

Car Use Behavioral Study for Commuting Trips: Parents' Work Trips and Children's School Trips

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Received: 23. 03. 2016 Accepted: 31. 12. 2017

Abstract

Negative consequences of car use along with deficiencies for investment in environmental friendly modes, have driven authorities to search for soft measure in order to encourage people for modal shift. The main objective of this study is to propose a model which describes car use behavior on parents' work trips and how this relates to mode choice regarding their children's school trips. A questionnaire survey was carried out in 24 randomly selected primary schools in Tehran, Iran (n=4000). A mean structural analysis based on the sample (returned questionnaires =1876) demonstrates that parents who accompany their children on school trips have a stronger intention to use car for work trips than parents who do not accompany their children on school trips. A structural equation model based on the theory of planned behavior suggests that using car on school trips along with car use behavior for work trips, significantly increases the car use behavior for work trips. Findings suggest that individuals as parents, and also parents who accompany their children on school trips need to be considered in planning and policy setting for modal shift providing soft measures sensitive to this issue, since parents are highly influenced by their parental roles involved with children's requirements in school trips.

Keywords: Car use behavior, mode choice, theory of planned behavior, commuting trips, escorting children to school

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**207 International Journal of Transportation Engineering,
Vol.6/ No.3/ (23) Winter 2019**

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1. Introduction

Although private car has been the dominant transport mode for several decades, urban areas are struggling with issues such as emissions, urban congestion, safety problems and overweight (especially in children) [Nelson, et al.2008]. Losses of life and property and resulting social, cultural and economic impacts have threatened human societies [Broujerdian, Dehqani and Fetanat, 2015]. These effects have finally induced an international focus on influencing people's travel mode use in an environmentally sound direction (e.g. from car to public transport). In order to develop efficient policies for influencing mode shifts, a better understanding of existing patterns of individual's mode choice behavior is needed.

Traditional mode choice behavior analysis principally focuses on socio-demographic factors, specifications of travel mode and context (e.g. weather, day of travel, purpose of trip). In recent decades, however, environmental psychology has been successfully applied in travel mode choice analysis [Klockner and Matthies, 2009]. The new perspective generally focuses on psychological and social characteristics such as subjective norm, perceptions and intention. De Witte (2013) emphasizes that traditional factors determine "the possibilities with respect to mobility" while the latest factors "influence how these possibilities are acted upon". Research indicates that the psychological perspective is performing better in predicting travel mode choice than socio demographic and infrastructure differences [Donald, Cooper and Conchie, 2014]. The psychological perspective is also important because many authorities, particularly in developing countries, do not have the financial resources to invest in the public transport sector. This necessitates "soft measures" in order to encourage individuals to shift from private to public transportation [Meloni et al.2013].

Two main trends can be pursued in the psychological perspective. The theory of planned

behavior (TPB) [Ajzen, 1991] emphasizes the role of intention and perceived behavioral control (PBC) as predictors of behavior. Intention in turn is predicted by attitude, norm and perceived behavioral control. The second focus has been on environmental behavior caused by normative considerations (i.e. to give up certain personal benefits for the benefit of the collective). Here, the norm-activation model (NAM) has been an influential theory [Schwartz and Howard, 1981]. The theory includes personal norm, environmental awareness of consequences and environmental awareness of need. Both theories have been successfully applied in modal choice analysis while a comparison between the models performed by Bamberg & Schmidt (2003) indicates that models based on the TPB show a better predictive ability. TPB was successfully utilized in mode use behavior studies [e.g. Lo et al.2016 ; Kaewkluengkrom et al. 2017 ; Frater, Kuijer and Kingham, 2017].

Commuting trips represent the most considerable share of daily trips and mode choice on these trips has accordingly received substantial empirical attention [Mamdoohi, Seyedabrishami and Baghestani, 2015 and Chakrabarti, 2017]. However, fewer studies have focused on the role parents have in choosing transport modes for their children's school travels. That is, parents are usually making proper accommodation in their mode choice behavior due to the requirements of their children [Ehteshamrad, 2017]. Children have different mental and physical abilities than adults which makes them totally dependent on their parents [Mackett, 2013]. As a result parents are always involved with their children's requirements: they usually have concerns about security and safety issues during trips [Park, Noland and Lapchappelle, 2013] and finally they are the ultimate decision makers of their children mode choice behavior [McMillan, 2005]. Especially in households with primary-school children, parents prefer to make necessary changes in their own mode choice behavior to answer the requirements of their children's daily school trips [Ehteshamrad, 2017].

The objective of this study is to contribute to the debate on individual's car use behavior as a parent. Applying the TPB, first a mean structural analysis is performed to show whether a significant difference exists in car use intention for commuting trips between two groups of escorting and non-escorting parents. Second, a structural equation model is proposed to illustrate different variables influence on car use behavior originating from intentional and ability related variables as well as parental role in household (children's school trips characteristics) and habitual manner.

The rest of the paper is organized as follows: section 2 describes data collection and measures, data analysis and default models. Results are reported in section 3. Section 4 discusses the results. Finally conclusions and further researches are summarized in section 5.

2. Methodology

2.1 Data Collection

A survey was conducted in Tehran, Iran, from April 21st to May 10th, 2015. A total number of 4000 questionnaires were randomly distributed among students of 24 primary schools (half girls/boys and half private/public school) picked randomly from 6 greater zones in the city. The questionnaires were requested to be filled by parents. A total number of 1876 questionnaires were returned indicating a return rate of 47.39 percent.

2.2 Measures

The questionnaire consisted of different sections: respondents' attitudes, subjective norms, perceived behavioral control and intention toward car use for work and school trips. The questionnaire items had been validated previously [Bamberg, Rolle and Weber, 2003].

Attitude refers to the degree to which a person appraises or evaluates the behavior in a favorable or unfavorable manner. Attitude was measured through two items: "For me, to use car from our current place of residence to my work place is overall good/pleasant". Subjective norm

describes the perceived social pressure to perform/not to perform a behavior. Two items were used to measure this construct: "Most people who are important to me would support using car/ think that I should use car from my current place of residence to my work place". Perceived behavioral control indicates one's perception of ease or difficulty of performing a behavior. PBC was measured through "For me, to use car from my current place of residence to work place is easy" and "most people who are important to me think that I should use car from my current place of residence to work place". Finally, intention is assumed to capture motivational factor which indicates how hard people are willing to perform a behavior [Ajzen, 1991]. Two items were used to measure intention: "I intend/try to use car from my current place of residence to my work place". Each item was scored on a Likert scale 1 (strongly agree) to 5 (strongly disagree).

The response frequency measure (RFM) [Verplanken, Aarts and Knippenberg, 1994] was utilized for measuring habit. In this regard, respondents were asked which mode they would choose for grocery shopping/ other shopping/ visiting family and friends/ going to a park and going to a restaurant. RFM is then defined as the total times that car is chosen among other means of transport.

2.3 Data Analysis

Based on a pilot survey, the questionnaire was tested and a limited number of interviews were accomplished to correct any misleading questions. Cronbach's alphas were calculated to assure structural validity and reliability of the scales. Prior to model estimation descriptive statistics were conducted. Furthermore, two multivariate analyses were carried out:

- 1- A mean structural analysis in order to investigate whether there were significant differences between escorting and non-escorting parents in car use intention for work trips, and
- 2- A structural equation model was applied to investigate the relative role of the TPB variables as well as parental role in

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household regarding school trips and habitual manner on car use behavior for joint commuting trips.

Both models were performed in the Amos Graphics 22 software package.

2.4 Default Model

2.4.1 Structural Mean Analysis

Intention section of theory of planned behavior was utilized in this section (Figure 1), where intention was predicted in a structure by attitude, norm and PBC. To show the difference between escorting and non-escorting parents, the structural mean of intention of two groups were compared: group A including parents who escort their children to school more than two times a week, and; group B including parents who escort their children to school at most two times a week.

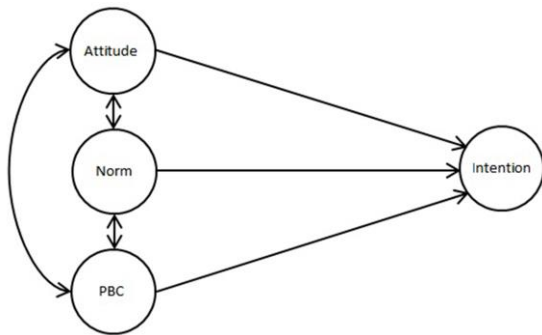


Figure 1. Conceptual model for structural mean analysis of intention to use car on joint commuting trips (Ajzen, 1991)

2.4.2 Structural Equation Model Predicting Car Choice on Joint Commuting Trips

Based on the theory of planned behavior, the default model was considered as proposed in Figure 2. The dependent variable is car choice [see also Klöckner & Blöbaum, 2010]. It is defined as the total number of times of reported trips by car divided by total number of trips. As proposed in the model, not only the intentional and ability aspects of car use for work trips are influential, but also the parental role regarding

school trips are assumed to be influential on the car use index. This includes the car choice index for school trips and the escort index while considering perceived distance to school. This is based on the hypothesis that using car for work trips among parents is related to their manner toward their children's school trips as well: whether they escort their children or use car for school trips. In addition, the relative role of habit on mode choice behavior was tested.

3. Results

3.1 Demographic Characteristics of the Sample

Descriptive characteristics including gender, age and education of parents as well as the children are summarized in Table 1. Additionally, 39 percent believe their income are lower than the average income of a typical household in Tehran, while 38 percent believe it to be similar and 23 percent believed it to be higher. Furthermore 6 percent of the respondents do not own a vehicle and 75 own one vehicle while others have two vehicles or more and 90 percent have driving license.

A total of 56 percent escort their child to school four times or more a week and 18 percent never escort their child to school. 28 percent of the children are never escorted to school neither by the respondents nor by other members of the household.

3.2 Test of Reliability

Validity tests showed that all the measurements had satisfactory Cronbach's alphas above 0.75 (attitude: 0.782, subjective norm: 0.882, PBC: 0.753, intention: 0.901).

3.3 Structural Mean Analysis

Prior to comparing the structural mean of the two groups, model fit for default model as a whole and for groups A and B was tested independently.

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As shown in Table 2, totally, comparative indices are close to 1, parsimonious indices are above .5 and the goodness-of-fit index, χ^2 , did not reach achieved for s confirms a

well-fitted structure for both groups and the whole data. This is essential since comparing means of different groups with a non-fitted structure causes an invalid analysis [Schumacke and Lomax, 2012].

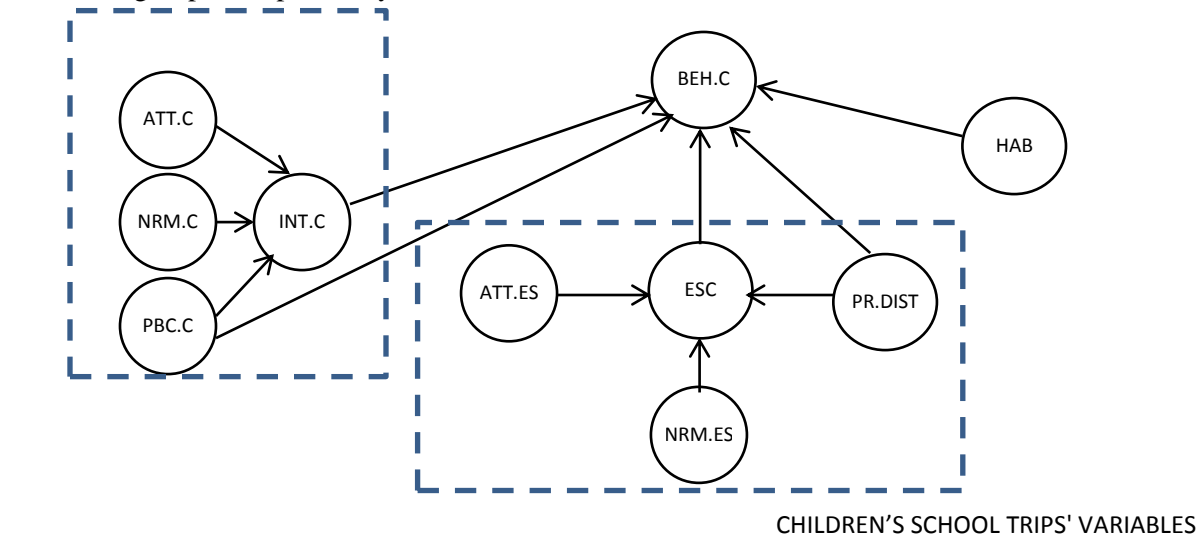


Figure 2. Conceptual structural equation model

ATT.C: attitude to car use for joint commuting trips, **NRM.C:** norm to car use for joint commuting trips, **PBC.C:** perceived behavioral control for car use for commuting trips, **INT:** intention to use car for joint commuting trips, **ATT.ES:** attitude to escort child for school trips, **NRM.ES:** norm to escort child for school trips, **PR.DIST:** perceived distance to school, **ESC:** escort index, **HAB:** habit of car use (RFM), **BEH.C:** average car use index

Table 1. Demographic characteristics of survey participants

Demographic Characteristics	n (%)	Demographic Characteristics	Relative frequency (percent)
Gender (parents)		Gender (children)	
Male	53	Male	36.9
female	47	female	63.1
Age in years (parents)		Age in years (children)	
mean	40.04	mean	9.65
SD	6.54	SD	2.09
Education (parents)			
high school education or lower	41.6		
Bachelor & Associate Degree	39.3		
Master & PhD	19.1		

Table 2. Model fit indices

Index type	Index	Default model		
		Group A	Group B	Total

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Comparative	CFI	.974	.986	.981
	TLI	.961	.953	.959
Parsimonious	PNFI	.564	.571	.569
	PCFI	.576	.543	.559
Absolute	X ²	354.042	412.486	30.024
	P-Value	.248	.879	.554

Another central assumption of structural mean comparison is the equivalency check of parameters' estimation in groups. While some researchers reasoned that *all* measurements are required to be equivalent [Byrne, 2001], others argued that equivalency of some (but not all) measurements are adequate [Kline, 2005]. This assumption was tested with a χ^2 test. As shown in Table 3, the p-value of $\Delta\chi^2$ indicates that the measurements of two models were similar.

Table 3. Comparison of χ^2 in constrained and unconstrained models

Default Model	χ^2	df	p-value
Unconstrained	390.024	22	.554
constrained	373.801	12	.224
Difference	16.223	10	.118
Critical χ^2	18.307	-	-

Assuring that the assumptions are met, group A was labeled as the reference group and the mean of the intention was set to zero. The mean of group B was subsequently a relative difference to the mean of the reference group. Table 4 summarizes the structural mean analysis.

Table 4. Results of analysis of mean structures

	index	
	Difference of mean	
Significance of difference	Difference of mean	-1.703
	S.E.	.061
	C.R.	-4.630
	P-value	.000
Fitness Indices	X ²	377.804
	P-value	.234
	PCFI	.501
	CFI	.978
	RMSEA	.047

Table 4 shows that there was a significant difference of 1.703 between the mean of intention of groups A and B. The minus sign shows that the mean of Group B was lower than in the reference group. Additionally fit indices of group B indicate a well-fitted model.

3.4 Structural Equation Model To Predict Car Choice Index

The final step was to test the fit of the hypothesized model (Figure 1). As shown by the fit indices ($\chi^2=378.21$, $df=17$, $p<.001$, $RMSEA=.053$, $CFI=.99$), the model shows a satisfactory fit structure to the data.

The default model explains 36% of the variance in the car use index. Except for the paths $PBC \rightarrow BEH.C$ and $ATT.ES \rightarrow ESC$, all other paths are statistically significant. Intention to car use for joint commuting trips, perceived distance to school, as well as escort index along with habit to use car are found to be positively related to car use behavior. Contrary to the TPB, PBC is found to be just indirectly related to car choice index, mediated by intention.

β -weight of attitude, norm and PBC show to be significant for which duplicates the result of previous researches [e.g. Donald, Cooper, & Conchie, 2014].

The variables of school trips appear to be positively related to the car choice index. The escort index is the third (after perceived distance with regression weight of 0.272) strongest predictor of behavior. Perceived distance to school exerts both direct and indirect effects on the dependent variable.

The significant and positive β -value of habit implies that the habitual factor influences a traveler's car use behavior as well. Additionally, comparisons of the regression weights suggest

that intention appears to be the most influential factor on car use behavior. This implies the strong intentional aspect of the behavior.

4. Discussion

The main objective of present study was to investigate the relative role of regarding school trips of children on car use behavior for joint

commuting trips. Precisely, two issues were considered in this regard: first whether there is any difference on car use intention for work trips between escorting and non-escorting parents, and second; whether escorting and school-related variables trips have any influence on car use index for joint trips.

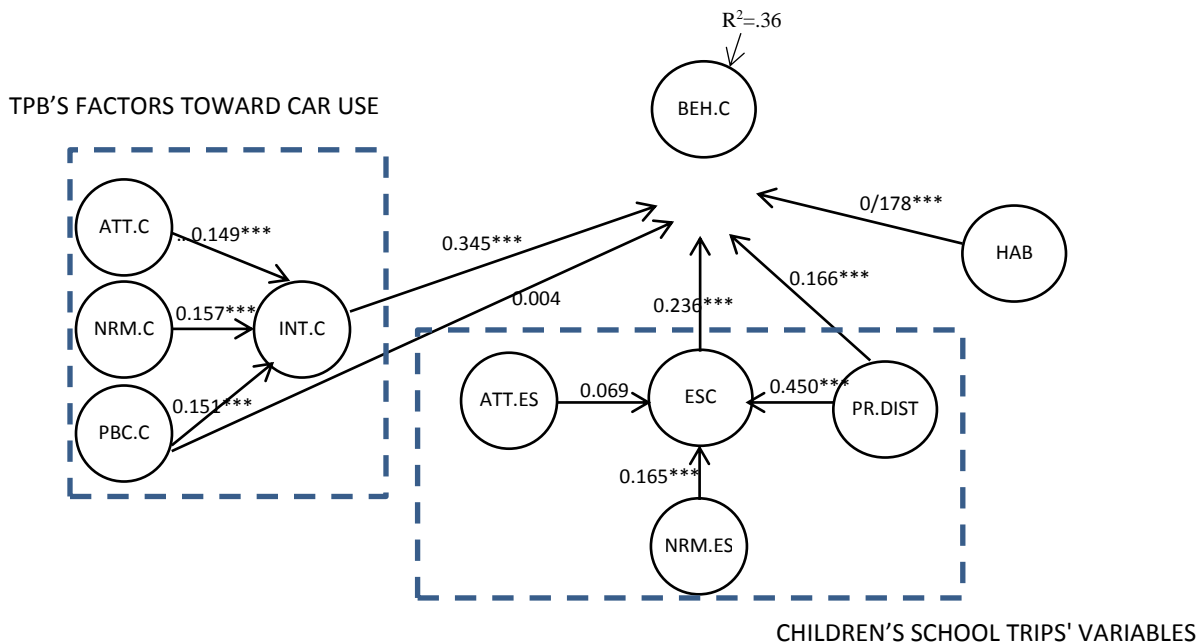


Figure 3. Result of model estimation: Adjusted β -weight (**p-value<0.05)

Results show that parents who escort their children more than two times a week use car for work trips 1.703 more than other parents. This indicates, while adjusting for all other variables between the two groups, that parents will show higher intention for car use in joint commuting trips if they escort their children to school, whereas they may have a lower intention to use car if they did not escort their children. This result shows that in the domain of modal choice behavior analysis, the role of individuals in households is worth considering for a more clear behavior prediction. Among escorting parents, 67 percent stated that time and route of the work and

school trips are rather to highly similar. Despite 48 percent of them stated that school is close to home (mean=3.38, S.D. =2.07), they used their car for escorting purposes and continued their route to work (mean distance=12.81, S.D. =10.9). This indicates that they intended to use car in order to drive their children to school. Therefore, car use for school trips, which is a decision made by parents [Park, Noland and Lachapelle, 2013], may influence the parents' car use also for their own commuting purposes. This result supports the idea that considering car use for school trips can effectively broaden the knowledge about parents' car use in commuting trips.

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The proposed SEM model provided more precise evidence of how parents' car use behavior is under the influence of variables related to school trips. While parents are the ultimate decision makers of their children mode use, their own mode use seems to be influenced by driving children to school. Positive significant β of escort index for school trips suggests that as escort index increases, car use grows among parents for joint commuting trips by car. Remembering results of mean structural analysis, the overall result is that parents, who escort their children, organize a travel chain to drive their children to school and continue their way to work place. Additionally, distance showed to be influential on car choice index directly and indirectly. Further distance to school lead to more escorting as well as more car use for school trips.

It is to be noted that the absolute distance is not considered in this study. However, the perceived distance is taken into account which has the advantage of capturing parental considerations about children's trip distance. To illustrate, since children are different from adults in their mental and physical capabilities, a short distance for adults may be considered as a long distance for a child. On the other hand, different parents may judge distance in different ways. This difference is originating from own risk seeking/aversion manner as well as expectation of children considering the unique characteristics of each child. Therefore considering perceived distance instead of the absolute value is considered to be capable of capturing different issues regarding distance.

Furthermore, habit shows a significant β which emphasize on the unreasoned aspect of the behavior: the more frequent people use their car for other trips, the more they use car for joint commuting trips as well. This duplicates the result of previous researches [e.g. Klockner and Matthies, 2009; Ching-Fu and Chao, 2011].

PBC of car use for work trips was found to have indirect relation to car choice index through intention. Where using car is perceived easy, it is more frequently used for work trips.

Additionally, β -weight of attitude confirms that favorably evaluating of car use, positively effect on intention to use car for joint commuting trips. Furthermore, receiving support or perception of social pressures from others will lead to a greater intention to use car for joint commuting trips.

Worth mentioning that intention showed to be the most powerful predictor of car use behavior which emphasize on the intentional and reasoned aspect of the behavior. This is followed by perceived distance and escort index which shows supports for our hypothesize that parental role in household regarding school trips of children influence on car use for work trips significantly. We found support for the TPB framework in predicting car use behavior in work trips. However adding habit and mentioned variables of school trips added to the explained variance in car use index, as hypothesized. This suggests that it is important to consider habit and parental role regarding school trips by car, while studying car use of parents for joint commuting trips.

5. Conclusions and Suggestions

Our study has shown that intention to use car for joint commuting trips are higher among parents who escort their children to school. Further analysis confirms that escorting and using car for school travel are both influential on parents' car use behavior. Parents, who escort their children or use car for school more often, drive to their work place more often as well. Additionally, since commuting trips are performed as a daily activity, considering habit in studying car use behavior captures the unreasoned aspect of the behavior. An implication is to take into account the car use behavior of school trips while studying car use behavior of parents for joint commuting trips. This becomes necessary while soft measures are planned in order to decrease car use for work trips. Furthermore, escorting children is another important issue that should be considered in this regard, since it increases car use intention as well as car use behavior among parents for joint commuting trips significantly. From a broader point of view, promotion of car

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use behavior change are required to be sensitive to escorting manners among parents with primary school children.

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