1: For me, escorting my child to school considering safety matters is essential. Q2: For me, escorting my child to school considering security matters is essential. Q3: For me, escorting my child to school considering convenience matters for my child is essential. Q4: For me, escorting my child to school is overall essential.
	Subjective Norm	Q1: Most people who are important to me would support escorting my child to school. Q2: Most people who are important to me think that I should escort my child to school.
	PBC	Q1: For me, to escort my child to school is easy. Q2: My freedom to escort my child to school is high.
	intention	Q1, Q2: I intend/ try to escort my child to school.
Commute to work/ school by public transport	Attitude	Q1, Q2: For me, to take public transport from my current place of residence to work/school place is overall good/ pleasant
	Subjective Norm	Q1: Most people who are important to me would support using public transport from my current place of residence to work/school place. Q2: Most people who are important to me think that public transport should be used for work/ school trips from my current place of residence.
	PBC	Q1, Q2: For me, to use public transport from my current place of residence to work/school place is easy/high.
	intention	Q1, Q2: I intend/try to use public transport from my current place of residence to work/school place.

Attitude refers the degree to which a person appraises or evaluates a behavior in a favorable or unfavorable manner. Subjective norm describes the perceived social pressure to perform/not to perform a behavior. Perceived behavioral control indicates people perception of ease or difficulty of performing a behavior. Intentions are assumed to capture the motivational factor which indicates how hard people are willing to perform the behavior [4]. For each item, respondents were asked to select one answer on a Likert-type scale ranging from 1 (strongly agree) to 5 (strongly disagree) and the sum score of the items of each construct were calculated and used in subsequent analyses.

Response frequency measure (RFM) [7] is applied for habit measurement. Accordingly, it is asked which travel mode the respondent is most likely to use for grocery shopping/ other shopping/ visiting parents and friends/ going to park/ going to restaurant. Habit strength is then equals the times that "transit" was chosen [1].

Similar to car choice index [12], transit choice index is defined and utilized as the dependent variable. The index is the number of reported trips by transit divided by total number of reported trips.

C. Data analysis

Cronbach's alpha coefficients were calculated for all measures. In a pilot survey, the questions were corrected for probable misunderstandings due to interviewing by the respondents. Prior to model estimation, descriptive statistics were studied and associations between factors of interest were carried out by Bi-variate correlations. To examine the effects of

analysis (enter method) were performed utilizing IBM SPSS 22 software package.

III. RESULT

A. Test of the measurements

For reliability test, the internal consistency of the items was tested by Cronbach's alphas which can also show construct validity of measurements.

Resulting alpha for each item is sufficiently high (Table 2), except for the PBC and intention of escorting child to school which are removed for further analysis.

B. Descriptive analysis

As summarized in Table 3, 47 percent of parents and 63.1 of children are female. The average age of parents is 40.4 years (SD = 6.54) and the average age of the children is 9.65 years (SD = 2.09).

A total of 41.6 percent have basic education (completed high school education or lower), while 39.3 percent report higher education (completed a university degree up to bachelor) and 19.1 percent completed master or PhD degree.

Occupational status of 55.1 percent is reported as full time. Regarding income, 39 percent believe their income are lower than the average income of a typical household in Tehran, while 38.1 percent believe it to be the same and 22.8 percent believed it to be higher.

5.9 percent of the respondents do not own a vehicle and 75.2 own one vehicle while others have two vehicles or more and 89.9 percent have driving license.

A total of 56 percent escort their child to school four times or more a week and 17.9 percent never escort

their child to school. 28.1 percent of the children are never escorted to school neither by the respondents nor by other members of the household.

32 percent of the children weren't picked up to school by car and 46 percent were picked up four times or more per a week. On the other hand, 71.7 of the children didn't use public transport and 15 percent used public transport 4 times or more a week in order to commute to school.

is supported by important people surrounding her. Similarly, due to high correlation between PBC and norm toward transit, while a person perceived easy and available transit infrastructure, she perceived more support for transit usage as well.

TABLE2. CRONBACH'S ALPHA OF MEASUREMENTS

Behavior	Variable	Cronbach's alpha
Escorting child to school	Attitude	0.915
	Subjective Norm	0.738
	PBC	0.510
	intention	0.580
Commute to work by public transport	Attitude	0.749
	Subjective Norm	0.778
	PBC	0.720
	intention	0.869
Commute to school by public transport	Attitude	0.793
	Subjective Norm	0.765
	PBC	0.777
	intention	0.898

TABLE3. FREQUENCY ANALYSIS OF DEMOGRAPHIC CHARACTERISTICS OF SURVEY PARTICIPANTS

Demographic characteristics	Relative frequency (percent)	Demographic characteristics	Relative frequency (percent)
Gender		**Gender (children)**	
Male	53	Male	36.9
female	47	female	63.1
Age (parents)		**Age (children)**	
Mean	40.0	Mean	9.65
SD	6.54	SD	2.09
Education			
high school/	41.6		
Bachelor/Associ	39.3		
Master & PhD	19.1		
Distance to work		**Distance to school**	
Mean(SD)	13.9	Mean(SD)	3.85
SD	21.5	SD	8.28
Number of vehicles		**Driving license**	
0	5.9	Yes	89.9
1	75.2	No	10.1
>=2	18.9		
Income compare to average income in Tehran			
Much lower	12		
Lower	27		
Similar	38.2		
Upper	21.1		
Much Upper	1.8		

C. Bivariate correlations

Table 4 shows the bivariate correlations between transit choice index and psychological dimensions. The strengths of the correlation coefficients ranged from small to moderate. The inter-correlations between the psychological variables were at the worst cases moderate, assuring that multicollinearity was not a matter of concern.

Negative coefficient for attitude and norm toward escorting and the transit choice index indicates stronger psychological dimensions for escorting lead to lower transit choice index. At the contrary, positive sign of the coefficient between psychological dimensions toward transit and transit use index shows better feeling about transit leads to more transit use. Correlation coefficient between PBC and intention to use public transport indicates whenever using public transport is perceived easy and available, stronger intention will exist to use public transport. Additionally high correlation among norm- intention and attitude-intention clearly indicates while a person feels favorable of using transit or this behavior is supported by important people surrounding her, she will show a stronger intention to perform the behavior. Intestinally, norm and attitude toward escorting are associated with high scores indicating while a person feel favorable of escorting her child, this behavior

D. Regression on transit choice index

A hierarchical multiple regression analysis (block regression) was employed to examine first; whether psychological factors and second; the children's trip-related-variables would add to the explained variance above or beyond other variables. Three consequential steps were conducted in the analysis to control conventional variables when considering the effect of new variables. Results are reported in Table 5. The first step was to investigate the impacts of the demographic factors. Among seven variables entered in the model, 4 variables (age, dummy variables of number of vehicles and dummy variable of high education) showed significant β-weights. The demographic factors explained a statistically significant proportion of the variance in transit choice index (R^2=.129).

The second step was to involvement of psychological dimensions toward public transport including attitude, norm, PBC and intention. These factors accounted for a significant increase in the variance of public transport

use (R^2 =.319, R2change =.190). While age significance vanishes, two out of four variables showed significant β-weights. This indicates including PBC and intention are statistical predictors of public transport usage.

TABLE4. BIVARIATE CORRELATIONS (KENDALL'S TAU COEFFICIENT) BETWEEN TRANSIT CHOICE INDEX AND PSYCHOLOGICAL DIMENSIONS

variables	1	2	3	4	5	6	7
(1)transit choice index		-0.01	-0.05*	0.29**	0.32**	0.33**	0.42**
(2)Attitude toward Escorting			0.57**	0.08**	0.07**	0.06**	0.05**
(3)Norm toward Escorting				0.09**	0.13**	0.09**	0.08**
(4)Attitude toward Commuting to Work by transit					0.56**	0.48**	0.61**
(5)Norm toward Commuting to Work by transit						0.48**	0.60**
(6)PBC toward Commuting to Work by transit							0.56**
(7)Intention toward Commuting to Work by transit							

**P<0.01, *P=0.05

The regression model for the third and final step was conducted with a further inclusion of children related variables including psychological factors toward transit use for school trips and escorting children, demographic factors and situational factors.

Significant β-weights for PBC and intention toward transit use and transit choice index for school trips, lead to a significant improvement to the value of R-square (R^2 =0.394, R2change = 0.075). This indicates that considering children's trip-related-variable would add to the explained variance beyond the psychological dimension of the second step.

IV. DISCUSSION

The presented data show that a three-level approach to public transportation can broaden the knowledge about the influence of different types of variables on travel mode usage. The results have implications for both the socio-demographic and psychological variables. The present study provides further support for the predictive validity of the children's trip-related variables in relation to transport mode use. These variables are in terms of revealed variables as well as psychological variables.

FIRST STEP- socio-demographic variables showed to be good predictors of commuters' transit use: owning at least one vehicle or being high educated lead to less use of transit use, while older parents use this mode more frequent. Gender and distance to work place didn't show significant β-weights.

SECOND STEP- At the second step, inclusion of the psychological variables lead to a higher explanation of the variance. Results of hierarchical multiple regression analyses showed that these variables significantly account for a 19 percent increase in the variance of transit usage after controlling the demographic variables. Support appeared on the important roles of PBC and intention with higher prediction ability of intention which duplicates the results of other

researchers while using same variables in different types of models [14], [3], [15].

Previous researches found a significant influence of subjective norms on intention and as a result indirect influence on the behavior of using a special mode (e.g. [3]). Similarly this study failed to show a direct influence of subjective norm on transit use. Similar evidence is appeared about attitude. Regarding the high correlation among attitude/norm with intention, previous research and the TPB, the overall conclusion would be to investigate the effects of subjective norm and attitude mediated by intension.

Inclusions of psychological variables at the second step made some socio-demographic variables vanish: age and the dummy variable of high education became insignificant.

THIRD STEP- The major objective of this study was to provide an examination of the necessity of considering children's trip-related factors of school trips in explaining of parents' transit use by considering various social and revealed factors of children mode use variables. This was investigated at the last step of the study.

Of the investigated variables, PBC and intention and transit choice index for school trips were found to significantly influence on transit use.

The influences of psychological variables of previous step remained significant during the last step. However, while distance to work was not qualified to be a predictor at the first and second step, it showed up at the final step. A longer distance was observed to lead to more public transport usage. This indicated that people residing in longer distance to their work place; tend to show much usage of public transport services.

Based on the significance of the psychological factors toward children transport mode and transit choice index for school trips, this study has successfully contributed to the literature on determinants of travelers' behavior.

V. CONCLUSIONS

Aiming to explain travelers' transit use, this study is an attempt to show the influence of children's trip-related variables on parents' transit use along with psychological and socio-demographic variables. Totally

the final model explained about 40 percent of parents' transit use for commuting trips.

TABLE 5. RESULTS OF BLOCK REGRESSION OF RELATIVE FREQUENCY OF COMMUTING TO WORK BY PUBLIC TRANSPORT

	Adj. R^2	Adj. R^2 change	F_{change}	Step1 β	Step2 β	Step3 β
Step 1	.129	-	-			
Age				.129**	.084	.078
Gender (Ref. Female)				-.041	-.055	-.067
Owning 1 car				-.466***	-.312***	-.356***
Owning more than one car				-.583***	-.341***	-.379***
Distance to work place				-.060	-.071	.100**
Having Bachelor				-.060	-.027	-.018
Having Master/ PhD				-.163***	-.073	-.068
Step 2	.319	.190	25.907***			
Attitude to transit use for work trips					.105	.094
Norm transit use for work trips					0.60	.061
PBC to transit use for work trips					.149**	.183**
Intention to transit use for work trips					.394***	.370***
Step 3	.394	.075	6.25***			
Attitude to transit use for school trips						.026
Norm to transit use for school trips						.044
PBC to transit use for school trips						.142**
Intention to transit use for school trips						.084**
Attitude to escort child						.062
Norm to escort child						.070
Age of child						.026
Gender of child						.010
Escort child Index						-.005
Transit choice index for school trips						.119**
Distance to school						-.078

Among socio-demographic variables, number of vehicles and distance to work place showed to be influential on dependent variable. Among psychological variables, PBC and intention showed major prediction ability of transit use.

After controlling demographic and psychological variables, children's trip-related variables for school trips were involved in the model which enhanced the variance prediction ability by 7.5 percent. PBC and intention to transit use for school trips and transit choice index showed to be significant among children's trip-related variables.

Our research showed variables from different categories namely socio demographic, situational and psychological are influential on mode choice behavior specifically transit use. Furthermore, it provided evidence of an association between children's trip-related variables school trips and parent's transit use. It means not only one's own variables (including socio demographic, situational and psychological variables) are influential on mode choice behavior, but also role in a household unit is interestingly effective on mode choice behavior for commuting trip.

Besides the examined variables in current research, considering other variables related to mode's specification and features of the decisional situations (e.g. weather and purpose of trip) would lead to higher explanation of the variance. In addition, while the current model revealed primary evidence, employing more capable models such as structural equation modeling would provide examination of different pattern

of combination of the variables which would lead to better understanding of complicated relationships of the influencing factors.

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