Investigation of School Students' Travel Patterns, Two Case Areas of Mashhad, Iran

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Abstract

Educational trips produce about 25 percent of the overall traveling within the city. A considerable share of the educational trips includes the elementary school students' commuting, which largely depends on the parental behavior and decision. This paper presents a report of a survey undertaken throughout the four residential neighborhoods selected from the Metropolitan Mashhad, Iran. The results showed significant differences between the travel patterns of the students at the neighborhood level. Household income, gender, driving license, and the distance from home to school were found to be the most important factors affecting the choice of mode. For the high-income households, the selection of the school depends on the school's overall quality rather than just the distance criteria. Girls found to be less interested in walking, partly, due to having no sense of security along the way to school. Owning a private car parking showed a significant association with all the travel modes although this variable, in turn, is affected by the household economic status and the quality of the residential unit. The parents' use of car was more likely when a student had a mother licensed to drive. The study recommends refining the policy of the spatial distribution of the schools, and designing the inter-connected street networks, sidewalks, and the other elements together in order to encourage walking and cycling as the sustainable modes of travel.

Keywords: Urban planning, Sustainable transport, School, Student, Mashhad

1. Introduction

Using a vehicle has become the main mode of journey for school students among the high and the middle-income Iranian societies. Less willingness can be observed to choose more sustainable and environment-friendly options such as walking and cycling due to various reasons even when traveling for short distances. Most schools have a high proportion of students who are driven to school by parents. This issue is not only a concern to increase the traffic volume within the city, but also has negative health consequences. Using cars frequently limits the students' presence in public spaces and oppurtunities available to make them more socialized. On the other hand, using collective mode of travel or choosing non-motorized options such as walking and cycling - called Active Travel to School (ATS) - make a kind of active and dynamic presence in urban environments. Of theory ground, a sustainable mobility pattern is based on a reasonable travel time and induces an appropriate level of physical activity thus reducing the negative impacts of movement (Banister, 2008).

In most western countries, programs to promote safer walking and cycling to school have been started. For example, American " Safe Routes to School (SRTS) " is a national program encouraging children to walk and bike to school. SRTS attempts to help children to become more physically active by seeking ways to improve infrastructure, education, and enforcement of safety laws (Safe-Routes website, 2011). However, in the majority of developing countries like Iran, no specific strategic plan has been developed to cope with the problem yet. In fact, in these countries, walkability of the environment has not been necessarily a priority in the decision-making process for school and land use planning.

It seems that some environmental factors such as the distance between home and school, traffic safety, and the quality of street network at the neighborhood level can encourage students to walk or bike to school (McMillan, 2005, p4). In addition to the environmental factors, the personal and social environment and the parental decision-making have significant roles in selecting a mode of travel by children. Therefore, the relationship

between the mode of travel, physical attributes and socio-economical characteristics is complex and nonlinear. Investigating this complexity and its causes and effects can identify some common patterns exist in students' commuting to the elementary school. Identifying the factors affecting household decision-making regarding children movement may help planners and policy makers to find solutions in reducing car dependency. Previous studies on the students' travel patterns have involved North American or West European cities and thus their findings are not necessarily transferrable to the developing societies, where the socio-economic statutes are significantly different.

This paper tries to explore the travel patterns of the elementary students, and find out the determinants of the parents' decision to send children to school. The identification of consistent correlations of the students' travel activity would help to refine the land use and the school planning policies to improve the level of physical activity. This paper consists of four parts. The following part is an overview of the literature. The third section introduces the case studies and the way of collecting data, and the forth section presents the results of some comparative analyses, and summarizes the model estimation results and the findings of the study. The last section offers a number of concluding views and some directions for further research.

2. Literature

2.1 Neighborhood unit and elementary school

The neighborhood concept has been used by planners as the principal building block in city design and it is closely linked to the understanding of community and the localism. The notion of " planning by neighborhoods " was first introduced by Lewis Mumford several decades ago (Madanipour, 2001). The neighborhood has been seen as a suitable unit for planning, mainly because at that level, the residents and other stakeholders can account for its unique needs and appreciate its unique assets (Burkholder et al., 2003). In this way, the planning area boundaries are defined by the neighborhoods within the proposed planning area. Comparing with the city-wide comprehensive planning approaches, the neighborhood planning approach generally is more responsive to the local characteristics, desires, and problems (Horn, 2004).

" The neighborhood can be a small world where meaning is created, where children are socialized and go through the process of self-identification " (Madanipour, 2003, 139). According to the classic idea of community planning by Clearnce Perry (1929), the school is explicitly located in the center of " neighborhood unit ". the concept of a walkable neighborhood is defined by a catchment of 400 m radius, or 5-minute walk, to determine the threshold for the provision of the schools, shops and community services within the walking distance of the home (Curtis and Olaru, 2010). In fact, the local school is one of the cornerstones of the community life.

In the Iranian traditional cities during the Islamic era, neighborhoods were identifiable based on the ethnic and the kinship features, thus dividing the society into the structural and spatial-racial categories. However, the neighborhood-based local communities were the foundations of Islamic urban societies. The society was strictly organized on a territorial basis in which the local school (*Mektebhane*) and the mosque (*Masjid*) played central roles. These two elements were not only the centers for the cultural and religious purposes, but also the spatial grounds to foster the social connections. They evolved, then, to become focal points for the local people participation, thus to help strengthen the communities through the increased interaction of the people (Farkicsh et. al. 2009).

The emphasis on establishing a community based on the neighborhood unit has been criticized. Today, neighborhoods are reminders of a community without the reality of community (Horn, 2004). The concept of neighborhood planning is associated with the risk of encouraging segregation and parochialism. Since the neighborhood planning is done in a small scale, it presents the economic, political, and logistical difficulties which are originated from the citywide or regional levels (Burkholder, 2003). The neighborhood concept cannot be easily developed in a big city because of the changing lifestyle in the modern societies. Cities exist as people can move and choose the places of recreation, work, shopping and even their children's education. Families are provided with a large set of choices including educational opportunities (Tonkiss, 2006, 83). The transition and the displacement of the population towards the outer suburbs is one of the main factors discouraging the use of the local services including schools available within the neighborhood boundary. Many families prefer to register their children in a high quality school rather than care for the travel distance (EPA, 2003). However, the physical accessibility still remains a crucial factor in choos a school.

2.2 movement pattern

The perceived quality of the residential neighborhood is the main factor that encourages or discourages the presence of the children. The environmental quality has a direct impact on the frequency rate of the children

presence. The children attendance in the urban spaces gives them opportunities to play and communicate with other children. Neighborhood is where the children can learn to be social and can form their own identity (Madanipour, 2003, 139). The parents usually feel safe letting their children walk independently in dense areas owing to numerous people on the streets (Jacobs, 1961). Walking along the streets can be more attractive than attending in playgrounds for the children. Commuting to schools can offer them an opportunity to enjoy.

Meanwhile, the studies conducted in different countries indicate that the children's walking to school has dropped significantly during the recent decades. In contrast, the trend towards the dependency on parents' private transport has increased. For example, the number of the children who walk or bike to school in the U.S. has decreased dramatically from 50% in 1969 to only 15% in 2001 (EPA, 2003).

2.3 Factors affecting students' mode of travel

Investigation of the factors affecting commuting patterns has a long history. The study of educational trips as a significant portion of daily trips has received considerable attention in the literature. Some of findings from the past studies are as follows. Increasing the distance of residence and the place of education increase the willingness to traveling by car, and, at the same time, decline the tendency to walking. In contrast, closer proximity encourages more walking. Living within a 400 m of school seriously increases the likelihood of walking or cycling to school across all racial groups (Dellinger and Staybtib, 2002). According to an American study, 31 percent of the children that live within 1.5 km of school walk, compared to only 2 percent of the children living within 2 or 3 km of school (McDonald, 2008). If the distance to school decreases to a 10-minute walk or 800 m, the percentage of those who would walk will increase by 129 percent (Ewing *et al.*, 2004). School sitting and location determines the distances students must travel between the home and the school; therefore, shorter distances are the best ways to encourage an active travel to school (EPA, 2003).

The neighborhood design is more important for the short school trips and for younger children (EPA, 2008). The design of the neighborhoods and where the work takes place in relation to the home all have some impacts on where a household places the school trip, and also on the corresponding mode choice within the daily pattern of activities (Faulkner *et al.,* 2010). The suburban counties have somewhat higher walk rates than more urban counties (Stiener, 2011). Students living in dense urban areas are less willing to take the bus to school and more dependent on their parents' vehicle (Ewing *et al*., 2004). Decreasing residential density and increasing the number of students per school generally result in fewer children living near their school. A residential density of nearly 400 people per square kilometer is necessary to sustain a 300-student community school in which all the students could commute by walking or cycling (assumed maximum travel distance: 1.6 km) (Wilson *et al*., 2010). The active travel from the school to the home was also associated with the lower residential densities and the lower neighborhood incomes (Larsen *et al*., 2009). The mixed land use areas could contain inadequate activities for children's safety and thus make parents more likely accompany their children during the school travel. The large blocks with a long distance between the intersections are negatively associated with bicycling to school (Ulfarsson and Shankar, 2008).

Improvements in the physical environment, such as sidewalks, traffic calming measures, and the well-designed crosswalks, can make walking and cycling to school more desirable and safer (Ewing *et al*., 2005). The existence of the high ratio of trails and bike paths has a positive effect on walking and cycling (McMillan, 2003). Against this, unsafe trails can be a negative element in choosing walking as a mode of school travel (Ridgewell, 2005). The high volume of motor traffic passing through the network surrounding the school negatively affects the walking level by elementary children (O'Conner, 2007). The lack of lights or crossings reduces the likelihood of walking or cycling to school (Weigand, 2008). The more children are exposed to traffic on their way to school, as measured by the number of intersections they have to cross, the greater is their risk of being hit by a car (Ewing *et al*., 2004). Landscape buffers and trees add to parents' perceptions of their children's safety and increase their willingness to let their children walk to school (Weigand, 2008). Parental decision is primarily influenced by the concerns about the traffic and the child's personal safety (Faulkner *et al*., 2010).

Despite the influence of the built environment, the most common reasons in using cars are cited in the parental attitudes and the socio-economic characteristics (Ridgewell *et al*., 2009). Numerous household conditions such as income, vehicle ownership, education level, employment status, and the social background are related to the school travel. Some natural environment features such as weather or season have a strong influence on the choice of the transport mode for students (Muller *et al*., 2008). Students living in the neighborhoods with a high proportion of new residents have less willingness to walk to school (Mc Donald, 2007). Due to various reasons such as the low access to the school bus service or higher affordance, some students are more likely about to take a car to school (Yarlagadda, 2008). The school quality influences the school travel. When the parents perceive the

neighborhood school to be of a higher quality, their children are more willing to walk (EPA, 2008). Parents would likely prefer to send their children to nearby schools, but some high-quality schools may offer some dimensions (curricular, quality, or other factors) that subsume the desire to send their children to the nearest school (Wilson *et al*., 2010). Children may follow other friends. It is possible that the parents living in the same neighborhood interact with one another and share experiences about the school travel of their children. When other children use a mode like cycling or walking, this creates a positive externality through improving the safety of bicycling and walking, thus increasing the utility of these travel modes for any particular household in the neighborhood (Sidharthan *et al*., 2010).

These results are related to the developed countries and may not be easily transferable to the circumstances of a developing country like Iran. Unfortunately, almost no other studies have investigated the travel to school, and since the transition from the developed countries might be critical, research in this area is important.

2.4 Conceptual model of research

The most important factors affecting the school travel patterns are shown in Figure 1 as a conceptual model derived from the results of the previous research. According to this model, the influential determinants of the mode of the students' travel can be classified into five categories: household characteristics, characteristics of parents, student's individual characteristics, urban physical attributes, and the school trip attributes.

3. CASE STUDY AREA

3.1 Sampled neighborhoods

The case studies were selected from Mashhad metropolitan area, the North-East of Iran. Metropolitan Mashhad is the second largest city in Iran in terms of the population, located in *Khorasan-e-Razavi* Province at North-East of the country and close to the borders of *Afghanistan* and *Turkmenistan*. It is the most religious and touristic city in Iran and it hosts over 20 million travelers and pilgrims annually because of accommodating the holy shrine of the 8th Imam of *Shiite*. Accordingly, it is recognized as the second religious metropolis in the world. The population of Mashhad is 2.4 million and its area is around 294 km square. Within the past 50 years, the city has grown ten-fold. Around 80 percent of the metropolitan area has low density areas. The average density of the metropolitan was 83 people per hectare in 2006 (Shakeri, 2010). The widespread sprawl pattern of the metropolitan makes it difficult and costly to service it by the conventional transit systems. Therefore, the car is the main mode of travel. According to a recent statistics on the urban traffic of Mashhad, approximately 53 percent of the people use their private car or the taxi, 24 percent use the bus, 14 percent walk or ride a bike, 5 percent take the motorcycles, and 3 percent was not reported. These trips can be categorized based on the trip purpose: work-related (39 percent), educational (24 percent), shopping and personal business (19 percent), social (14 percent), unreported (four percent) (Farnahd consultant, 2009, p 25). This data confirms both the car dependency and the important share of the educational travel.

This research is limited to two municipality regions out of the total of 12 regions: Region 1 with an area of approximately 2100 hectares and nearly 300 thousand inhabitants and Region 3, with an area of approximately 1375 hectares and roughly 170 thousand inhabitants. Two sample neighborhoods were chosen from each region and were investigated further. These neighborhoods were Malekabad (M) and Ahmadabad (A) from Region 1, and Fatemieh (F) and Gas (G) from Region 3.

It should be noted that the determination of the boundary of the neighborhoods was affected by the social norm and not necessarily by the homogeneity of the neighborhood context in terms of social and physical characteristics. The general characteristics of the selected neighborhoods are provided in Table 1. On the average, the property value (price) and the average parcel size are greater in the neighborhoods A and M than those of the two other neighborhoods, F and G. The neighborhood A has the highest level of dwelling density (floor area ratio) while the neighborhood G has the lowest. In fact, the first two neighborhoods are well-known as accommodating high-income residents while the two other neighborhoods have relatively low-income residents. The detailed comparison of the collected data indicates significant differences of physical features including the average floor area and the parcel size among the case study neighborhoods. Generally, these neighborhoods are different in terms of the urban, physical, and socio-economic status.

3.2 Sample size of the survey

Overall, there are 9 elementary schools throughout the four neighborhoods. A survey using questionnaires was conducted to collect the information regarding the school travel patterns. The main content of the questionnaires was about the students' mode of travel both to and from the school as well as the behavioral, demographic, and

environmental questions. However, only the mode of going to school was analyzed in detail. The survey was conducted from November to December in 2009.

Considering the population size of 2972 students - aged between 6 and 10 years- studying in these elementary schools, the sample size for the questionnaire survey was determined. According to the research nature and its limitations, 10 percent error is considered. Based on the proposed formula to determine the sample size (Israel, 2009), the number of the required samples was 232. While 500 questionnaires were distributed randomly among the students, only 315 questionnaires were returned (the response rate was 63 percent). GIS was used to include only those students who lived within 1.6 km of the school, therefore, 60 cases were removed. This was because of the claim of some former studies that children are more likely to walk to school if the distance is no more than 1 mile (1.6 km) (Schlossberg *et al*., 2006; McDonald, 2007; Larsen *et al*., 2009). Also 17 cases were removed because they were not completed carefully. The distribution of the questionnaires is detailed in Table 2. 4- DATA.

4. ANALYSIS

4.1 Primary findings

There is a considerable difference between the modes of travel by students living in different areas. Six alternatives were available for students to choose: walking, cycling, vanpool, public transportation (bus), employed parents' vehicle, and non-employed parents' vehicle. While 61.5 percent of the students living in the neighborhoods F and G walk to school, only 18.5 percent of those living in the neighborhoods A and M go to school on foot. In these two neighborhoods, the parents' vehicle is the main mode of travel with a share of 44.0 percent while this figure for the two other neighborhoods is only 18.5 percent. On the other hand, using the public bus (2.8 percent) and the cycling (1.7 percent) have the lowest shares without a significant difference among the neighborhoods (Figure 2).

According to the self-reported information, the modal choice was affected by the gender. Being 1.9 times more willing to walk, the male students walk by the threshold distance of 700 m. In contrast, the female students showed more interest in the use of private transportation services and also showed interest to walk to school if the distance to school is less than 300 m. A similar result was found by McMillan (2006) and Larsen *et al*. (2009) in California and Toronto, respectively. It seems that in the neighborhoods with the high-income residents, the distance from the school is of little importance to choose a mode of travel. In the low-income neighborhoods, the proximity to school encouraged students to choose walking.

4.2 Development of modal choice prediction model

To explore the potential effects of different factors on the modal choice, a multinomial logit regression (MNL) model was developed. Based on the available data, several explanatory variables were considered. Self-reported demographic variables included: the age and the gender of the student, the education status of the mother, the education status of the father, the household income, the housing price (value), driving license for the mother, driving license for the father, the household size, the number of vehicles available, and the number of students in the household. The following physical characteristics of the neighborhood were included: the housing type (single detached homes, apartments), the floor area, the existence of the private car parking space, the reported distance to school and the route directness (calculated objectively as the ratio of block distance to Euclidian distance). To avoid multicollinearity bias during the regression analysis, some of the explanatory variables were, then, removed initially. It should be noted that due to the low share of the three modes, including the bicycle (1.7 percent), and the public bus (2.8 percent), they were eliminated from the choice set available for a student. Therefore, the number of observations decreased to 220 cases, and the share of the main modes for the final sample of school trips is as below: walking 43.2 percent, vanpooling 26.2 percent, employed parents' vehicle 23.3 percent, and non-employed parents' vehicle 10.3 percent.

To develop a mode choice model, the random utility framework was used which assumes that the modes have utilities, and that families show utility maximizing behavior when selecting the mode. This approach was firstly developed by McFadden (1973) and since then it has been broadly applied in the fields of modal choice modeling (Ulfarsson and Shankar, 2008; EPA, 2003; McMillan, 2003; Ewing *et al*, 2004). The modeler assumes the utility U_{ij} of a travel mode *i* to a student *j*, and includes a deterministic part V_{ij} and an additive random part $\in_{ij}$ which represents errors in the model's ability to include all the elements that influence the utility of a travel mode to an individual (Eq. 1).

$$U_{ij} = V_{ij} + \in_{ij} \tag{1}$$

V_{ij} is linear in the parameters. Assuming that $\in_{ij}$ is independently and identically Gumbel-distributed across the individuals and the travel modes, the multinomial logit (MNL) model can be as follows (Eq. 2):

$$P_{ij} = \frac{\exp V_{ij}}{\sum_1^I \exp V_{ij}} \tag{2}$$

Where P_{ij} is the probability that the transport mode i is selected by the student j, and I is the choice set of different travel modes (Muller *et al*., 2008). The MNL model will capture most of the variables that affect the utility, or benefit, of choosing a particular mode for the school trip in question. The estimation is based on the maximum likelihood estimation procedure. Further discussion about the theory and the application of the logit models can be found in the relevant literature (McFadden, 1973; Ben-Akiva and Lerman, 1985).

The details of the model are provided in Table 3. The coefficient values, the odds ratio and Wald-statistics indicate the effects of the independent variables on the mode choice probabilities. The convergence of the MNL model was found to be satisfactory. The pseudo R-square as the goodness of fit measure of the model is 77.4 percent based on the Nagelkerke formula. In general, the pseudo R-square which is greater than 0.4 can be interpreted as a very good goodness of fit (Muller *et al*., 2008). With reference to these aspects, accordingly, the model appears to have good explanatory qualities.

The confidence level is assumed to be 95 percent, the non-employed parents' vehicle is defined as the reference category, and the parameters are set to zero. This means that all the other regression coefficients have to be interpreted in relation to this category.

Based on the results of the model, the effects of different variables on the modal choice of the students can be discussed. The household income is the only variable significantly associated with the likelihood of choosing all the options. Based on the variable coefficients, the households with high incomes tend to take children to school using the private transportation or the vanpool service. The negative coefficient of the household income to choose walking as a travel option means that the children from the high-income households prefer taking the private transportation to walking. McDonald (2005) has achieved similar results in his study in U.S. One possible explanation is that the households with the higher income have a greater vehicle ownership on the average, and may prefer to drive their children. The parental concerns about safety, infrastructure, and aesthetics may negate the potential of the children to walk to school (Kerr *et al*., 2006). Alternatively, the lower income households might not have the means or enough time to drive their child; instead they may rely on walking or busing (Wilson *et al*., 2010, p 2181).

Possessing the driving license by the mother is positively associated with choosing parents' car. This shows that the choice of the parent mode is important and the finding is consistent with the outcome of a study in U.S. that found walking or biking less likely when a household had more licensed drivers to provide rides (McMillan, 2002). The households who have a private parking area available are more interested in using the employed parents' car and the vanpool service. This variable showed a negative coffiecient with walking. As the car parking area is an indicator of the economic status and the residential quality, it seems that the variable plays a proxy role for the socio-economic status of the households,

Increase in the distance between the home and the school results in a decrease in the likelihood of choosing the walking mode. In contrast, it increases the likelihood of using the parents' car and the vanpool service. This is consistent with the studies of Schlossberg (2006), Ewing *et al*. (2004), and Jen-Jia and Hsiao-Te (2010) in the literature. Two statistically insignificant variables include the mother's education and the housing price.

5. Conclusion

An analytical comparison was made between the two types of neighborhoods with different urban, physical, and socio-economic status that substantially influence the school commuting and the travel behavior. Gender is also important as the male students prefer to walk a longer distance with a threshold of 700 m. In contrast, the female students showed more interest in using the private transportation services and walking if the distance to school is less than 300 m. This may partly be due to no sense of security along the way to school. Any new strategy to improve the physical activity through the active travel to school should be considered empowering, and target the female students and their parents (O'Connor, 2007). In the neighborhoods with high-income households, the distance from the school is less important in choosing the walking mode, while in the low-income neighborhoods, a reasonable proximity to school encouraged students to walk. In fact, the school quality influences the school travel. The selection of an elementary school for the households with high-income is more dependent on the overall quality of the school, not just the distance from the residence. For this reason, the high-quality schools may enroll a big share of students residing outside the neighborhood with less chance to walk to school.

The study found the household income as a crucial factor in selecting a mode of travel to school, so that the students in the high-income households use the private transportation in priority. On the other hand, the students of the low-income households consider walking as the main option to go to school, especially where the school is located in a reasonable distance. The household income is the only significant economic factor in selecting among the set of all available options. Furthermore, the mothers who have a driving license and access to the private vehicles tend more to drive children to school. The access to a private parking in the residential units is effectively significant in choosing a mode. The students who have a private parking lot available in the residential place are less willing to walk, but more likely to take a motorized mode.

These findings are consistent with the previous literature. According to the findings of this study, several physical and economical factors, such as the physical proximity, the quality of the school, and the household affluence affect the travel patterns of the elementary school students. Therefore, a combination of the land use policies and the educational policies which are working to maximize walkability and encourage their implementation are required to be considered by the authorities. Planning, sitting schools (where schools are built), and preparing the walk-zone guidelines should be in a manner to promote the physical activity among the students. Refining the policy of the spatial distribution of the schools and designing the inter-connected street networks, sidewalks, and the other elements together would help to locate the schools in the neighborhoods within an attractive and a safe walking distance, hearkening back to the Clarence Perry's Neighborhood Unit concept for community planning (Weigand, 2008). This study also may help other practitioners in the local or the urban transportation planning systems in their efforts to address the issue of the induced car travel, and may present better solutions for the sustainability concerns.

This study is one of the first studies in the Iranian context which applied a disaggregated approach and encouraged a considerable additional analysis. Actually, to improve the understanding of the school travel decision-making and its correlations, advances are needed to be made in the conceptual modeling of these decisions, in the quality of the data available to the test, and in refining the models. Only have four neighborhoods been studied here and has a modest survey response rate been obtained; so these results are not necessarily generalisable unless they are replicated in other contexts and for populations with different socio-economic status. A low variation between the urban forms of the variables in the geographical areas, due to the small sample size, plus the lesser variation within the neighborhoods make the urban form of the measures less insensate in detecting the effect of the urban physical form on the travel choices of the students. Therefore, increasing the sample size and taking a bigger set of potential factors into account would result in better findings.

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Table 1. Physical characteristic of case study neighborhoods

Region	Neighborhood	Avg. property price (in 10000 Rials)	Avg. parcel area (square meters)	Avg. floor area (square meters)	Avg. floor area ratio (percent)	Avg. no. of building stores
1	A	2000	280	600	240	4.6
	M	1800	400	450	180	2.6
3	F	750	180	200	120	1.5
	G	1000	200	230	120	1.2

(Source: authors, 2011)

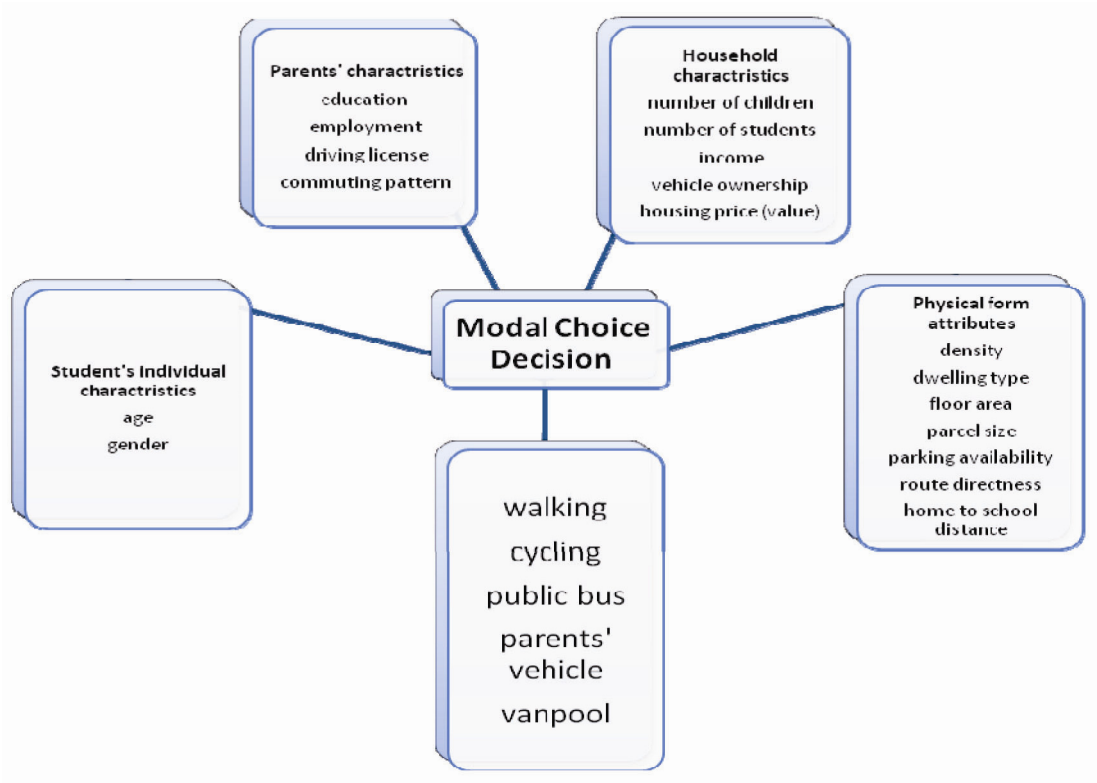
Table 2. Neighborhood population and number of elementary school students

Region	Neighborhood	Population	School	No. of students	Sample size
1	A	12107	A1	560	26
			A2	430	17
	M	11866	M1	238	27
			M2	210	26
			M3	286	25
3	F	19774	F1	180	27
			F2	336	28
	G	22379	G1	320	39
			G2	410	23
sum	-	66126	-	2970	238

(Source: authors, 2011)

Table 3. Details of MNL model

Mode of travel	Explanatory variable	Coefficients	Standard error	Wald statistics	P - value	Odds ratio
walking	constant	17.783	6.606	7.247	0.007	
	Mother's education level	1.000	0.856	1.366	0.242	2.718
	Household monthly income (10000 rials)	**-0.005***	0.002	4.889	0.027	0.995
	Private parking ownership (dummy)	**-16.954***	0.714	563.265	0.000	3.398 E-09
	Housing price (10000 rials)	0.043	0.033	1.705	0.192	1.044
	Distance to school (m)	**-3.500***	0.904	14.992	0.000	0.030
	Mother's license status (dummy)	-0.799	2.172	0.129	0.720	0.459
Vanpool	constant	22.384	6.532	11.741	0.001	
	Mother's education level	0.665	0.859	0.599	0.439	1.945
	Household monthly income (10000 rials)	**0.340***	0.001	2.113	0.036	1.400
	Private parking ownership (dummy)	**15.047***	0.891	285.264	0.000	3426 855.1 52
	Housing price (10000 rials)	0.047	0.033	1.988	0.159	1.048
	Distance to school (m)	0.184	0.357	0.264	0.607	0.832
	Mother's license status (dummy)	-0.138	2.224	0.004	0.950	1.148
E-parents' vehicle	constant	20.457	6.501	9.902	0.002	
	Mother's education level	0.974	0.857	1.290	0.256	2.947
	Household monthly income (10000 rials)	**0.430***	0.001	4.173	0.025	1.549
	Private parking ownership (dummy)	**15.782***	0.000	281.347	0.000	7146 210.2 12
	Housing price (10000 rials)	0.043	0.033	1.727	0.189	1.044
	Distance to school (m)	0.138	0.333	0.171	0.679	1.148
	Mother's license status (dummy)	**1.755***	0.896	4.495	0.038	5.785
No. of cases						
-2 Log Likelihood (constant only)						543.0 10
-2 Log Likelihood						263.7 11
$\chi 2$ Coff.						279.2 99
Degree of freedom						36
Nagelkerke pseudo R2						0.774



(Source: authors, 2011)

Figure 1. Conceptual Model of Research

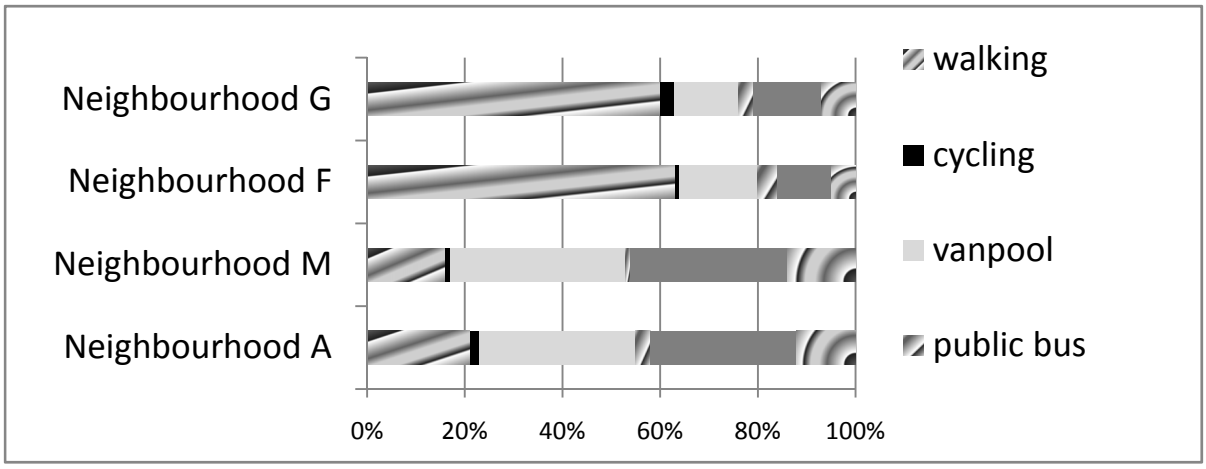


Figure 2. Modal split of four neighborhoods