TeMA

The concept of "Smart City", providing a the solution for making cities more efficient and sustainable has been quite popular in the policy field in recent years. In the contemporary debate, the concept of smart cities is related to the utilization of networked infrastructure to improve economic and political efficiency and enable social, cultural and urban development.

SMART CITIES
RESEARCHES, PROJECTS AND GOOD PRACTICES FOR BUILDINGS

TeMA

SMART CITIES:

RESEARCHES, PROJECTS AND GOOD PRACTICES FOR BUILDINGS

2 (2013)

TeMA
Journal of
Land Use, Mobility and Environment

TeMA - Journal of Land Use, Mobility and Environment offers researches, applications and contributions with a unified approach to planning and mobility and publishes original inter-disciplinary papers on the interaction of transport, land use and Environment. Domains include: engineering, planning, modeling, behavior, economics, geography, regional science, sociology, architecture and design, network science, and complex systems.

The Italian National Agency for the Evaluation of Universities and Research Institutes (ANVUR) classified TeMA as one of the most highly regarded scholarly journals (Category A) in the Areas ICAR 05, ICAR 20 and ICAR21. TeMA Journal has also received the Sparc Europe Seal for Open Access Journals released by Scholarly Publishing and Academic Resources Coalition (SPARC Europe) and the Directory of Open Access Journals (DOAJ). TeMA publishes online under a Creative Commons Attribution 3.0 License and is blind peer reviewed at least by two referees selected among high-profile scientists. TeMA is a four-monthly journal. TeMA has been published since 2007 and is indexed in the main bibliographical databases and it is present in the catalogues of hundreds of academic and research libraries worldwide.

TeMA

SMART CITIES: RESEARCHES,
PROJECTS, AND GOOD PRACTICES FOR BUILDINGS 2 (2013)

Contents

TeMA

Journal of
Land Use, Mobility and Environment

TeMA

Journal of
Land Use, Mobility and Environment

ABSTRACT

The effects of neighbourhood-level land use characteristics on urban travel behaviour of Iranian cities are under-researched. The present paper examines such influences in a microscopic scale. In this study the role of socio-economic factors is also studies and compared to that of urban form. Two case-study neighbourhoods in west of Tehran are selected and considered, first of which is a centralized and compact neighbourhood and the other is a sprawled and centreless one. A Multinomial Logit Regression model is developed to consider the effects of socio-economic and land use factors on urban travel pattern. In addition, to consider the effective factors, cross-sectional comparison between the influences of local accessibility and attractiveness of the neighbourhoodcentres of the two case-study areas are undertaken. Also the causality relationships are considered according to the findings of the survey. The findings indicate significant effects of age and household income as socio-economic factors on transportation mode choice in neighbourhoods with central structure. One the other hand, no meaningful association between socio-economic or land use variables are resulted by the model for the sprawled case. The most effective land use concept in micro-scale is considered to be satisfaction of entertainment facilities of the neighbourhood. Also the descriptive findings show that the centralized neighbourhood that gives more local accessibility to shops and retail generates less shopping trips. In considering the causal relations, the study shows that providing neighbourhood infrastructures that increase or ease the accessibility to neighbourhood amenities can lead to higher shares of sustainable transportation modes like walking, biking, or public transportation use.

KEYWORDS:

LUTI, sustainable urban form, travel behaviour, Multinomial Logit Model, Iran.

MODELING THE TRAVEL BEHAVIOR IMPACTS OF MICRO-SCALE LAND USE AND SOCIO-ECONOMIC FACTORS

HOUSHMAND E. MASOUMI

Center for Technology and Society, TU Berlin, Germany
e-mail: masoumi@ztg.tu-berlin.de
URL: http://www.tu-berlin.de/ztg/

1   INTRODUCTION

In contrast to the sprawled patterns, the sustainable urban forms like compact developments have been claimed to have the capabilities to decrease car dependence and improve sustainable transportation (Cervero, Radisch, 1995; Khattak, Stone, 2003; Khattak, Rodriguez, 2005). To find the relations between the built environment and the travel behaviour, different aspects of the urban form have been examined. Density has been one of the urban form factors that have gained great attention. Large amount of research has been done on the effects of density (Pushkarev, Zupan, 1977; Holtaclaw, 1990, 1994, 2002; Cervero, Kockelman, 1997; Greenwald, Boarnet, 2001), land use mix (Hare, 1993; Ewing et al. 1994; Cervero, Radisch, 1995) and design (Kitamura et al. 1994). Such studies cover a wide range from region and city scale to neighbourhood. A number of researches related to this subject is done in neighbourhood scale (micro) and include a general topic of design. These studies consider the role of neighbourhood attitudes, neighbourhood street structure, sidewalks quality and design, bike routes, walkable distances, etc. on local travels (Ryan, McNally, 1995; Crane, 1996; Plaut, Boarnet, 2003). Although in 1993 Cervero had come to the conclusion that the micro-factors like travel costs and density are more effective than the micro-factors like design, but the number of studies that give better understanding of how and in what scale can design influence travel have increased during the recent years. For example Handy (1993) found the possibilities of neighbourhoods to increase walking trips while the trip lengths to other places in the city would not be affected. Another study of this kind is done by Crane and Crepeau (1998), who showed that fewer car trips are generated by neighbourhoods with special design concepts like high street connectivity. However they emphasize that the role of land use in micro scale is little.

The present paper investigates the above effects of land use and also socio-economic trends in the context of Iranian cities. Most of the existing literature about this subject comes from North America, Australia and Western Europe. The volume of similar studies on the Middle Eastern cities is very small and does not let decision making based on scientifically demonstrated conclusions that show what can make urban transportation more sustainable. The limited research that has been done about the Iranian cities shows that the socio-economic issues are of special importance in defining the travel behaviour. This has been discussed in city and regional level (Arabani, Amani, 2007; Soltani, Zamiri, 2011; Mirmoghtadaee, 2012; Shokoohi et al, 2012) and on zone/district level (Soltani, Esmaeili-Ivaki, 2011; Soltani et al. 2012). However the smallest scale, which is the neighbourhood level, has gained the least attention. It is not exactly known if the Iranian neighbourhood, which has strong roots in the traditional Iranian urbanism has capabilities of promoting sustainable mobility. Developing such studies can connect the Iranian studies to the international research going on about local accessibility and its advantages for sustainable mobility.

During the past decade the Iranian city has experienced inclusive transformations. After 1930s the city form was changed to let cars move freely in the texture of the cities. Therefore the compact cities were cut through to construct streets. The result was that the bazaars, neighbourhoods and their centers lost importance and instead the streets become the destination of urban travels (Masoumi, 2012a). Consideration of the physical form of the traditional neighbourhood shows that it had a distinct center with local public facilities within the walking distance of the houses (Masoumi, 2013a). Nonetheless the urban transformations of after 1970 and 1980 have led to urban sprawl that has made the destinations far away. The automobile-oriented planning has changed the form of the cities, especially in the peri-urban areas (Masoumi, 2012b). The centralized form that is explored in the traditional neighbourhood is not any more seen in the modern quarters. The basic difference is lack of powerful local centers that draw the urban trips to themselves. The most influential qualities of such neighbourhood centers are attractiveness and accessibility. Theoretically, it seems that people must be eager to walk to attractive public spaces and

facilities that are located in the vicinity of their houses. This accessibility is satisfied in the neighbourhood scale, when there is a reasonable level of centrality of facilities like retail, shops, grocery stores, urban parks and green spaces, open spaces, etc.

The present paper attempts to measure the above in District 5 of Tehran. The main questions meant to be answered are 1) Which measures are more important in defining the travel behaviour circumstances? The socio-economic factors or land use and design?; 2) Is there any usable differences in the land use and form of centralized neighbourhoods that have a center to promote sustainable transportation? 3) What causality relationships are there between land use and mode choice of the home-based urban travels?

To answer the mentioned questions, firstly the methodology including case-study areas, survey and sampling, and modelling are described. Then findings comprised of descriptive analysis, mode choice, and causality relationships are explained. Finally the concluding remarks are presented.

2   METHODOLOGY

The study employs empirical research methods to explore the differences in travel habits in the two selected neighbourhood types. The observation also has a comparative nature. Two neighbourhoods are selected; one represents the centralized compact neighbourhoods with a distinct center (Keyhan) and the other neighbourhood is an example of sprawled quarters located on the periphery of many Iranian cities (Bahar). The urban forms of the selected areas are meaningfully different. Cross-sectional analysis is conducted on the travel behaviour, demographic and socio-economic factors and the attitudes of people in the two neighbourhoods.

2.1 CASE-STUDY NEIGHBORHOODS

Both neighbourhoods are located in Region 5 of Tehran in west and north-western part of the city (Fig. 1). The distance between the borders of the neighbourhoods is about 500 meters. In 2006, Region 5 had a total population of 677085 people accommodated in 5287.1 hectares. That makes a gross population density of 128.1 persons/hectare and net population density of 162.1 persons/hectare. The dominant land use of the region is residential use which makes 26.4 per cent of the whole lands. Other large uses are street networks and open spaces with 20.7 per cent, unbuilt lands with 16.5 per cent, gardens with 9.8 per cent and green space with 9.6 per cent. The region includes 7 zones and 27 neighbourhoods (Tehran Master Plan, 2006).

The definition of neighborhood in the master plan is different from the one that is applied in this paper. In this study, the traditional area, size, arrangement of neighborhood units is taken as the standard neighborhood form. The best way to define the neighborhood boundaries is based on the perceptions of people. According to a recent study, the traditional Iranian city consisted of a number of neighborhoods and neighborhood units. The neighborhood units had an area of less than 30 or in larger cases 35 hectares (Masoumi, 2013a). In contrast, the administrative divisions of the Iranian cities are based on regions and zones. Recently neighborhoods are added to this division system, but the areas of such neighborhoods are so large that they are often not human-scaled. They lack a unique center and the distances are not walkable. To make a comparison between the travel behaviors generated by the centrally-structured, compact neighborhoods with the sprawled ones, it is not meaningful to use the administrative boundaries of the neighborhoods, because they are so large that the pedestrian mobility is not significant. Instead two small areas as large as the traditional neighborhood units are selected.

Keyhan presents the traditional form of neighbourhood units. Although it is not old but it has apparently a center with a local urban park including playground for children and a number of local shops including grocery stores, fruit shop, barber, etc. Also the situation of the houses is in a way that the

neighbourhoodhas a compact formation. The form of the selected area is in accordance with the traditional units that are comprised of about 300 buildings in small areas that let the residents access the Neighbourhood Unit Centers' (NUC) facilities easily. The short way to the center of the traditional neighbourhood units provides walkable distances that are mainly less than 670 meters (Masoumi, 2013a). The same is seen in Keyhan. The distance between the farthest houses of Keyhan to the center is 540 meters calculated on a street network basis.

Bahar is a neighbourhood that represents dispersed and sprawled urban patterns that have emerged in Iranian cities during the past four decades. Leapfrog development is seen in the development pattern of Bahar. This urban pattern is a basic characteristic of Iranian urban sprawl along with lack of public open spaces, less compact form, and low density (Masoumi, 2012b). In large and medium-sized Iranian cities, the density of recently built quarters is less than the city centers and the historical cores (Masoumi, 2013b). In other words when the distance of the quarters with the city center increases, the population density drops. Another specification of Bahar that exemplifies the sprawling areas is lack or dispersal of local public facilities like retail. The shops found in Bahar are not located centrally so it does not give the visitor the impression that the neighbourhood has a center.

The two selected areas have similarities that make the comparison meaningful. Firstly, the areas are both about 35 hectares. Secondly the distance between the areas are so short that the socio-economic factors such as household income, car ownership, household size, education, etc. are more or less alike. Thirdly, accessibility to public transportation and other transportation infrastructure like highways and main streets are in the same level. Finally, the distance to the central city of Tehran is the same.

Fig. 1– Tehran and the location of the observation areas within the urban context

Fig. 2 - Location of Keyhanand Bahar in Region 5 of Tehran

Fig. 3 The Bahar and Keyhan areas, with the location of the KeyhanNeighborhood Center. Lack of public spaces and neighborhood amenities is notable inBahar.

Fig. 4 There is an urban park in Keyhan neighborhood (left). A highway with bus lines passes from the north of Bahar(right).

2.2 SURVEY AND SAMPLING

This paper shows the results of an empirical comparison between the travel attitudes of residents of the two mentioned neighbourhoods. A survey was conducted in autumn 2012 by face-to-face interviews with the residents. Based on the interviews the questionnaires were filled out by the interviewers. The sample number was calculated according to Cochran (1963, 75):

$$n_0 = \frac{z^2 pq}{e^2} \qquad (1)$$

The above is used to define the sample size, where Z^2 is the abscissa of the normal curve, p is the estimated proportion of an attribute, e is the level of precision which is here taken as 10%, and finally q is equal to 1-p. The result is adjusted by the following relation

$$n = \frac{n_0}{1 + \frac{(n_0 - 1)}{N}} \qquad (2)$$

Whereas n is the sample size. Since the data derived from the detailed plan of Tehran is based on the administrative neighbourhoods and this study uses smaller areas, it was not possible to apply the existing neighbourhood populations. Therefore the number of buildings, the average residential units per building, and the household size were applied to calculate the case-study neighborhood population. There is 600 buildings in Keyhan and 400 in Bahar. The household size of Region 5 in the year 2011 has been 3.37 persons. Assuming 9 residential units per building for Keyhan and 7 for Bahar, the neighbourhood population will be 18,000 and 9,500 persons in Keyhan and Bahar respectively (N). For precision of ±10%, the sample size should be 95.53 for Keyhan and 95.09 for Bahar. As a result 96 questionnaires were filled out for each of the neighbourhoods.

2.3 MODELING

As a discrete choice model approach, Multinomial Logit Regression modeling (MNL) is applied to examine the transportation mode choice decisions of the interviewees. This type of modeling is selected because of its capabilities for analysing personal choices that are not in relation with each other. The effects of socio-economies and urban form characteristics on mode choice are investigated. It is also meant to compare these effects in the two selected neighbourhoods. In general 7 explanatory variables are tested. Five socio-economic measures including, age, household income, gender, owning a driving license, and household car ownership are analysed as explanatory variables. Two independent variables representing neighbourhood amenities are evaluation of neighbourhood retail and public space as well as satisfaction of neighbourhood entertainment facilities. All the mentioned independent variables are employed as categorical variables.
Socio-economic characteristics: gender, holding a driving license, and household car ownership are defined as dummy values. Age is a basic social specification that is distributed into 5 categories. Another seemingly influential factor is household income. A 6-point scale is used to show the amounts. The respondents have been asked if the monthly income of their family lies in "no income", "less than 11,000,000 Rials", "11,000,000-17,000,000 Rials", "17,000,000-22,500,000 Rials", 22,500,000-33,500,000 Rials", or "more than 33,500,000".

The land use factors that are discussed here are the ones that are in relation with what the residents perceive about the attractiveness of the neighbourhood retail, shops, entertainment facilities of the neighbourhoods, etc. They were asked about their evaluation of the quality of their neighbourhood shops and public spaces on a 5-point scale including "very weak", "insufficient", "average", "good", and "very good". They were also asked about their evaluation of the entertainment facilities of their neighbourhood. They answered the question by selecting among "not satisfied at all", "not satisfied", "average", "satisfied", and "very satisfied". The above data were applied to the MNL model to indicate differences in the two case-study neighbourhoods.

3   FINDINGS

3.1 DESCRIPTIVE ANALYSIS

Keyhan and Bahar have been selected in a way that there are large similarities between their socio-economic characteristics. The average age, daily activity pattern, and car ownership rates are largely alike in Keyhan and Bahar. The female interviewees in Keyhan have been more than in Bahar. However the effects of the difference in gender ratios do not have any important effect on the daily activity (p-value= 0.313). As seen in Table 1, although 57 % of the respondents of Keyhan are women (compared to 36 % in Bahar), but difference in the percentage of working individual in the two neighborhoods is only 2 %. Also the household income in Keyhan is slightly more, but the difference is negligible because no significant difference is seen (p-value= 0.509). Table 1 shows the findings of the survey in section 1 of the questionnaires.

PERSONAL AND HOUSEHOLD CHARACTERISTICS	KEYHAN (N = 96)	BAHAR (N = 96)	p-VALUE
Gender			
Female	57 (59.4%)	36 (37.5%)	0.313
Male	39 (40.6%)	60 (62.5%)	
Age			
Mean	34.86	35.80	
Min	18	20	
Max	64	62	
Standard deviation	10.21	9.59	
Daily activity			
Work	71 (74.7%)	73 (76%)	0.509
Education	12 (12.6%)	7 (7.3%)	for "working"
Work at home	12 (12.6%)	16 (16.7%)	
Car ownership			
Own driving license	86 (89.6%)	80 (84.2%)	0.612
Personally own a car	39 (40.6%)	43 (44.8%)	0.846
The family owns a car	74 (77.1%)	66 (68.8%)	0.412
Household income			
No income	0 (0%)	0 (0%)	
< 1,100,000s Rials[1]	28 (29%)	37 (39%)	
11,000,000-17,000,.000 Rials	39 (41%)	41 (44%)	0.288
17,000,000-22,500,000 Rials	16 (17%)	14 (15%)	
22,500,000-33.500,000 Rials	11 (11%)	2 (2%)	
>33,500,000 Rials	2 (2%)	0 (0%)	

Tab.1 - Key socio-economic characteristics in the two neighbourhoods

---

1   Rial is the official currency of Iran. One US Dollar was unofficially equal to 40.000 Rials on 2 Feb. 2013. In 2012 and 2013, due to political conflicts the conversion rate of Rial to other currencies has fallen rapidly and remained unstable. Therefore the reader probably cannot use the above conversion rate in the time of reading this paper.

Compared to 82.3% in Bahar, 85.3% of residents of Keyhan commute to their work or education place in a daily manner. While the number of people who commute daily as well as the share of public transport modes and slow modes are similar in the two neighborhoods, car use of Keyhan is 10 % more. Most of the people who drive to work place from both areas use cars because of more comfort, safety and security. Among the 192 people who were interviewed, no one commutes by bike. The time duration of commute travels do not show any significant difference. The main reason can be the similar distance to the central parts of Tehran that contains most of the employment centers and jobs.

The centralized local shops of Keyhan and the dispersed ones in Bahar equally attract shoppers. No difference is seen in the mode choice of either neighborhood level non-commute travels or travels to outside. The dominance of personal cars in non-work travels to outside of the neighborhoods is obvious (54.8% for Keyhan and 55.7% for Bahar). The important point is that the public space and neighborhood amenities are more attractive for the residents of Keyhan (64.6%) compared to those of Bahar (51.6%). The satisfaction of the people from the shops and public spaces of their neighborhood is also tested in another way, which shows they are more pleased in Keyhan. 60 % of the respondents of Kayhan evaluate the shops and open spaces of that neighborhood as very good or good, while the same figure is 32.3% for Bahar.

The results of the survey indicate a uniform attitude about public transportation use in the two neighborhoods. The most apparent difference is about the negative effect of poor accessibility on public transportation use. 33.3% of the respondents of Bahar have declared that the main reason for not using public transportation is "Little accessibility to stations, long distance between the stations", while only 20.4% have given such an answer in Keyhan (Table 2) .

PUBLIC TRANSPORT USE CHARACTERISTICS	KEYHAN	BAHAR	P-VALUE
Number of times of public transport use			
Every day	30 (31.3%)	38 (39.6%)	
A couple of times per week	12 (12.5%)	12 (12.5%)	
A couple of times per month	17 (17.7%)	17 (17.7%)	0.0014
Seldom	31 (32.3%)	28 (29.2%)	
Never	6 (6.2%)	1 (1%)	
The main reason for public transportation use			
It is cheaper	12 (24.5%)	16 (30.8%)	
It is faster	20 (40.8%)	18 (34.6%)	
It is safe and secure	6 (12.2%)	5 (9.6%)	
It is more comfortable	3 (6.1%)	6 (11.5%)	
Because of no access to car	8 (16.4%)	7 (13.5%)	
The main reason for not using public transportation	20 (40.8%)	17 (37.8%)	
It is not comfortable	4 (8.2%)	4 (8.9%)	
It is expensive	10 (20.4%)	15 (33.3%)	
Little accessibility to stations, long distance between the stations			
No access to public transportation at all	8 (16.3%)	8 (17.8%)	
Because of social and cultural problems	7 (14.3%)	1 (2.2%)	
Public transportation system privileged			
Metro	33 (35.5%)	31 (34.8%)	
Bus or Minibus	8 (8.6%)	6 (6.8%)	
Taxi			
Line Taxi	20 (21.5%)	21 (23.6%)	
Passenger Taxi	17 (18.3%)	21 (23.6%)	
Telephone Taxi	15 (16.1%)	10 (11.2%)	

Tab.2 - The characteristics of public transportation use

What connect Bahar to the central parts of the city in the east are urban highways in the north and south of the neighborhood. Only one bus station covers a part of each of the two neighborhoods. That is why the bus/minibus is not a popular option. Apart from accessibility the most important reason for not using public transport is low comfort. This option received 40.8 % of the responses in Keyhan and 37.8 % in Bahar.

While sense of belonging in the two neighborhoods is in the same level, people in Keyhan are more satisfied of their living environment (41.1 % satisfied or very satisfied) than those who live in Bahar (26.6 % satisfied or very satisfied). Apart from neighborhood satisfaction, Table 3 indicates notable difference between the circumstances of residential self selection in Iran with that of Western Europe and North America. What we see here is that most of the people choose their living places based on economic factors rather than mobility-related reasons. The reasons given by the respondents for selecting their living location are 68.7 % related to economy (affordability or rise of the prices in the future) in Keyhan and 69.2 % in Bahar. In contrast, the reasons in connection with transportation, including commute travels or proximity to the relatives make 19.8 % in Keyhan and 15.9 % in Bahar. This meaningful difference shows how the residential self selection functions under the effect of economic factors.

FACTORS RELATED TO PERCEPTIONS AND SELECTIONS	KEYHAN	BAHAR
SENSE OF BELONGING TO THE NEIGHBORHOOD		
Yes	77 (80.2%)	77 (82.8%)
No	19 (19.8%)	16 (17.2%)
SATISFACTION OF THE NEIGHBORHOOD ENTERTAINMENT FACILITIES		
Very satisfied	9 (9.5%)	4 (4.3%)
Satisfied	30 (31.6%)	21 (22.3%)
Indifferent	27 (28.4%)	31 (33%)
Not satisfied	25 (26.3%)	35 (37.2%)
Dissatisfied	4 (4.2%)	3 (3.2%)
THE PLACE PREFERRED FOR ENTERTAINMENT AND SOCIAL ACTIVITIES		
Inside the neighborhood	41 (43.2%)	31 (34.4%)
Out of the neighborhood	54 (56.8%)	59 (65.6%)

Tab.3 - Human perceptions and selections

3.2 MODE CHOICE

To consider the relationships between different factors and transportation mode choice, a Multinomial Logit Regression Model is developed. The general model output such as model fitting information, likelihood ratio tests, pseudo R-square, and Nagelkerke R-square are illustrated in Table 4 and Table 5. The model generally shows good fit. Although some of the variables for Keyhan and all of them in Bahar have high p-values. The result of this model gives the opportunity to study the association of several variables with mode choices. Table 4 indicates the results of the model for the two case-study areas.

Model	KEYHAN				BAHAR			
	Model Fitting Criteria	Likelihood Ratio Tests			Model Fitting Criteria	Likelihood Ratio Tests		
	-2 Log Likelihood	Chi-Square	df	Sig.	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	317,903				305,598			
Final	61,672	256,231	84	,000	72,004	233,594	76	,000

Table 4. Model fitting information for the two neighbourhoods.

The model is meant to, firstly, show the association of different variables with mode choice in general and, secondly, provide with data usable for making comparison between the two neighborhoods. The output shows significant (p-value< 0.05) association between satisfaction of entertainment facilities, age, and household income with transport mode choice in Keyhan. This result is presented in Table 6 for selection of car, bicycle, motorbike, and pedestrian trips. The significant and insignificant statistical outputs of all the seven 7 independent variables are presented this table to give better insight to the reader. Public transportation including bus/minibus, taxi, and metro are not seen in the model because it only takes into account the intra-neighborhood trips and public transportation is not used in the very small limitation of the neighborhoods. "Car" is taken as reference in the calculations because it is the strongest variable in the model. Therefore higher values of coefficients show higher pedestrian, bike, or motorbike trips. The model results for the pedestrian travels are of absolute importance; in Keyhan satisfaction of entertainment facilities can lead to increase in pedestrian travels (B=4.584, P=0.038).

Age has a positive effect on walking trips (B=26.248, P=0.000). The findings show that older people in Keyhan are more willing to walk to their non-work destinations inside the neighborhood. The influence of income is negative (B=-39.618, P=0.000). In other words, more affluent people walk less and use more cars. In Bahar the null hypothesis is not rejected for any of the explanatory variables, so they are not significant. This shows that the modes are selected randomly and there are no relationships between the variables and the decisions. Three socio-economic traits, namely gender, owning a driving license, and household car ownership, have not produced significant relationships with mode selection in both neighborhoods. Surprisingly, the evaluation of people from local retail is significant neither of the neighborhoods. More studies seem to be needed for examining the role of accessibility to local shops.

Significance of three variables out of seven in Keyhan while none of them are meaningful for Bahar shows that the difference in the urban structure of Keyhan has something to contribute to sustainable transportation and this can be used by urban policy makers. Providing with attractive urban spaces and local facilities can attract people in quarters that have and accessible local center such as a neighborhood center.

Effect	KEYHAN					BAHAR				
	Model Fitting Criteria	Likelihood Ratio Tests				Model Fitting Criteria	Likelihood Ratio Tests			
	-2 Log Likelihood of Reduced Model	Chi-Square	df	Sig.	Nagelkerke	-2 Log Likelihood of Reduced Model	Chi-Square	df	Sig.	Nagelkerke
Intercept	61,672a	0,000	0			72,004a	0,000	0		
RETEV	71,069b	9,397	16	,896		80,823b	8,819	16	,921	
SATISENT	72,310b	10,638	20	,955		77,573b	5,569	16	,992	
AGE	166,129b	104,457	16	,000	0,928	80,744b	8,740	12	,725	0,901
INCOME	833,501b	771,829	16	,000		80,077b	8,073	16	,947	
FEMALE	67,307b	5,635	4	,228		74,185b	2,181	4	,702	
DRIVINGLIC	68,400b	6,728	4	,151		74,664b	2,660	4	,616	
COHOUSE	225,522c	163,850	4	,000		75,336b	3,332	4	,504	

Table 5. Likelihood ratio tests and Pseudo R-squared results

Mode Choice	Independent Variable	Description	KEYHAN				BAHAR			
			B (COEFFICIENT)	STD. ERROR	WALD	SIG. (P-VALUE)	B (COEFFICIENT)	STD. ERROR	WALD	SIG. (P-VALUE)
	[RETEV=]	Retail evaluation	10,042	221,266	,002	,964	23,049	168,989	,019	,892
	[SATISENT=]	Satisfactionofentertainmentfacilities	24,297	1,391	304,945	,000	9,042	77,879	,013	,908
	[AGE=]	Age	356,382	1,415	63419,821	0,000	20,098	70,403	,081	,775
	[INCOME=]	Household Income	63,325	1,180	2881,815	0,000	5,023	20,403	,061	,806
	[FEMALE=]	Gender	22,530	100,523	,050	,823	22,741	109,812	,043	,836
	[DRIVINGLIC=]	Own a drivinglincense	20,863	56,567	,136	,712	20,914	67,407	,096	,756
	[COHOUSE=]	Householdcarownership	21,012	57,079	,136	,713	23,112	109,362	,045	,833
Bicycle	[RETEV=]	Retail evaluation	,000	386,049	,000	1,000	,000	229,833	,000	1,000
	[SATISENT=]	Satisfactionofentertainmentfacilities	12,186	798,284	,000	,988	11,006	0,000		
	[AGE=]	Age	338,724	7,289	2159,439	0,000	10,056	312,304	,001	,974
	[INCOME=]	Household Income	47,004	5,983	61,728	,000	,000	72,047	,000	1,000
	[FEMALE=]	Gender	10,488	0,000			-,511	0,000		
	[DRIVINGLIC=]	Own a drivinglincense	,000	255,524	,000	1,000	,000	258,103	,000	1,000
	[COHOUSE=]	Householdcarownership	,000	255,524	,000	1,000	-,069	0,000		
Motorbike	[RETEV=]	Satisfactionofentertainmentfacilities	,000	650,775	,000	1,000	11,006	528,455	,000	,983
	[SATISENT=]	Satisfactionofentertainmentfacilities	22,704	5,398	17,694	,000	,000	152,104	,000	1,000
	[AGE=]	Age	353,431	5,221	4583,138	0,000	-,629	85,304	,000	,994
	[INCOME=]	Household Income	60,374	3,548	289,585	,000	,000	39,250	,000	1,000
	[FEMALE=]	Gender	-1,299	303,986	,000	,997	-,511	230,331	,000	,998
	[DRIVINGLIC=]	Own a drivinglincense	0	-	-	-	,000	140,631	,000	1,000
	[COHOUSE=]	Householdcarownership	,000	184,569	,000	1,000	,219	230,331	,000	,999
Pedestrian	[RETEV=]	Retail evaluation	-9,273	185,646	,002	,960	,236	114,308	,000	,998
	[SATISENT=]	Satisfactionofentertainmentfacilities	4,584	2,212	4,294	,038	-8,136	70,026	,013	,908
	[AGE=]	Age	26,248	1,322	394,489	,000	,706	42,832	,000	,987
	[INCOME=]	Household Income	-39,618	1,198	1094,273	,000	-4,113	18,087	,052	,820
	[FEMALE=]	Gender	0	-	-	-	-,009	113,333	,000	1,000
	[DRIVINGLIC=]	Own a drivinglincense	,152	60,979	,000	,998	,204	70,607	,000	,998
	[COHOUSE=]	Householdcarownership	,331	60,979	,000	,996	,412	113,332	,000	,997

Tab. 6 - Multinomial Logit Regression model for transportation mode choice in Keyhan and Bahar

3.3 SHOPPING ACTIVITY

As a continuous variable, the number of times that each individual in Keyhan and Bahar goes shopping in is compared by t-test. The number of shopping per week is asked from every interviewee during the direct questioning. The statistical test (Table 7 and 8) shows that Keyhan (Mean= 2.719) has significantly less number of shopping trips. Bahar (Mean= 2.958) produces higher number of shopping travels including pedestrian or motorized trips. The t-value of 0.000 shows rejection of null hypothesis and a meaningful difference between the means of shopping frequency in the two neighborhoods. Less shopping travel generation of Keyhan can be in relation with high accessibility to retail and shops inside the neighborhood. In fact people feel that the shops are within their reach so less shopping trips are generated.

	N	MEAN	STD. DEVIATION	STD. ERROR MEAN
Shopping per Week in Keyhan	96	2,72	1,351	,138
Shopping per Week in Bahar	96	2,96	,994	,101

Tab. 7: One-sample statistics for shopping per week in the case-study areas

	TEST VALUE = 0					
				Mean Difference	95% Confidence Interval of the Difference	
	t	df	Sig. (2-tailed)		Lower	Upper
Shopping per Week in Keyhan	19,717	95	,000	2,719	2,45	2,99
Shopping per Week in Bahar	29,165	95	,000	2,958	2,76	3,16

Tab. 8: One-sample test for shopping per week in the case-study areas

3.4 CAUSALITY ANALYSIS

Studying the causal relations between different issues with travel behavior is another objective of this paper. Because of better attractiveness of the places of Keyhan for entertainment, the residents are willing to stay in their own neighborhood about ten % more than what the respondents of Bahar declare (Table 9). There is the same good evaluation about the better quality of the retail and public spaces of Keyhan, but there is no sign of higher percentages of walking in Keyhan. The reason behind little walking or biking can be sought at the first step in the socio-economic trends. The cultural problems and lack of bicycle infrastructure are the main reasons for little biking (93 % in Keyhan and 88 % in Bahar). Many people like to drive rather than walk to show the affluence or social class. This can be seen in many cultures from developing to developed countries. The situation for improving biking is even more difficult than that of walking. Methods for removing such cultural barriers against biking, especially biking of women, can be a special topic for the Iranian researchers in the future. As a side strategy to encourage people to use more alternative transportation modes, this paper suggests methods to increase local accessibility and attractiveness. The logic can be found in the responses of people in the observation areas. Far-away destinations are declared as the main reason for not walking in both neighborhoods, but the difference between the percentages is considerable. 52 % of people in Keyhan say the destinations are far away, so they cannot walk to them, while this amount is 35 % more in Bahar. The reason can be found in the central structure of Keyhan that gives more accessibility to the neighborhood amenities.

FACTORS RELATED TO PERCEPTIONS AND SELECTIONS	KEYHAN	BAHAR

THE MAIN REASON FOR NOT TO PARTICIPATE IN SOCIAL ACTIVITIES AND SHOPPING INSIDE THE NEIGHBORHOOD		
Lack of suitable facilities, retail, and shops	6 (17.1%)	16 (32%)
Lack of suitable spaces such as streets and allies	8 (22.9%)	9 (18%)
Absence of suitable social environment	7 (20%)	10 (20%)
Expensive services and materials	11 (31.4%)	12 (24%)
Lack of safety and security	0 (0%)	2 (4%)
Personal reasons	3 (8.6%)	1 (2%)
THE MAIN REASON FOR PUBLIC TRANSPORTATION USE		
It is cheaper	12 (24.5%)	16 (30.8%)
It is faster	20 (40.8%)	18 (34.6%)
It is safe and secure	6 (12.2%)	5 (9.6%)
It is more comfortable	3 (6.1%)	6 (11.5%)
Because of no access to car	8 (16.4%)	7 (13.5%)
THE MAIN REASON FOR NOT USING PUBLIC TRANSPORTATION	20 (40.8%)	17 (37.8%)
It is not comfortable	4 (8.2%)	4 (8.9%)
It is expensive	10 (20.4%)	15 (33.3%)
Little accessibility to stations, long distance between the stations		
No access to public transportation at all	8 (16.3%)	8 (17.8%)
Because of social and cultural problems	7 (14.3%)	1 (2.2%)
THE MAIN REASON FOR NOT BIKING INSIDE THE NEIGHBORHOOD		
Cultural problems	51 (59.3%)	31 (41.3%)
Lack of biking routes and infrastructure	29 (33.7%)	35 (46.7%)
High price of bike	6 (7%)	9 (12%)
THE MAIN REASON FOR PREFERRING CAR TRAVEL TO PEDESTRIAN TRAVEL INSIDE THE NEIGHBORHOOD		
The destinations are not near the living place	26 (52%)	20 (87%)
No attractive and beautiful streets and spaces are on the route	7 (14%)	2 (8.7%)
Lack of safety/security in the streets	6 (12%)	1 (4.3%)
Because of social problems	11 (22%)	0 (0%)

Table 9. Causality relationships: reasons for poor sustainable mobility behavior

Although the central urban structure of Keyhan provides better accessibility and attractiveness (for entertainment and shopping), but still significantly higher percentage of walking is not seen in the modal split of the neighborhood compared to that of sprawled Bahar. According to the survey results, people evaluate the neighborhood amenities and entertainment facilities of Keyhan more attractive. However attractiveness and accessibility must work together. According to the survey, a major part of the respondents of Keyhan prefer to stay inside the neighborhood for entertainment activities. This provides an opportunity to localize the travels and as a result increase the share of pedestrian and bicycle trips. Nevertheless this opportunity has not been used because there is not a huge difference between the share of slow modes in Keyhan and Bahar. When the respondents are asked about the reason for not walking, their main reason is "the destinations are not near the living place". The accessibility-related reasons include 52 % of the responses. While the same option makes 87 % of the responses in Bahar that has less accessibility. 35 % difference between the responses of the two neighborhoods show that people believe the facilities for entertainment, being with friends and passing time in Keyhan is more accessible while other options like lack of safety/security and social problems can also stop people from walking to their destinations. In Keyhan, one third of people have selected these problems as obstacles of walking. Considering the above, the reason for the approximately equal shares of walking in the two neighborhoods is not clear. On the other hand 65.3%in Keyhan has said that they use public transport because it is cheaper

or faster. This amount is 66.4% for Bahar. This shows how it is possible to add to the privilege of public transport over car by enhancing the quality and accessibility of the metro, bus and Taxi systems.

4   CONCLUSIONS

This paper shows that the socio-economic factors like age and household income have strong effects on travels in compact neighborhoods. This finding is consistent with the result of the previous works done by Iranian scholars. In connection to previous studies (such as Handy et al. 2005), here we find that the built environment cannot individually solve the transportation problems without socio-economic factors. The urban design elements can improve the sustainable transportation, but they are not the most effective factors. Nevertheless this study also demonstrates that the phenomena connected to urban form are not completely ineffective in changing travels. Positive association of presence of entertainment facilities within the neighborhood centers with pedestrian trips has been also shown. It has been also shown in this paper that residential self selection is not so important in defining the urban travel patterns in Iranian cities in contrast to the western countries. That is because people usually do not select their living location due to transportation-related reasons.

Despite uniform techniques applied to the two areas and also similar socio-economic qualities in the two studies neighborhoods, the dispersed and centerlessneighbourhood showed weak capacity to change the travel patterns by means of land use characteristics. In contrary, the compact and central neighborhood form indicated signs of capabilities that can affect urban travels positively. Such potentials can be used in urban planning and design in order to localize the non-commute trips including shopping and entertainment travels. The present study emphasizes on planning accessible local centers to present entertainment facilities and attractive retail. This method is in line with promotion of local accessibility.

According to descriptive findings of this article, the attractiveness of the local centers can urge residents to have their non-work trips (entertainment, social behavior, shopping, etc.) inside the neighborhood. However this can only be done when there are enough infrastructures for walking and biking. Providing such infrastructures can complete the attractiveness and accessibility of the local facilities. The causality study done in this research shows that the existence of neighborhood infrastructures and facilities has a strong effect on the travel behavior of people.

Like the previous Iranian literature that pointed out that socio-economic characteristics are important in defining the nature of the urban travels, this study finds some of these factors like age and income important. However there are two main differences; firstly, approximately all of the mentioned studies take medium and large scale, while this article is zoomed on neighborhood. Secondly, the present study finds only age and income effective on mode choice. For finding association between other factors and travels more observations seem to be needed.

REFERENCES

Arabani, M. and Amani, B. (2007), "Evaluating the Parameters Affecting Urban Trip-Generation", Iranian Journal of Science & Technology, Transaction B, Engineering, Vol. 31, No. B5, pp. 547-560.

Cervero, R., Kockelman, K. (1997), "Travel Demand and the Three Ds: Density, Diversity, and Design", Transportation Research D, 2, pp. 199–219.

Cervero, R., Radisch, C. (1995) "Travel Choices in Pedestrian versus Automobile-Oriented Neighborhoods", Transport Policy, Vol. 3, No. 3, pp.127–141.

Cochran, W. G. (1963), Sampling Techniques, 2nd edition, New York: John Wiley & Sons.

Crane, R. (1996), "Cars and Drivers in the New Suburbs: Linking Access to Travel in Neotraditional Planning", Journal of the American Planning Association 62 (1):51–65.

Crane, R., Crepeau R. (1998). "Does Neighborhood Design Influence Travel?: A Behavioral Analysis of Travel Diary and GIS Data", Transportation Research Part D 3(4): 225-238.

Ewing, R., Haliyur P., Page G. (1994), "Getting around a Traditional City, a Suburban PUD, and Everything In-Between", Washington, D.C. Paper presented at the 73rd Annual Meeting of the Transportation Research Board.

Greenwald, M. and Boarnet, M. (2001), "Built Environment as Determinant of Walking Behavior: Analyzing Non-work Pedestrian Travel in Portland, Oregon", Transportation Research Record 1780:33–42.

Handy, S. (1993), "Regional versus Local Accessibility: Implications for Network Travel", Transportation Research Record, Vol. 1400, pp. 58-66.

Handy, S., Cao, X., Mokhtarian, P. (2005), "Correlation or Sausality between the Built Environment and Travel Behavior? Evidence from Northern California", Transportation Research, Part D, Vol. 10, pp. 427–444.

Hare, P. (1993), "Junking the Clunker: And Other Strategies for Making the Suburbs Manageable for Single-Car Households", Western Cities 68, 10: 23-29.

Holtzclaw, J. (1990), "Manhattanization versus Sprawl, How Density Impacts Auto Use Comparing Five Bay Area Communities", Proceedings of the Eleventh International Pedestrian Conference, Boulder Colorado: City of Boulder, pp.99-106.

Holtzclaw, J. (1994), Using Residential Patterns and Transit to Decrease Auto Dependence and Costs, National Resources Defense Council, (www.nrdc.org).

Holtzclaw, J. and Clear, R. and Dittmar, H. and Goldstein, D. and Haas, P. (2002), "Location Efficiency: Neighborhood and Socio-Economic Characteristics Determine Auto Ownership and Use?" Transportation Planning and Technology, Vol. 25, pp. 1-27.

Khattak, A. J., Rodriguez, D. (2005), "Travel Behavior in Neo-traditional Neighborhood Developments: A case Study in USA", Transportation Research Part A, Vol. 39, pp. 481–500.

Khattak, A., Stone, J. (2003), Traditional Neighborhood Development Trip Generation Study, Report No. NCDOT 2003-13, North Carolina Department of Transportation.

Kitamura, R. and Mokhtarian, P. L. and Laidet, L.(1994), A Micro-Analysis of Land Use and Travel in Five Neighborhoods in the San Francisco Bay Area. Institute of Transportation Studies, University of California, Davis.

Masoumi, H. E. (2012a), A New Approach to the Iranian Urban Planning, Using Neo-Traditional Development, PhD Dissertation, TU Dortmund, Dortmund.

Masoumi, H. E. (2012b), "Urban Sprawl in Iranian Cities and its Difference with the Western Sprawl", Spatium International Review, No. 27, August 2012, pp.12-18.

Masoumi, H. E. (2013a), "Neo-Traditional Neighborhood Design Concepts Based on the Urban Form of the Historical Cities of Central Iran", paper accepted to be published in International Journal of Sustainable Society.

Masoumi, H. E. (2013b), "Urban Sprawl in Central Iran, 1970-2006: Evidence from Yazd and Kashan", paper to be published in Planning Perspectives.

Mirmoghtadaee, M. (2012), "The Relationship between Land Use, Socio-Economic Characteristics of Inhabitants, and Travel Demand in New Towns- A Case Study of Hashtgerd New Town (Iran)", International Journal of Urban Sustainable Development 4(1), pp: 39-62.

Plaut, P. and Boarnet, M. (2003), "New Urbanism and the Value of Neighborhood Design", Journal of Architectural and Planning Research 20 (3):254–265.

Pushkarev, B., Zupan, J. (1977), Public Transportation and Land Use Policy, Bloomington: Indiana University Press.

Ryan, S. and McNally, M. (1995), "Accessibility of Neotraditional Neighborhoods: A Review of Design Concepts Policies, and Recent Literature", Transportation Research Part A 29 (2):87–105.

Shokoohi, R. and Hanif, N. R. and Dali, M. M. (2012), "Children Walking to and from School in Tehran: Associations with Neighborhood Safety, Parental Concern and Children's Perceptions", Procedia- Social and Behavioral Sciences 38, pp. 315-323.

Soltani, A. and Saghapoor, T. and Izadi, H. and Pakshir, A. (2012), "Trip Generation and its Relationship with Land Use Diversity: Case Studies of Four Urban Districts in Shiraz Metropolitan Area", Urban - Regional Studies and Research Journal, 3rd Year – No. 12 - spring 2012.

Soltani, A. and Zamiri, M. (2011), "Investigation of School Students' Travel Pattern, Two Case Areas of Mashhad, Iran", Modern Applied Science, Vol. 5, No. 5.

Soltani, A., EsmaeiliIvaki, Y. (2011), "The influence of urban physical form on trip generation, evidence from metropolitan Shiraz, Iran", Indian Journal of Science and Technology, Vol. 4 No. 9.

Tehran Master Plan (2006), Urban Development Planning Foundation of Tehran, Municipality of Tehran.   Cervero, R., Tsai, Y. (2003),*City CarShare in San Francisco: Second-Year Travel Demand and Car Ownership Impacts*, Transportation Research Record (1887): 117-127.

IMAGES SOURCES

Figure in the front page is by the author; figures 1, 2 and 3 are from Googlemaps. Figure n. 4 on the right is from www.panoramio.comphoto24391724; figure n. 4 on the left is from www.panoramio.comphoto25690224

AUTHORS' PROFILE

Houshmand E. Masoumi
Houshmand E. Masoumi is senior researcher in Center for Technology and Society, Technical University of Berlin, where he did a postdoc research on the interactions of land use on urban trips in Iranian cities. He holds PhD in urban planning and development from Technical University of Dortmund. His research interests include the effects of urban transformations on travel behavior, walkable neighborhoods, traditional urban form, and sustainable transportation.