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EFFECTS OF TRIP PURPOSE ON PREFERRED WALKING ENVIRONMENT AND ROUTE CHOICE OF PEDESTRIANS IN NARMAK, TEHRAN

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ABSTRACT

In addition to widely cited macro-scale components of walkability (e.g. street network pattern, accessibility, density, land use diversity), environmental quality aspects of walking routes (e.g. safety, vitality, comfort, aesthetics) have increasingly emerged as requisites of a high quality walking environment. Yet little evidence exists to clarify how these environmental qualities vary in importance to pedestrians going to different destinations (different trip purposes) and how this then influences pedestrians' route choice decision in their trips to different destinations. The aim of this research is, therefore, to identify various environmental qualities that pedestrians would seek from the walking environment for different types of destinations using Narmak, an urban neighbourhood in Tehran generally recognised for its walkability, as a case study. A total of 100 respondents were asked about their preferred walking environments on trips to three types of destinations: a park, a subway station and a neighbourhood shopping centre. Data analysis reveals that out of eight environmental qualities that have been derived from the literature, four qualities – 'distance', 'presence of people', 'presence of formal and informal activities' and 'visual attractiveness' – are of varying importance to pedestrians going to different destinations. These qualities, except 'distance', are related to pedestrians' sense of enjoyment. The remaining four qualities – 'pathway amenities', 'sense of security at night', 'sense of security during the day' and 'sense of safety from traffic' – do not vary in importance for different destinations, suggesting that they are always prioritised by pedestrians regardless of where they are going to. Indeed, according to the respondents' ranking of route attributes for walking trips to different destinations, the most determinant factors in pedestrians' route choice are 'sense of security at night', 'sense of security during the day' and 'sense of safety from traffic', which are those qualities that give pedestrians 'sense of protection'; followed by 'pathway amenities', the quality which offers sense of comfort. This explains why most pedestrians in Narmak prefer the same category of route – the district distributor, which offers most of the qualities – for their trips to all three types of destinations. The findings of this study may apply as empirical evidence to further refining pedestrian travel behaviour modeling and

simulation approaches as well as planning and design policies for improving walkability in the city.

Keywords: Pedestrian route choice; trip purpose; walking environmental quality; sense of protection, comfort and enjoyment; distance

1.0 INTRODUCTION

Walking has been currently considered as a response to many social, environmental and economic issues, from reducing air-pollution, traffic congestion and foreign oil dependency to slowing down global warming; from solving obesity and other health problems (Brown et al, 2007) to increasing social interaction and sense of community (Toit et al, 2007). If walking can bring promising economic, environmental, social and health benefits to the society, one of the most critical questions for urban planners, designers and policy makers is how can the built environment be shaped to support and encourage people to walk more – the quality of the built environment which is called 'walkability' (Park, 2008).

Much research has been done to examine the relationship between the built environment and actual walking by people. The earliest and largest body of these studies focus on investigating the connection between land use and transportation behaviour in the macro-level built environment, which is known as 'urban form' (Greenwald and Boarnet, 2001) and is often defined by three major variables: 1- Density, which focuses on increasing the housing density within a walkable distance to some important destinations in the neighbourhood such as the neighbourhood shopping centre or transit station; 2- Land use diversity, to reduce trip distance to shopping and other services; and 3- A close-knit street pattern, to increase the connectivity between the housing area and major destinations in the neighbourhood. The main goal of research of this kind is to improve accessibility within the neighbourhood (Park, 2008).

Although providing accessibility is a necessary condition, it is not a sufficient one for a high quality walking environment (Greenwald and Boarnet, 2001). The quality of the street as a micro-level built environment is another important component of walkability which affects pedestrians' walking experience, such as sense of safety from traffic, sense of security from crime, and sense of enjoyment (Sucher, 1995; Saelense et al, 2003; Heath et al, 2006).

Many urban design theorists have attempted to investigate the non-functional qualities of a good walking environment (Gehl, 1987; Southworth, 2005; Agrawal et al, 2008; Park, 2008; Ewing and Handy, 2009). They seek to reveal what makes an enjoyable walking experience for pedestrians over that of ensuring efficient traffic flows. The priority of the studies done up to the 1990s have been to focus on the qualities which are essential for a vital urban space and explore how these qualities affect livability of the street. Table 1 presents a summary of some key studies before 1990.

Table 1: Summary of key studies that have been done on non-functional qualities of a good walking environment up to 1990

Authors	Year	Key Aspects	Findings/Results	Limitations
Jacobs	1961	Safety, social contacts, assimilating children in city sidewalks	Sense of security from crime in the street is achieved by: - Surveillance by residents (eyes upon the street) - Presence of people (strangers) and activities in the street - Public responsibility of the community	Although these qualities are essential to having a liveable and walkable neighbourhood, and consequently may affect pedestrians' walking behaviour, the relationship between these qualities and walking behaviour has not been actually tested
Cullen	1961	Visual interests (serial vision)	Visual experience of pedestrians is gained from series of views during walking	
Newman	1973	Sense of territory (defensible spaces)	Sense of territory is provided by: - Visual connection between inside and outside - Clear separation between public and private	
Appleyard	1981	Sense of safety from traffic Street as an ecosystem	When traffic slows down, the street becomes safer and more pleasant. Key components: - Safe vehicle speed - Low traffic volumes - Low noise and vibration from traffic - Improved pedestrian right-of-way	
Lang	1987	Sense of privacy	Sense of privacy is provided by: - Creating semi-public spaces as transitional spaces between public and private	
Whyte	1989	Self-congestion (presence of people)	Presence of people in the street attracts more people to the street	

Indeed, pedestrians' walking behaviour was largely overlooked until the early 1990s when the New Urbanists entered the walkability discussion. Their main goal has been about creating built environments that enhance the sense that walking is enjoyable and more convenient than driving for people. While much of their interest has been about the walkable 'urban form', which is expressed by compactness, mixed use and the gridiron street pattern (Park, 2008), they have also established design guidelines that aim at making streets nicer for walking. However, despite the widespread acceptance and application of these guidelines, particularly in the U.S. and Australia, how they actually affect pedestrians' evaluation of walkability of the street remains untold. In response to this, some scholars have developed environmental audit methods that provide a systematic way of evaluating walkability of the built environment (Schlossberg and Brown, 2004; Moudon and Lee, 2006; Agrawal et al, 2008). Nevertheless, their outcomes do not generally reflect pedestrians' opinions as people's perception is not normally involved in this kind of audit.

One critical branch of research that aims at identifying qualities of the walking environment has been conducted by Gehl and Gemzøe (1996) of the Centre for Public Space Research in Copenhagen. They establish a set of quality criteria for the design of the pedestrian landscape which are divided into three groups: 'protection', 'comfort' and 'enjoyment' (*Appendix A*). Gehl's work leads to valuable design criteria which have been applied in many cities around the world (e.g. Melbourne, London, New York, Sydney and Zurich). However, the effect of these quality criteria on pedestrians' walking behaviour again remains unclear. For instance, it is not clear which quality is more important to pedestrians or more relevant to a certain type of destination, and how this then influences pedestrians' route preference due to the presence or absence of such quality, or even whether they have the same effect on walking behaviour in strolling trips vis-à-vis walking to reach a destination.

Ewing et al (2006) has conducted perhaps the most relevant research about urban design qualities of the walking environment. They develop a measurement protocol for urban design attributes that have been found to determine walkability, which includes five qualities: imageability, enclosure, human scale, transparency and complexity. While their research involves an intensive study that explains objectively urban design qualities related to walkability rather than addressing the physical features of the environment, it defines the walkability components from the expert panel point of view, which may not fully echo the views of pedestrians as real users of the walking environment. Furthermore, the focus of their

research has been on strolling trips and so the findings may differ from when walking is considered a transportation mode with the purpose of reaching a destination.

Working to fill these gaps, Park (2008) asks people who walk to the transit station about their perception of a set of route attributes and finds five qualities which are more significant for pedestrians walking to the transit station: sense of safety from traffic, sense of security from crime, sense of comfort, sense of convenience and visual attractiveness. He also identifies the components of each quality and the physical features that define these components. Despite Park's critical findings, a key question remains unanswered: how do these qualities affect pedestrian route choice? That is, after providing an accessible network of streets to a specific destination, how do these qualities influence which route people may choose to arrive at the destination? Is it always about the shortest route? If the shortest route is unsafe or unpleasant, people may stay away from it unless the route is the only possible link to the destination they are headed to (Gemzøe and Gehl, 2006). So if the chance for choosing a route to a destination is given to people by a grid street network with small block sizes in a mixed use neighbourhood, where major destinations are within a walkable distance, which route would the people choose and which environmental qualities would significantly influence their route choice to the destination in the neighbourhood?

Agrawal et al (2008) seek to answer the above questions in their research entitled: *How Far, by Which Route, and Why? A Spatial Analysis of Pedestrian Preference*, which asks pedestrians directly about the qualities they would seek from the walking environment leading to a transit station. The analysis generates some key findings about pedestrian behaviour and preferences. Firstly, pedestrians tend to prioritise minimisation of time and distance over other reasons when choosing a route. This finding indicates that efforts to provide direct routes for pedestrians would likely be appreciated, and could potentially lead to an increased rate of walking. Secondly, safety is important to pedestrians, ranked next after distance. 'Safety' includes both traffic safety and safety from crime, although the qualitative answers seem to indicate a greater concern about traffic safety. Thirdly, availability of sidewalks is a priority for 43% of the respondents and aesthetic factors such as landscaping are mentioned as important by 35% of the respondents.

Therefore, the first priority for pedestrians in choosing their route is minimising distance, where the fastest and shortest route is preferred. However, this may be attributable to their

research considering, again, the transit station as a destination. If the destination differs, for example being a park or a shopping centre, would the result be different? The aim of this research is to investigate pedestrian perception of the walking environment in reaching a transit station as well as two other types of destinations – a park and a shopping centre – in the context of Tehran, Iran, to examine how trip purpose (type of destination) influences the environmental qualities people seek from their preferred routes. Do the qualities people seek from the walking environment depend on the type of destination, or, as repeatedly confirmed in previous research, is distance the key factor affecting people's route choice regardless of the type of destination?

2.0 TRIP PURPOSE AND TRAVEL BEHAVIOUR

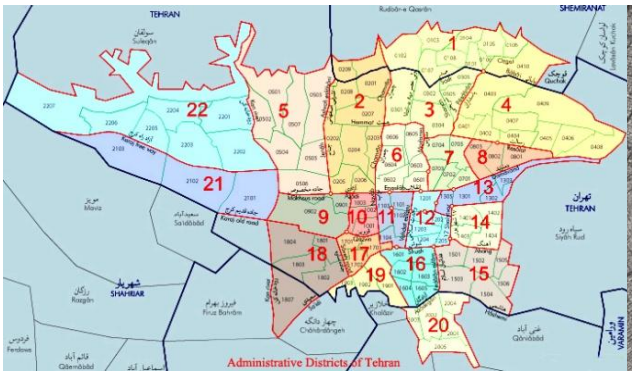
People travel to different destinations in the city for different purposes and different trip purposes have been found to influence people's travel behaviour, including their mode choice and route preference. According to Handy (1996), travel behaviour differs considerably depending on the purpose of the trip and different characteristics of urban form are likely to influence travel choices in different ways depending on the purpose of the trip. Towards better understanding the relationship between trip purpose and walking, Cerin et al (2007) investigate the association between access to four types of destinations (workplace, transit station, park and shopping centre) and walking as a transport mode. They find that the contribution of 'access to destinations' to the total amount of transport-related walking depends on the type of destinations. For instance, proximity to workplace is found to be the most significant contributor to transport-related walking whereas no significant association is found between transport-related walking and proximity to recreational destinations (Cerin et al, 2007).

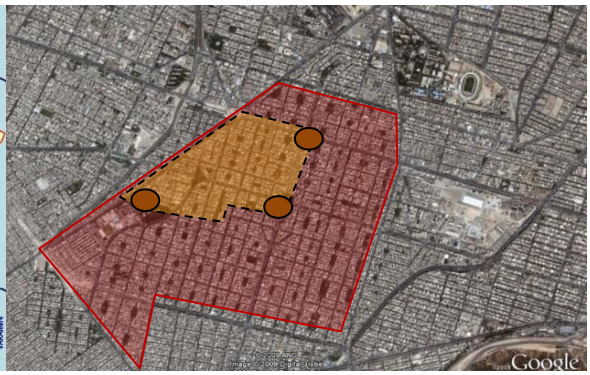
Therefore, it is important to separately test the link between the walking environment and travel behaviour for different trip purposes, especially in considering the different demands that different trip purposes put on walking. For example, work travel is generally less flexible in terms of distance (both spatial and temporal) than most kinds of non-work travel; workers usually need to be in a specific place at a specific time for a specific period of the day. Thus, it is probable that urban form will have a greater direct, day-to-day influence on non-work trip route choice than on work trip route choice (Handy, 1996). Moreover, there has hitherto been relatively lesser attention given to the influence of the built environment on non-work

travel (Rajamani et al, 2002), even though non-work trips constitute about three-quarters of urban trips and represent an increasingly large proportion of peak period trips (Saelense et al, 2003). In this light, this study investigates how three different trip purposes – recreational, shopping and commuting – influence people's route choice and the way pedestrians assign priorities to different quality aspects of the walking environment in Tehran's Narmak neighbourhood.

3.0 CASE STUDY: NARMAK NEIGHBOURHOOD

Narmak neighbourhood, designed and developed fifty years ago, is one of the earliest planned residential developments in the eastern part of Tehran (*Map 1*). Based on its primary plan, which has not been altered since its inception, Narmak consists of 100 small squares, each shared by surrounding houses as a "semi-public space", laid out in a grid street pattern with small block size (Mirgholami, 2007) (*Map 2*). According to Azizi (2006), this specific structure has made Narmak a sustainable neighbourhood in terms of livability, accessibility, and safety both from crime and traffic in the car-oriented metropolis of Tehran.





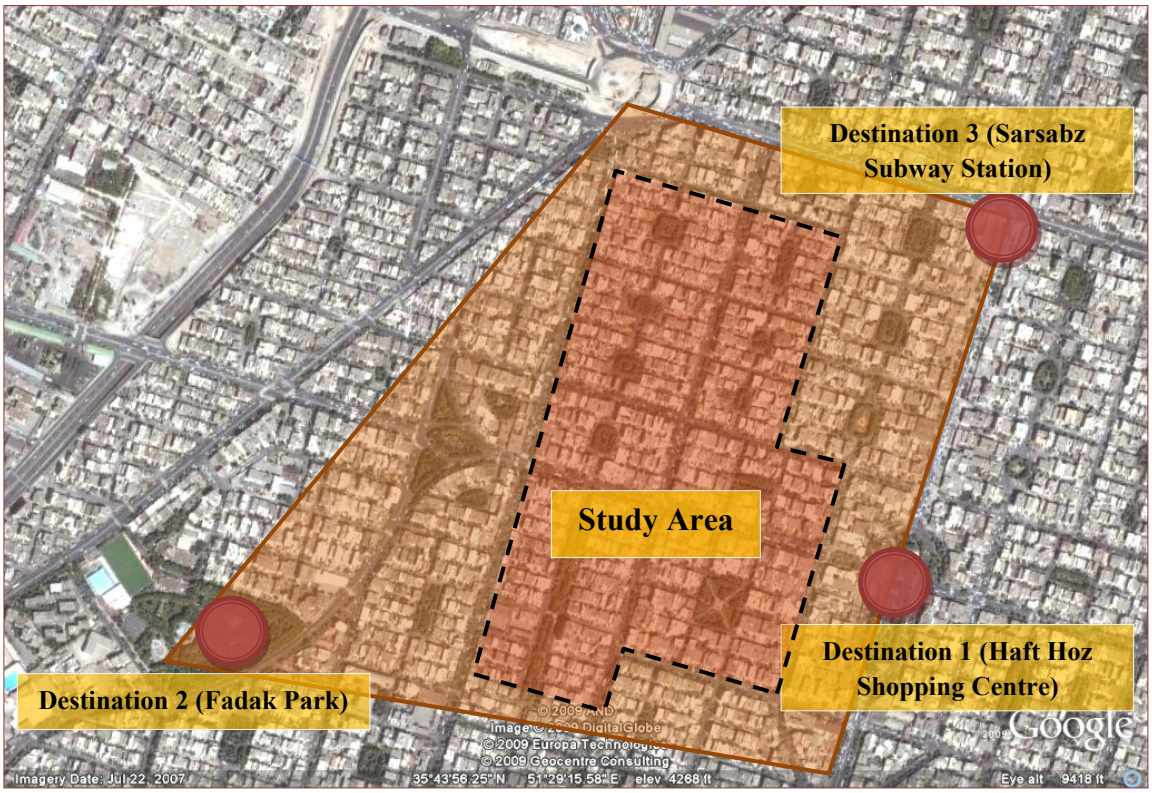
Map 1 (left): Location of Narmak (district no.8) in Tehran metropolis (Source: Official site of Tehran Municipality; http://en.tehran.ir/Default.aspx?tabid=12512, access date: 2/10/2010)

Map 2 (right): Structure of Narmak neighbourhood and location of the three destinations of the study (Source of background satellite image: Google Earth)

These attributes make Narmak an appropriate case for this research since, due to the largely orthogonal grid street layout, distance is almost invariable for various routes that connect an origin to a destination. Therefore the focus of the study can be shifted from distance to other environmental qualities of a route which play a role in pedestrians' route decision. Furthermore, according to the Iran Statistical Centre (2007), 78 percent of Narmak's residents

have lived in the neighbourhood for more than 10 years; they are as such sufficiently familiar with the area and, thus, aware of the route choices available to them.

As this study's purpose is to investigate the different qualities people would seek from the walking environment on trips to three types of destinations – a park, a neighbourhood shopping centre and a subway station – the study area as an origin of trips should be located in an area with reasonable distances to each of these destinations. Moreover, respondents should have at least two somewhat equal-length route choices for each destination. As such, residential blocks located on the edges of the neighbourhood have been excluded. Finally a part of the neighbourhood which is located between these three destinations and within a walkable distance to them has been chosen as the study area (*Map 3*).



Map 3: The study area and location of the three destinations – a park, a neighbourhood shopping centre and a metro station in Narmak (Source of background satellite image: Google Earth)

The first destination in this study is the neighbourhood shopping centre located in the main square of Narmak called Haft Hoz Square. Haft Hoz is located approximately at the centre of the Narmak neighbourhood and consists of a big square and a variety of shops around it. Fadak Park as a destination for pedestrians making recreational trips is another focus of this research. Although there are green spaces in each sub-neighbourhood, many residents have

been observed to go to Fadak Park for leisure and entertainment, probably attracted to the park's sports facilities such as a skating rink, tennis courts, a swimming pool, various playgrounds as well as a leisure complex. In addition, coffee shops and a traditional teahouse are other attractions in this park. Finally, Sarsabz Subway Station which connects the residents of Narmak to other parts of the city for work and/or other purposes is the last destination in the research (*Figure 1*).

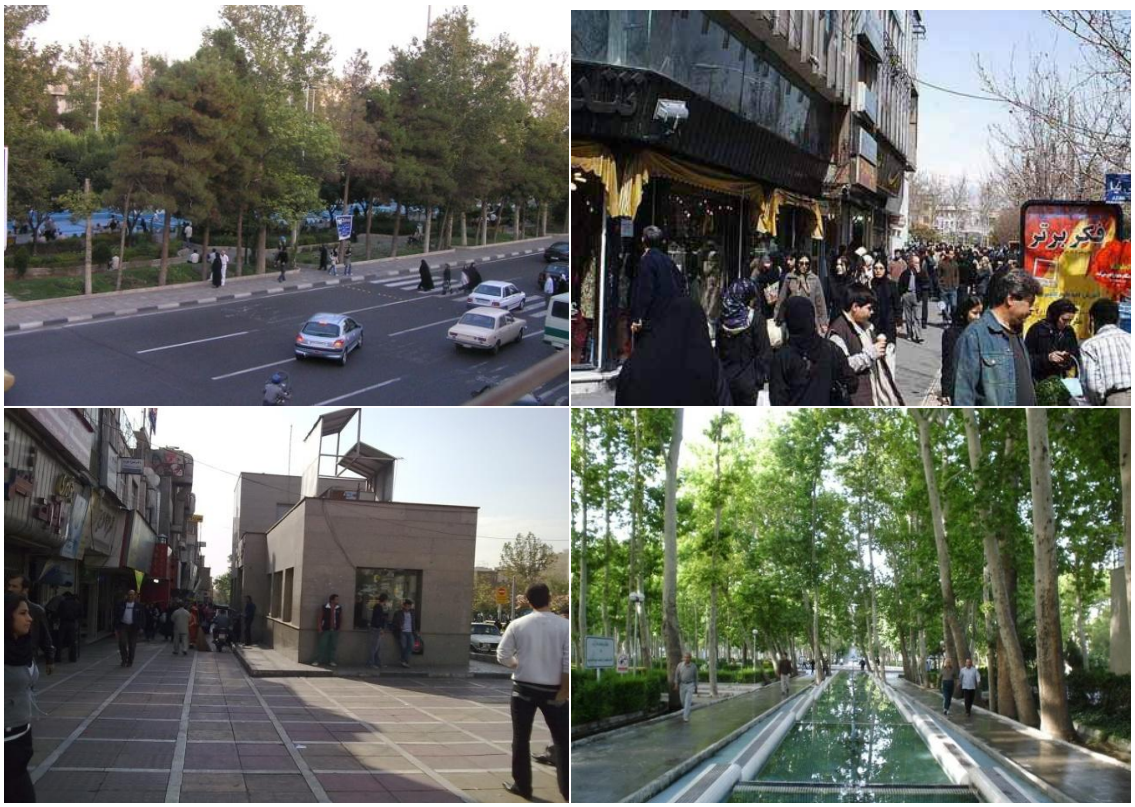


Figure 1: Three destinations of the study: (top (left and right)) Haft Hoz Square neighbourhood shopping centre; (bottom left) Sarsabz Metro Station; (bottom right) Fadak Park (Source: Fieldwork, 2009)

3.1 Sampling and Survey Respondents

The statistical population of this study includes all residents of the Narmak neighbourhood within the study area who are 18 years old or older and used to walk to all three destinations of the study. As the area consists of some sub-neighbourhoods which may have different socio-spatial attributes, Stratified Random Sampling is the appropriate sampling method for this study (Clifton and Handy, 2001). This method is used when the study context or respondents can be divided into smaller categories and each category may have different attributes. In the context of this study, this method provides the opportunity to represent not

only the overall neighbourhood but also key sub-neighbourhoods of the study area; there are enough cases from each sub-neighbourhood to make meaningful sub-neighbourhood-scale inferences. A total number of 100 respondents participated in this study. As shown in Map 4, there are 10 sub-neighbourhoods in the study area, each contributing to 10 respondents. However, because the size and population of Square No.64 and Square No.65 are significantly smaller than the other blocks, they have been combined into one block. On the other hand, Square No.73 is divided into two blocks taking into account its bigger size compared to the others.

Map 4: Squares included in the context of this study (Source of background satellite image: Google Earth)

3.2 Data Collection

The research investigates two different types of information: First, the route which is used by most of the respondents for each destination and secondly, the qualities of the route as a walking environment which are mentioned most by the participants for each type of destination. Before collecting the data, a survey questionnaire form consisted of two main sections was prepared (*Appendix B*). Respondents were first given a map of Narmak and were asked to draw their preferred route for each destination from their home as the origin of their

trips. They were then asked a series of questions about the environmental qualities which are crucial in their route choice decision. Since, according to Azizi (2006), squares in Narmak are sub-neighbourhood open spaces and are the most important places for social gathering and casual interaction between residents of surrounding houses, the squares have been used as places for interviewing the respondents.

For this purpose the researcher went to the squares in the residential blocks selected for the study (Squares no.62, 63, 64, 65, 66, 73, 74, 75, 76 and 77) as trip origins to the three destinations from 6pm to 8pm and asked respondents which were randomly selected among residents who were in the squares to fill out the survey questionnaire form. Those people who responded that they had walked to all three destinations of this study were asked follow-up questions to determine their eligibility for the study: (1) if they were over 18 years of age, and (2) if they would be willing to participate in the study anonymously. Willing survey respondents received a four-page written survey and a pen. The researcher then followed the respondent through in filling out the form to maximise the accuracy of the answers as well as help them if they faced any difficulties, particularly in the map section where they were asked to trace their route to the three destinations and the open-end questions such as the reasons why they choose that specific route to each destination. Since the questionnaire forms were given out to the 100 respondents one by one and the researcher followed them through in filling out the form, all 100 questionnaire forms were collected.

3.3 Data Analysis: Relationship between Destination Type and Pedestrians' Preferred Walking Environment

A key purpose of this research is to find out whether there is a relationship between the type of destination (trip purpose) and the preferred walking environment from the pedestrian's point of view, leading to the following hypotheses:

H_0: The qualities pedestrians seek from the walking environment do not depend on the type of destination they are going to.

H_1: The qualities pedestrians seek from the walking environment depend on the type of destination they are going to.

To test these hypotheses, the respondents were requested to evaluate a list of eight pedestrian environmental qualities that have been derived from the literature and assign a score of 1 to 4 to each of the qualities based on its importance with respect to each of the three destinations of the study. The non-parametric analysis technique of 'Kruskal-Wallis Test' has been selected for analysing the data. The non-parametric Chi-square test is an appropriate method when there are two groups of variables whose relationship is to be tested while the Kruskal-Wallis Test is suited for the same type of analysis involving three or more groups of variables. Because there are three groups of variables – three types of destinations – in this study that are to be compared with one another, the Kruskal-Wallis Test is therefore the appropriate method for data analysis. The analysis results are shown in Tables 2 and 3.

Table 2: Result of Kruskal-Wallis Test

	Sense of safety from traffic	Pathway amenities	Visual aspects	Presence of people	Formal and informal activities	Sense of security during day	Sense of security at night	Distance
Chi-Square	1.767	.404	11.74	12.18	29.78	.527	1.343	13.34
Df	2	2	2	2	2	2	2	2
Asymp. Sig.	.413	.817	.003	.002	.000	.768	.511	.001

According to Table 2, four out of eight environmental qualities – 'sense of safety from traffic', 'pathway amenities', 'sense of security during the day' and 'sense of security at night' – do not depend on the type of destination in pedestrians' opinion (significance > 0.05, insufficient evidence to reject H_0); pedestrians, it seems, will seek out these four qualities in their walking environment regardless of their destination type. The remaining four qualities – 'visual aspects', 'presence of people', 'formal and informal activities' and 'distance' – are however found to be of different importance to pedestrians going to different destinations (significance < 0.05, rejecting H_0); the importance of these qualities therefore varies according to whether the respondents are walking to the park, the shopping centre or the metro station.

So how do these environmental qualities actually vary in importance with respect to destination type? According to Table 3, residents of Narmak seem to prefer routes which have higher 'visual quality' when they are walking to the park while for trips to the metro station they tend to pay less attention to the visual quality aspects of their surrounding environment.

On the other hand, pedestrians appear to desire routes that are livelier when they go shopping, as both components of 'presence of people' and 'formal and informal activities' have the highest mean rank for shopping centre trips compared with trips to the other two destinations. Furthermore, while 'formal and informal activities' is of the same importance for trips to the park and the metro station, the respondents however prefer different levels of 'presence of people' on routes to these two destinations; specifically, 'presence of people' is more important on walking journeys to the park than to the metro station. Also as shown in Table 3, pedestrians prefer the shortest route when walking to the metro station whereas for the park and the shopping centre, 'distance' appears to be a much less determinant factor in pedestrians' route choice.

From the above, pedestrians prioritise differently four out of eight quality aspects of the walking environment when going to different destinations; these quality aspects (except distance) are related to pedestrians' sense of enjoyment. At the same time, pedestrians also seek out four other quality aspects of the walking environment which mainly give them sense of protection and sense of comfort in walking to all three destinations. How, then, do pedestrians choose their walking routes to different destinations? Do they tend to choose a particular type of road whose walking environment gives them greater sense of protection or do they prefer different types of roads that offer them different levels of comfort and enjoyment in walking to different destinations? In the next section, the pattern of pedestrians' preferred routes to each of the three destinations is examined to explore how pedestrians' opinions about the walking environment affect their route decisions. For this purpose data collected through the maps in which the respondents traced their route to each of the three destinations are analysed.

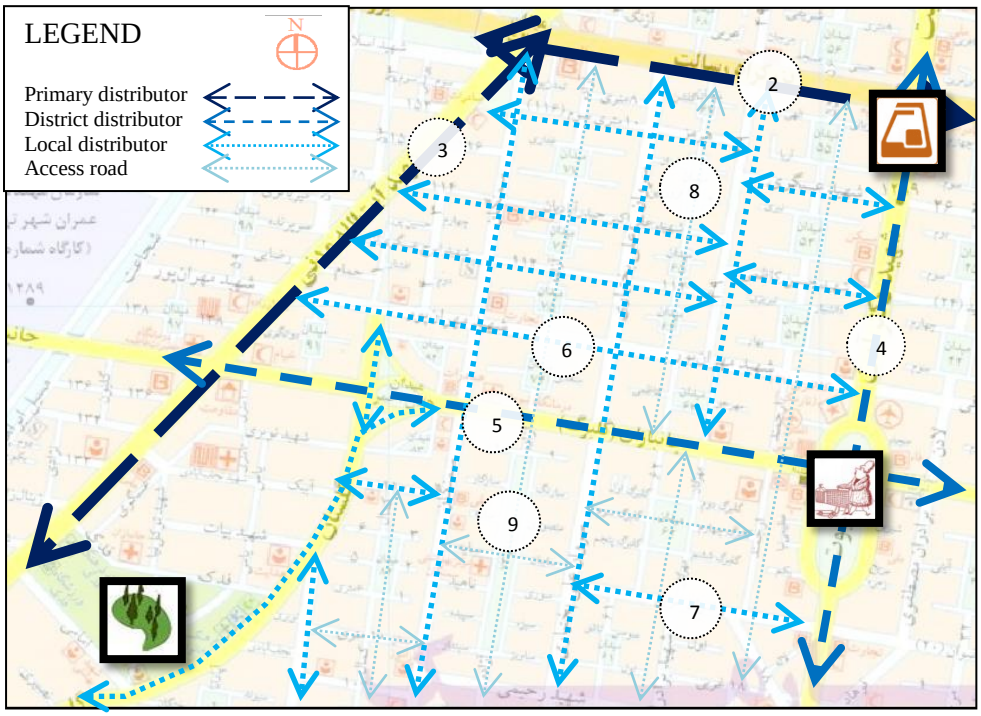
Table 3: Mean rank of each environmental quality for three destinations of the study area

Environmental Quality	Type of destination	N	Mean Rank
Sense of safety from traffic	Metro	100	151.93
	Shopping centre	100	142.22
	Park	100	157.35
	Total	300	
Pathway amenities	Metro	100	147.20
	Shopping centre	100	149.96
	Park	100	154.35
	Total	300	
Visual aspects	Metro	100	130.69
	Shopping centre	100	152.24
	Park	100	168.58
	Total	300	
Presence of people	Metro	100	129.64
	Shopping centre	100	170.99
	Park	100	150.88
	Total	300	
Formal and informal activities	Metro	100	131.88
	Shopping centre	100	187.86
	Park	100	131.77
	Total	300	
Sense of security during day	Metro	100	150.04
	Shopping centre	100	146.95
	Park	100	154.52
	Total	300	
Sense of security at night	Metro	100	152.46
	Shopping centre	100	145.16
	Park	100	153.88
	Total	300	
Distance	Metro	100	174.55
	Shopping centre	100	139.22
	Park	100	137.74
	Total	300	

3.4 Pedestrian Route Choice: Analysing the Traced Route Maps

For analysing pedestrians' preferred routes to different destinations, first of all, roadways in the study area are classified based on their functional hierarchies into four main road types – 'primary distributors', or arterial roads; 'district distributors', or commercial streets of the neighbourhood; 'local distributors'; and 'access roads', which are residential streets that continue through neighbourhood squares' (*Map 5*). While being classified according to their functional hierarchies, each road type is nonetheless characteristically distinctive and visibly distinguishable in terms of reserve width, vehicular traffic level, pedestrian density, building

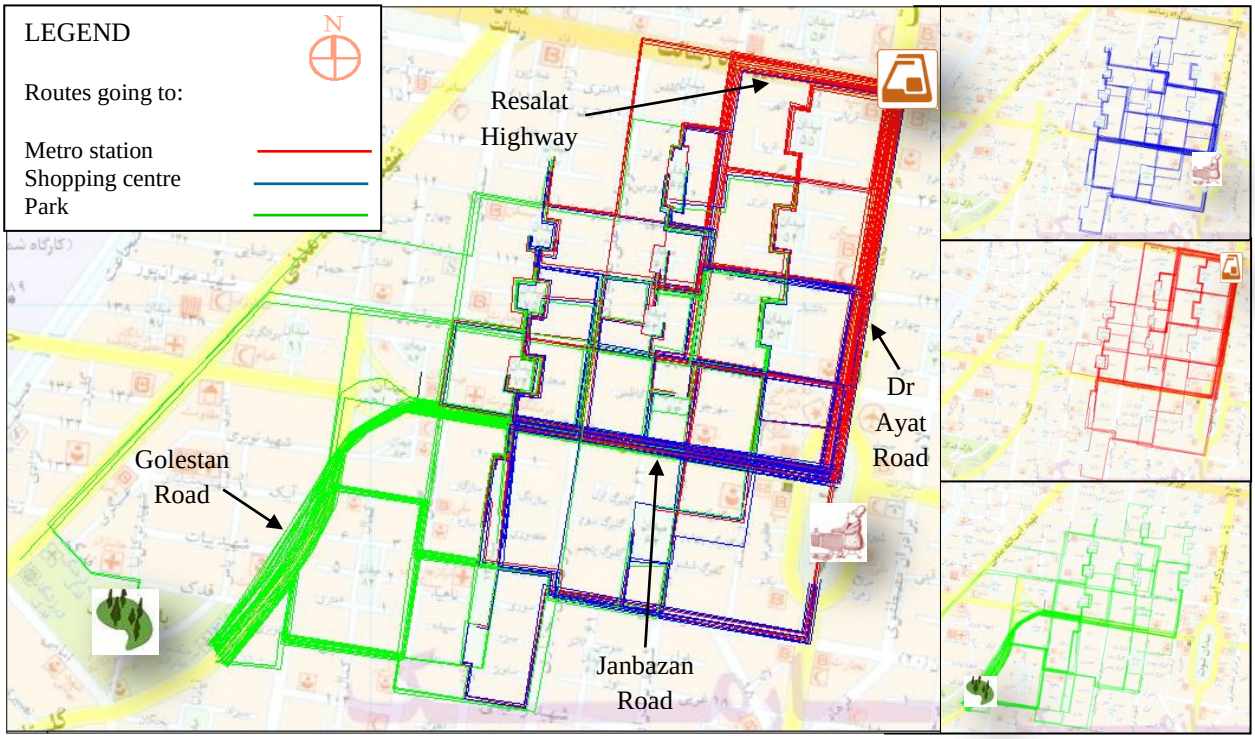
use, activity intensity, spatial definition, pavement amenity and landscaping. Figures 2-9 depict the typical street environment for each road type (figure numbers correspond with circled numbers in *Map 5* which indicate the location the photographs were taken).



Map 5: Classification of streets in Narmak (Source: Authors)

On the whole, level of vehicular traffic (related to traffic hazard) is the highest in the primary distributor road and lowest in the access road whereas commercial activity intensity and pedestrian density (both related to presence of people, liveliness and, concomitantly, sense of security from crime as well as sense of enjoyment), and pavement amenity (related to pedestrian comfort) are the highest in the district distributor road. Generally, spatial definition, street planting (related to visual quality) and residential use increase as we go down the hierarchy towards the access road. Therefore, different road types offer varying levels of different walking environmental qualities to pedestrians. How does this influence pedestrians' route choice in Narmak?

Map 6 presents the respondents' preferred routes to all three destinations in the study area, coloured according to the type of destination. Also, routes to each destination are extracted in separate maps (*Maps 7, 8, and 9*) to show the route pattern for each of the three destinations more clearly.



Map 6 (left): Routes traced by respondents according to the types of destination

Maps 7 (right, top), 8 (right, middle) and 9 (right, bottom): Routes traced by respondents separately for each of the three destinations (shopping centre, metro station and park)

A comparison between the route patterns in Maps 6-9 and the route classification map of Narmak (*Map 5*) reveals that the district distributor (commercial streets of the neighbourhood, e.g. Janbazan Road, Dr Ayat Road) is the most popular road type chosen by pedestrians regardless of where they are going to and, in the absence of the district distributor, the local distributor then becomes the next priority of the respondents. For example in trips to Fadak Park which is not connected to any district distributor, Golestan Road (*Map 6*) as a local distributor, though coincidentally also the most direct route to the park, is the most preferred by the respondents.

Therefore, despite the earlier findings that pedestrians prioritise differently four out of eight walking environmental qualities when going to different destinations, and that different road types are characterised by different quality aspects of the walking environment, on the whole

the pedestrians prefer one particular road type – the district distributor – for trips to all three destinations. Why do pedestrians not use different types of roads that offer different environmental quality aspects on their trips to different destinations, as may be reasonably expected of them?

A quick answer would be that the district distributor or commercial street of the neighbourhood offers pedestrians the richest walking environmental qualities – presence of people (related to sense of security from crime), high activity intensity (liveliness and enjoyment), medium traffic level (traffic safety), good pavement amenity (comfort) – as evident in Figures 4 and 5 above; the district distributor is therefore able to fulfil the pedestrians' need for protection, comfort and enjoyment better than other road types. It appears that as soon as they leave home, pedestrians tend to take the most direct and shortest route to get to the nearest district distributor that connects to their intended destination. In some cases, pedestrians appear to do so even if it means a slight increase in their overall walking distance due to some necessary backtracking in the route. But that is not all.

Perhaps a theoretically even more significant reason behind why the respondents have been inclined to use the district distributor as a key part of their walking routes to all three destinations is that environmental quality aspects that relate to pedestrians' sense of protection, which have earlier been found to be independent of destination type, are in fact the most important qualities that pedestrians consider first in their route choice decision. On the other hand, quality aspects that relate to pedestrians' sense of enjoyment, which have been found earlier to be dependent on destination type, may not necessarily be the most important considerations for pedestrians. It is likely that in choosing their walking route, whether it is to the park, metro station or shopping centre, pedestrians consider aspects of enjoyment of the route *only after* their need for protection (security, safety) is sufficiently fulfilled, hence their prioritisation of the district distributor road which offers high sense of security due to continuous presence of people.

In order to confirm this, further analysis is necessary to determine the importance of each of the eight environmental quality aspects to pedestrians in walking to different destinations.

3.5 Analysing the Importance of Various Walking Environmental Qualities

Tables 4-6 show the eight environmental qualities ranked according to their mean score of importance to pedestrians respectively for walking routes to the metro station, the neighbourhood shopping centre and the park.

Table 4: Rank of qualities by importance on trips to metro station according to their mean score

	N	Minimum	Maximum	Mean	Std. Deviation
Sense of security at night	100	1.00	4.00	3.7500	.67232
Sense of security during day	100	1.00	4.00	3.3800	.97214
Distance	100	1.00	4.00	3.2300	.89730
Sense of safety from traffic	100	1.00	4.00	3.2000	.87617
Pathway facilities	100	1.00	4.00	3.1100	.87496
Visual aspects	100	1.00	4.00	2.9600	1.10937
Formal and informal activities	100	1.00	4.00	2.1700	1.05462
Presence of people	100	1.00	4.00	2.1100	1.03372
Valid N (list-wise)	100				

Table 5: Rank of qualities by importance on trips to neighbourhood shopping centre according to their mean score

	N	Minimum	Maximum	Mean	Std. Deviation
Sense of security at night	100	1.00	4.00	3.6900	.70632
Sense of security during day	100	1.00	4.00	3.3800	.90766
Sense of safety from traffic	100	1.00	4.00	3.2700	.95193
Formal and informal activities	100	1.00	4.00	3.2100	.89098
Pathway facilities	100	1.00	4.00	2.9900	.95869
Presence of people	100	1.00	4.00	2.8700	1.17770
Distance	100	1.00	4.00	2.8700	1.10696
Visual aspects	100	1.00	4.00	2.6900	1.07961
Valid N (list-wise)	100				

Table 6: Rank of qualities by importance on trips to park according to their mean score

	N	Minimum	Maximum	Mean	Std. Deviation
Sense of security at night	100	1.00	4.00	3.7600	.66848
Sense of security during day	100	1.00	4.00	3.4600	.85776
Sense of safety from traffic	100	1.00	4.00	3.4500	.91425
Pathway facilities	100	1.00	4.00	3.2800	.80503
Visual aspects	100	1.00	4.00	3.1900	.80019
Distance	100	1.00	4.00	2.8700	1.15168
Presence of people	100	1.00	4.00	2.4300	.95616
Formal and informal activities	100	1.00	4.00	2.1100	1.04345
Valid N (list-wise)	100				

It is immediately obvious from Tables 4, 5 and 6 that the most important aspects that pedestrians consider in choosing their walking route are sense of security at night and sense of security during the day; these aspects are consistently ranked the most important and second most important environmental quality aspects in walking trips to all three destinations in this study. Sense of safety from traffic then follows as the third most important environmental quality aspects in walking trips to the neighbourhood shopping centre and the park, and fourth (after distance; see discussion below) in walking trips to the metro station. Therefore, regardless of trip purpose and when a trip is made, pedestrians would firstly look for routes that they perceive as sufficiently secure and safe, from both crime and traffic, before considering other route factors related to sense of enjoyment.

Apart from the above three environmental quality aspects that relate to pedestrians' sense of protection, the other environmental aspect related to sense of protection – pathway facilities – whose importance to pedestrians has also been found to be independent of trip purpose emerges as the fourth most important environmental quality aspect that pedestrians consider in choosing their walking route to the park and fifth in walking trips to the metro station as well as the neighbourhood shopping centre.

As for the remaining four environmental quality aspects whose importance in pedestrian route choice has been found to vary according to trip purpose, presence of formal and informal activities in the street gets the fourth, seventh and eighth rank respectively on trips to the shopping centre, the metro station and the park. Visual quality aspects of the walking environment is at its best ranked fifth in pedestrian route choice on trips to the park, sixth on trips to the metro station and eighth on trips to the neighbourhood shopping centre. Presence of people is the sixth determinant quality for the respondents on trips to the neighbourhood shopping centre, seventh on trips to the park and eighth on trips to the metro station. Interestingly, while being widely accepted as among the most important factors influencing pedestrian route choice (particularly with respect to transit related walking), distance is only ranked the third key determinant factor in pedestrian route choice on trips to the metro station whereas for trips to the park and the shopping centre, it is respectively ranked the sixth and seventh out of eight environmental factors.

4.0 DISCUSSION

This research has been an attempt at probing the relationship between trip purpose and pedestrians' prioritisation of various quality aspects of the walking environment, and how this then influences their walking route choice to different destinations in the urban neighbourhood context. A few features set this research apart from the main volume of existing literature on pedestrian route choice: 1) a scope of trip purpose that includes not only "time-distance-sensitive" transit related walking but also walking for recreation and shopping; 2) a shift of focus from the more utilitarian factors (e.g. distance, accessibility, street network, land use variety and density etc.) to more subjective quality aspects of the walking environment (safety, enjoyment, comfort, aesthetics etc.); and 3) an emphasis on direct viewpoints of pedestrians as actual users of the walking environment.

So far, several key findings have emerged from this research. Firstly, it is found that quality aspects of the walking environment that are associated with pedestrians' sense of protection (security from crime at night and during the day, safety from traffic) are the most important and will be considered first by pedestrians in deciding which route to take in walking to all three destinations in this study. Pedestrians seem to choose routes which they perceive as sufficiently secure and safe from both crime and traffic above other environmental factors. Quality aspects of the walking environment that are related to pedestrians' sense of comfort

(pathway facilities) are considered next for all three destinations, followed by those that are more related to sense of enjoyment (visual aspects, presence of people, formal and informal activities), which are only considered secondarily depending on their destination.

This explains why the respondents consistently prioritise the district distributor road, which they perceive as more secure and safer from crime and traffic, as a major part of their preferred route to all three destinations. The district distributor road, which is also the neighbourhood commercial street, hosts many formal and informal activities and consequently generates a constant flow of people during the day and at night, giving rise to an on-going lively environment and the concomitant feeling of security and safety among pedestrians (but see below). Furthermore, the district distributor road also has moderate traffic levels which, coupled with good pathway facilities (see *Figures 4-5*), contribute to pedestrians' feeling of safety from traffic and sense of comfort. Also, since the local distributor road is the next type of road (after the district distributor) capable of offering the above qualities to pedestrians (see *Figures 6-7*), they become the second priority road type in the respondents' preferred routes. The local distributor road is where residents' local needs may be met at convenience stores and grocery shops that are located mostly on street corners.

Secondly, it is found that distance does not really play as crucial a role in pedestrian route choice as has been generally suggested in the literature thus far, although it remains, in line with many past studies about pedestrian route choice with respect to transit stations as destinations, one of the key determinant quality aspects for walking routes to the metro station. Even so, distance only comes in third in importance after sense of security at night and sense of security during the day in influencing pedestrians' choice of route to the metro station; this lends further support to Gemzøe and Gehl's (2006) statement that pedestrians may avoid the shortest route if it is deemed unsafe. As for walking trips to the park and the shopping centre, distance does not figure as a significant consideration (ranked sixth for recreational trips and seventh for shopping trips) among the respondents, which is in agreement with Cerin et al's (2007) findings reviewed earlier.

This finding that distance does not figure as importantly in pedestrian route decision, even for walking trips to the metro station, as suggested in previous studies (e.g. Agrawal et al, 2008) warrants further discussion. It is proposed here that at least two types of decisions are made in any walking trip: *destination choice* decisions (choosing a destination) and *route choice*

decisions (choosing a route to the destination). It is possible that distance is the most important factor in decision making on *destination choice*, for instance in deciding which shopping centre, park or transit station to go to from a number of available choices, so that ceteris paribus, a nearer destination will have a higher probability of being chosen (though even here, it is likely that a slightly farther destination which has more to offer may be preferred to a nearer one; but this requires a different discussion). But once a destination is fixed, distance possibly no longer plays a crucial role in the *route choice* decision that follows, especially when available routes to the destination are somewhat equal in length, for example due to a permeable grid street network.

It may be added further that at the urban neighbourhood scale, since most destinations would have already been located within reasonable walkable distances from their origin, it is probable that pedestrians do not normally have to consider distance in making route choice decisions. Pedestrians then mainly consider quality aspects of protection, comfort and enjoyment (and in this order) in the walking environment, but not distance, in deciding which route to take to their destination.

Thirdly, apart from distance, visual quality aspects of the public realm, which have traditionally been an important scope of urban design (e.g. Sitte, 1889; Lynch, 1960; Cullen, 1961; Bacon, 1967; Jacobs, 1993), also do not emerge as important as may be expected in pedestrian route choice. For walking trips to the park in which visual quality emerges as important (*Table 3*), it is only ranked fifth (*Table 6*) among eight quality aspects whereas for trips to the metro station and shopping centre, it is respectively ranked sixth and eighth in importance (*Tables 4* and *5*). It seems that at the neighbourhood scale of movement pedestrians do not pay much attention to the artistic and visual aspects of cities such as aesthetics, legibility, streetscape, vistas, spatial definition and experiences in deciding their walking route.

However, this may be due to the peculiarity of this case study of Narmak, which is a master-planned neighbourhood laid out largely in a grid street system that is internally punctuated at somewhat regular intervals with small neighbourhood squares (see *Map 3*). This produces rather homogenous streetscapes outside the residential blocks, with long, straight views, though with different street widths, down most of the streets (see *Figures 2-7*). Therefore, visual characters and aesthetics have perhaps never been a significant part of Narmak's

residents' daily life in the public realm. Furthermore, the residents' long-time familiarity with the neighbourhood may have rendered the visual quality aspects of the area daily normalcy and appreciation of such aspects, if any, subconscious. In this light, it is felt that visual quality is actually an important aspect of the walking environment as it enriches the sensory experiences of pedestrians (which may well include visitors and non-locals who need to walk through the neighbourhood) and, perhaps subconsciously, adds to the pleasantness of walking.

Fourthly, and lastly, it is curious to note that while pedestrians consciously and consistently emphasise security and safety (sense of protection) in choosing their walking route, the quality aspects of presence of people and presence of formal and informal activities, which according to the literature are essential ingredients of sense of security and safety in urban streets, are never ranked as highly important in route choice for all three destinations. In fact, presence of people is ranked sixth for shopping trips, seventh for trips to the park and last for trips to the metro station (see *Tables 4-6*) while presence of formal and informal activities is ranked seventh for trips to the metro station and last for trips to the park (see *Tables 4* and *6*); for shopping trips, presence of formal and informal activities has been better ranked – fourth in importance (see *Table 5*) – presumably because these activities are part of, or directly related to, shopping activities.

According to Jacobs (1961), sense of security is provided in the street which is under constant surveillance by its residents and it happens when 1) the adjacent buildings are oriented to the street and 2) they have a transparent frontage on the ground floor which opens to the street and allows visual connection between inside and outside. Moreover, the basic necessity for such surveillance is a significant number of stores, public places and restaurants along the sidewalks of a neighbourhood as well as the constant flow of people who are attracted to these activities, not only during the day but also at night. Therefore, the respondents' prioritisation of the district distributor in their route choice as discussed earlier must be due not only to perceived security and safety but also attributable to the ongoing presence of activities and people in the district distributor road.

How, then, are we to rationalise this inconsistency in the way pedestrians emphasise the security and safety aspects of the walking environment in choosing their routes and yet at the same time deemphasise those quality aspects that contribute to the walking environment's

feel of security and safety? Could this be simply due to the people at large being unaware of the positive causal relationship between presence of people and sense of security and safety in the walking environment? Or could it be that pedestrians opt for a busy street with many activities and people mostly for security and safety but not so much for enjoying the vitality and liveliness of the street? Or could it be due to conflicting demands that people subconsciously put on the walking environment – for a secure and safe yet less populated street, or for a sufficiently safe and unobstructed (e.g. not crowded by people) passage to a destination they need to get to as quickly as possible?

The last postulation above, that pedestrians prefer a walking route that is perceived to be sufficiently safe and unobstructed by the presence of too many people, may be observed for walking trips to the metro station, where distance has been ranked the third most important consideration and presence of people the least important in pedestrian route choice (see *Table 4*). Going back to Map 6, we see that for walking trips to the metro station (routes shown in red) whose origin is closer to Resalat Highway (a primary distributor road), pedestrians choose it as part of their route over Dr Ayat Road (the district distributor road). This preference may be due to 1) Resalat Highway being part of the shortest route to the metro station and 2) lower pedestrian volume in Resalat Highway (see *Figure 2*). In other words, in walking trips to the metro station, pedestrians may prefer routes that are more direct and less crowded as, presumably, presence of people may reduce their walking speed.

5.0 CONCLUSION

As encouraging walking as a transportation mode and improving walkability in the city become increasingly important policy aspects in urban planning and design for more sustainable, liveable and healthier cities, improved understanding of pedestrians' walking behaviour, their perception and expectation of the walking environment and their route preference is fundamental, particularly with regard to walking to various major destinations within the urban neighbourhood. In this regard, this research is meaningful on two counts.

Firstly, improved understanding about the way pedestrians prioritise various quality aspects of the walking environment in relation to trip purpose in the context of an urban neighbourhood, as discussed above, means better guidance to city officials, planners and designers in identifying priority walkability enhancement projects for implementation; and, in

each project, prioritising quality aspects of the walking environment that need to be enhanced according to their importance to pedestrians and in relation to the type of destination. This is essential especially in considering the budgetary and resource constraints that most cities are increasingly facing.

For instance, understanding that pedestrians prioritise sense of protection in choosing their route, the priority of urban planners, designers and policy makers should be about providing sufficient sense of protection from crime and traffic hazards in all available routes in an urban neighbourhood. This may be achieved through mixing land uses that encourages continuous ground-floor active commercial uses with residential units above, especially along the main commercial streets of the neighbourhood. In predominantly residential streets, residential units with higher street-level transparency should be encouraged with windows, entrances and porches addressing the street while local shops and stores are permitted around major street corners. In addition, neighbourhood open spaces should be defined by building fronts and gap spaces which are not adequately visible should be minimised. All these should take place within a network of interconnected streets that have been traffic calmed with lower vehicular speeds, narrower carriageways, wider pedestrian pavements with sufficient shading, adequate lighting at night and priority crossings for pedestrians at major junctions. Wider pavements that reduce the sense of crowdedness are especially important along main commercial routes that connect to time-distance-sensitive destinations such as transit stations.

It is suggested that all new urban neighbourhoods should be designed with the above characteristics from the outset whereas for existing urban neighbourhoods, the above should be achieved through progressive physical redesign and functional retrofit that aim first and foremost at improving pedestrians' sense of protection in all streets, especially the main commercial streets, that connect major destinations within the neighbourhood. This will be followed subsequently by improvements to the walking environment through pavement facility and visual quality enhancements.

Secondly, better understanding about the varying importance of various quality aspects of the walking environment to pedestrians with respect to trip purpose provides researchers with empirical evidence that is applicable to developing more precise and realistic pedestrian travel behaviour modelling and simulation approaches. For example through applying better justified weighting and more precise parameter values to various walking environment

variables in pedestrian travel and behavioural models. It is hoped that this will contribute to continuous improvement in the theoretical understanding of pedestrian behaviour and route choice in relation to different destination types, leading eventually to more practical and workable designs of the walking environment in the urban neighbourhood.

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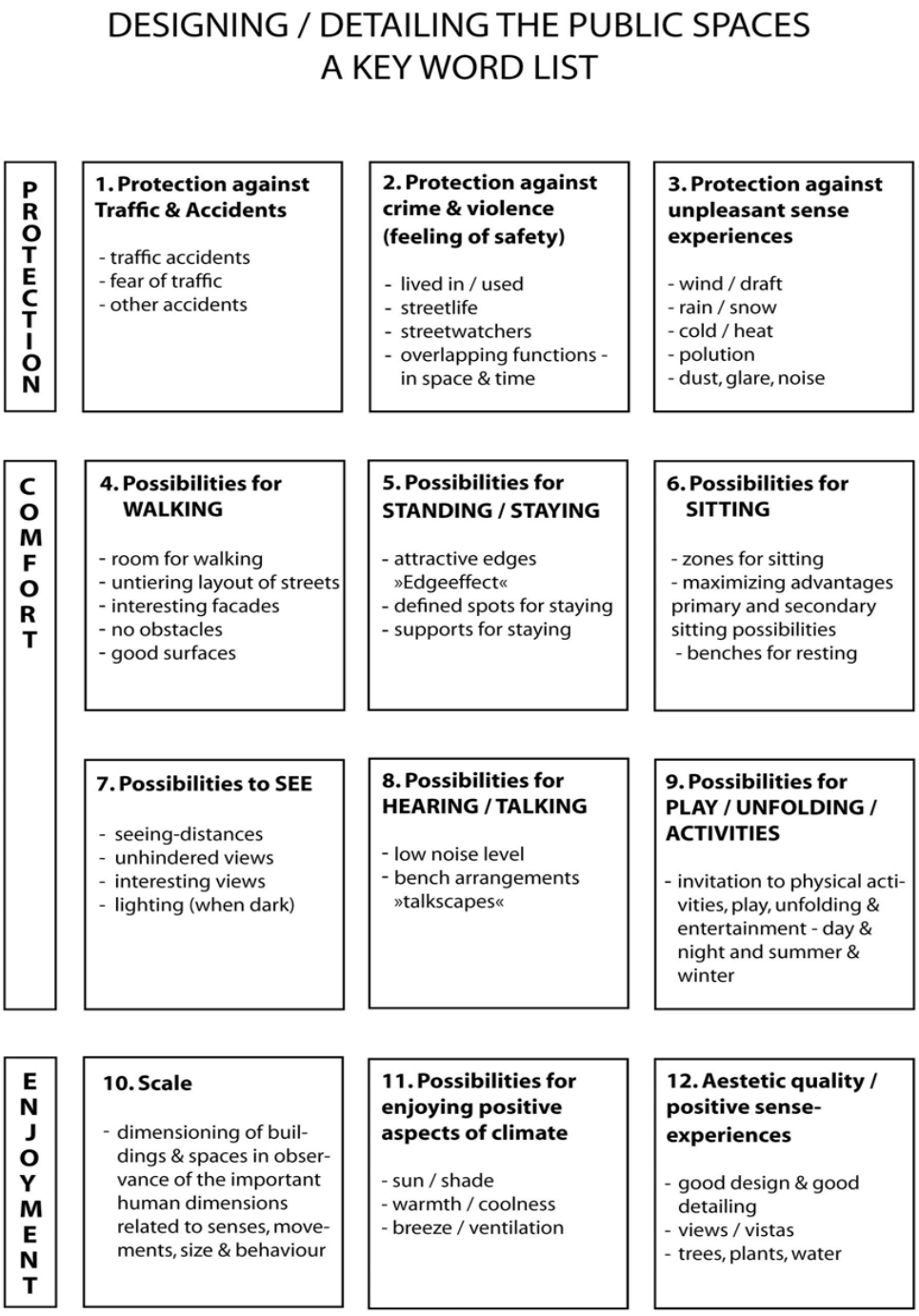
Appendix A

Criteria of a Walkable Environment (Source: Gehl and Gemzøe, 1996)



Appendix B

Survey of pedestrian's route choice to different types of destination

SURVEY QUESTIONNAIRE FORM (ENGLISH VERSION)

Thank you very much for your participation; this is a survey of pedestrian's route choice to different types of destination administered by researchers of Universiti Teknologi Malaysia's (UTM) Faculty of Built Environment, Department of Urban and Regional Planning. Your answers will help us understand ways of improving general walkability in Narmak and also similar cases in other neighbourhoods. In this survey no personal information (such as your name, address, or telephone number) will be asked. All data collected through this survey will be kept confidential.

SECTION A: RESPONDENT'S PROFILE

1- What is your age?

[ ] 18-30 [ ] 31-45 [ ] 46-60 [ ] more than 60

2- What is your gender?

[ ] Male [ ] Female

3- How many years have you lived in Narmak neighbourhood?

[ ] Less than one [ ] 1-5 [ ] 5-10 [ ] 10-20

[ ] More than20

SECTION B:

4- How often do you have access to a car?

[ ] Always [ ] Most of the time [ ] Occasionally [ ] Never

5- What is usually the main purpose of your trip to each of these destinations?

Fadak Park……

Haft Hoz Square Shopping Centre……

Sarsabz Subway Station……

6- What is your main reason of walking instead of driving to reach these destinations?

[ ] I sometimes walk because it is the faster and/or most convenient way to get somewhere

[ ] I like walking

[ ] I sometimes walk because it is the cheapest way to get around

[ ] I walk to get exercise or other health benefits

7- Does the neighbourhood design affect your decision about mode of transport?

[ ] Strongly yes; I choose Narmak to live because its design strongly supports me to walk

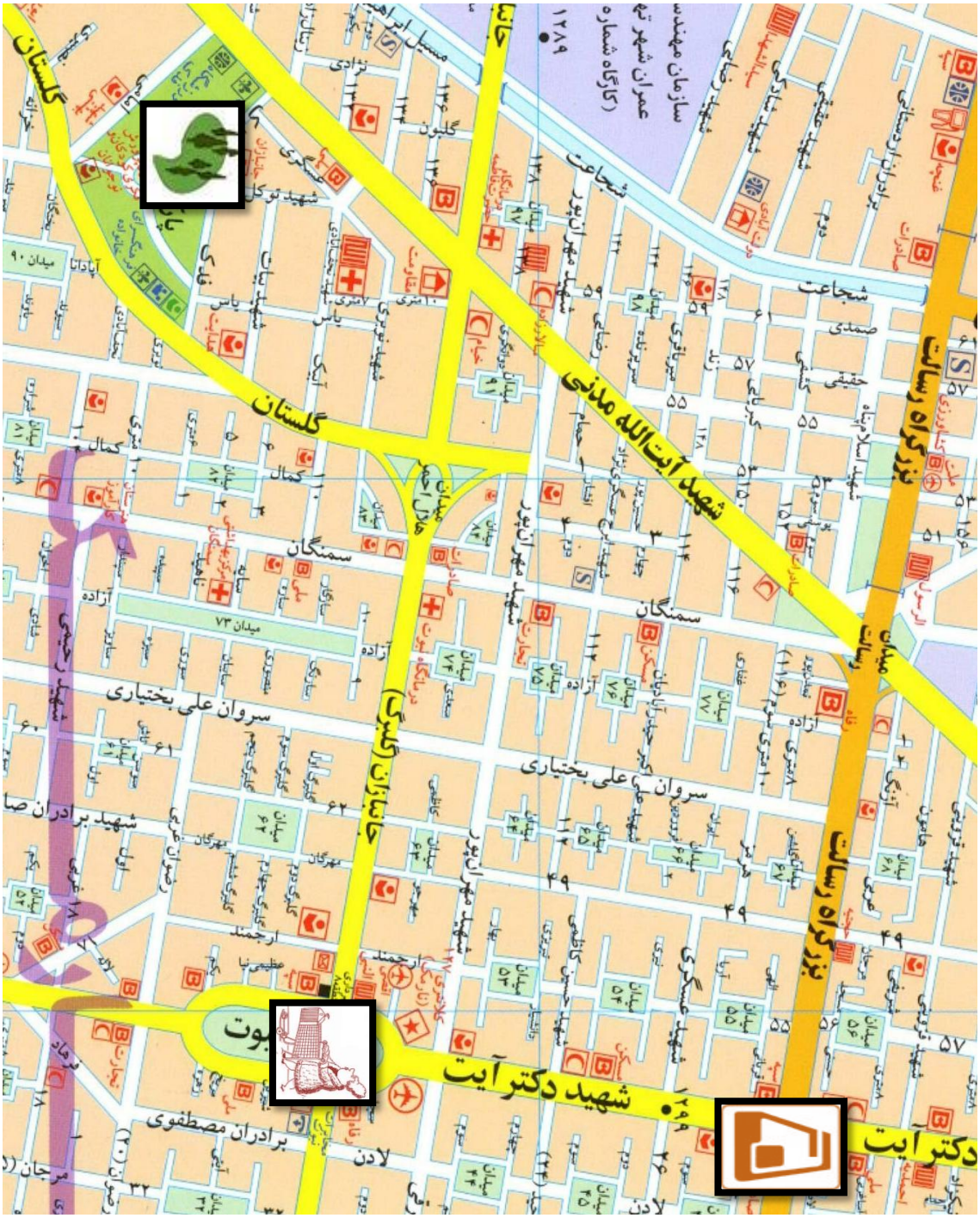
[ ] Yes; it encourages me to choose walking as my main mode of transport

[ ] No; design of the neighbourhood is not important for me; I like walking and I will choose walking wherever I live.

[ ] No; its design is discouraging but I still choose walking because of some other reasons

SECTION C:

8- The map below shows a part of Narmak neighbourhood (the area between Fadak Park, Haft Hoz Square Shopping Centre and Sarsabz Subway Station). By using a colored pen please draw the walking route that you use most frequently to each of the three destinations shown in the map. First indicate the location of your home and draw the line to each destination (Fadak Park, Haft Hoz Square Shopping Centre, Sarsabz Subway Station). If you use different routes for home-to-destination and destination-to-home walking trips, please draw both of them and label them so we can differentiate those two routes.



9- What are the main reasons you choose this route for each destination?

- Going to the park……
- Going to the shopping centre……
- Going to the metro station……..

10- Below is a list of factors that other researchers have found to influence the choice of routes people walk along. For each destination please mark how important it is to you using the following scoring:

1= very important 2= important 3= somewhat important 4= not important

	Fadak Park	**Haft Hoz Sq. Shopping Centre**	**Sarsabz Subway Station**
a) It is safe for walking because there are traffic control devices like traffic lights, stop signs and crosswalks, and vehicle speed is controlled			
b) The sidewalks are wide enough and in good conditions, without litter, cracks or obstacles			
c) There are attractive trees, beautiful landscaping, and/or buildings with appropriate size and appearance along the street			
d) Presence of other people in the streets: I prefer presence of other people because it makes the environment more interesting, livelier and safer for me to walk			
I do not like a noisy environment and prefer routes where there are not many people			
e)Local or public routes: I prefer more public routes rather than the local routes because I feel these routes belong to surrounding residents			
I prefer local routes because they are calm and there is less air and acoustic pollution			
f) There are shops, business, or activities which I like to look at			
g) I feel safe to walk because if I am mugged, someone from nearby houses and/or businesses will see me and call 119 During the day			
At night			
h) It is the shortest route			

11- Are there any other factors positive or negative that influence your choice of route to any of these destinations?

_____

12- Choose only three of the above qualities (by letter from a to h) and list them according to their importance to you for each of the destinations below (1 being the most important):

- Going to Sarsabz Subway Station

  1-…….

  2- ……..

  3-……..

- Going to Fadak Park

  1-…….

  2- ……..

  3-……..

- Going to Haft Hoz Square Shopping Centre

  1-…….

  2- ……..

  3-……..

Thank you very much for your time.

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