Volume 20 Issue 34
Originally issued as H6



Global Journal of human-social science: H
Interdisciplinary
Volume 20 Issue 6 Version 1.0 Year 2020
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals
Online ISSN: 2249-460x & Print ISSN: 0975-587X

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By Samaneh Khabiri, Mohammad Reza Pourjafar & Mohammad Saeid Izadi

Tarbiat Modares University

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GJHSS-H Classification: FOR Code: 870105



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A Case Study of Walkability and Neighborhood Attachment

Samaneh Khabiri [α], Mohammad Reza Pourjafar [σ] & Mohammad Saeid Izadi [ρ]

Abstract- The neighborhood attachment provides psychological benefits and has positive behavioral consequences for residents and communities. Much of the literature examines the impacts of individual and social indicators as predictors of place attachment. This research paper concentrates on the place dimension of this bond, examining influences of the built environment in the context of perceived walkability on neighborhood attachment and determining which variables of neighborhood walkability have the most significant impact on promoting neighborhood attachment. Moreover, the effects of neighborhood walkability variables on three main dimensions of neighborhood attachment, namely emotional, functional, and behavioral, are compared.

In this study, we draw a random sample of 348 Ekbatan residents aged 15 and above by using the stratified sampling method, and a multidimensional scale is adopted to measure neighborhood attachment and walkability. The findings confirm that respondents assign high or very high ranks to both variables. The correlations show a significant comovement between variables of perceived walkability and neighborhood attachment. The regression analyses point out that perceived walkability accounts for 39 percent of variations in neighborhood attachment. Besides, among all indicators for perceived walkability, the results show that proximity, environmental desirability, and then security are respectively the most significant driving forces of neighborhood attachment.

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I. Introduction

The neighborhood attachment is a psychological bond between people and the neighborhood in which they live. It encompasses emotional, cognitive, and behavioral dimensions. Numerous studies indicate that attachment to the place of residence is a psychological bond that carries beneficial effects for people and their communities (Lewicka, 2008). It also entails positive emotions such as love, joy, and pride. As put forward by Manzo and Perkins (2006), emotional connections to residential places relate to community social cohesion, organized participation, and community development. Besides, research conducted by Mesch and Manor (1998) shows that high neighborhood attachment among residents leads to protective behavior that safeguards the place and environment in which they dwell.

The individual and social benefits of place attachment, globalization, and destruction of ties between people and neighborhoods caused by factors such as growing mobility, development of new technologies, and their inevitable outcomes in life patterns have brought place attachment to the attention of policymakers and scholars across the world. Moreover, the rapid urbanization and dominance of modernist planning discourse in Iran's urban development programs in the past decades have caused a major spatial transformation in neighborhood structures, which once featured continuity of residence. Nowadays, the neighbors' alienation and ignorance undermine those neighborhoods that, in the past, enjoyed social capital as a result of close relationships and social ties among residents (Fallahpasand, 2011). Overlooking local communities and people's emotional connection with their places of residence has led to a decline of local communities' role in building social trust and cohesion. Such circumstances call for more attention to the physiological dimensions of cities in urban development plans.

The previous research on place attachment often concentrates on economic, political, or social dynamics (Manzo and Perkins, 2006) and underestimate the effects of physical dimensions of places on such ties (Scannell and Gifford, 2010). Today, walkability is a major topic in sustainable city and neighborhood planning and design (Southworth, 2005). The concept of walkability is concerned with the extent to which the built environment makes walking experience safe, secure, and pleasant. Gehl (2010) emphasizes that "in lively, safe, sustainable and healthy cities, the prerequisite for city life is good walking opportunities"(p.19). Various benefits of walkability for cities and communities, namely economic, social, and environmental, transport, and public health have resulted in a shift in the urban policymaking approach from auto-centric planning to more sustainable urban transport modes, especially walking and cycling. This trend has made walkability a

Author α: Ph.D Candidate in Urban planning, Urban Planning Department, School of Arts and Architecture, Tarbiat Modares University, Tehran, Iran. e-mail: s.khabiri@modares.ac.ir
Corresponding Author σ: Professor, Urban Planning Department, School of Arts and Architecture, Tarbiat Modares University, Tehran, Iran. e-mail: pourja_m@modares.ac.ir
Author ρ: Associate Professor, Urban Design Department, School of Arts and Architecture, Bu-Ali Sina University, Hamedan, Iran. e-mail: ms.izadi@basu.ac.ir

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priority for urban planning and design aimed at creating walkable cities and neighborhoods through developing policy frameworks and planning guidelines (Dong, 2017; Rafiemanzelat, Zebardast, and Latifi, 2017) for the built environment.

This study aims at identifying the relationships between perceived walkability and residents' place attachment in Ekbatan neighborhood in Tehran by means of survey research methods and quantitative analytical tools. The rest of this article is organized as follows. Section 2 briefly reviews relevant theoretical framework, Section 3 lays out research methods, hypotheses, and models, and Section 4 presents results and interpretations. Finally, Section 5 sums up all discussions and concludes.

II. Theoretical Framework

a) *Neighborhood attachment*

Lewicka (2010a) states "neighborhood is considered as the most popular spatial scale in place attachment literature". As a complicated, multilateral, and multidisciplinary concept, place attachment implies a positive psychological bond between people and places by which groups and individuals assign symbolic meaning to those places. Of course, some positive sentiments such as love, joy, and pride, unpleasant emotions like grief, distress, or desolation caused by being distant from the place or losing it, could accompany the formation of such a tie (Scannell and Gifford, 2013). The bond is also reflected in a series of specific behavior such as a tendency to maintain proximity to places (Hidalgo and Hernandez, 2001), social support, pro-environmental demeanor, and a tendency to participate in local affairs (Lewicka, 2005).

Initially introduced by Proshansky in 1978, the concept of place identity is also referred to as emotional place attachment in the respective literature and it is known as a notion related to place attachment. The place identity is part of a person's identity and is the result of his cognition of the physical world where they live. The cognition itself consists of memories, ideas, emotions, viewpoints, values, preferences, concepts, and experiential and behavioral ideals in interaction with varied and complex surroundings that shape every person's experimental space, including cognition and behavior. Twigger-Ross and Uzzell (1996) set the formation of place identity in connection with senses of self-efficacy, continuity, self-esteem, and distinction (Lewicka, 2008). Therefore, if a particular place raises a sense of distinction, self-efficacy, self-esteem, and compliance with beliefs, it is deemed more likely to have a highlighted role in the person's identity structure.

Moreover, the functional attachment is another dimension of the place attachment (Scannell and Gifford, 2013), defined by Stokols and Shumaker (1981) as the potential of a particular place in satisfying a person's needs and goals (Williams, Patterson, and Roggenbuck, 1992). In their viewpoint, two factors affect the way people perceive place dependency; First, quality of current place to meet their needs, and second, the relative quality of comparable alternatives in addressing those needs. Korpela (1989) puts forward that there exists a close relationship between place attachment and place identity through the concept of self-efficacy (Livingston, Bailey and Kearns, 2008). Twigger-Ross and Uzzell (1996) state "feelings of self-efficacy are maintained if the environment facilitates or at least does not hinder a person's everyday lifestyle".

A review of the research background in conceptualizing the psychological link between people and places shows that it involves three main dimensions of behavioral, emotional-cognitive, and functional. Scannell and Gifford (2010) have introduced a tripartite organizing framework for the concept of place attachment. According to their model, the place attachment is a bond that includes three main components of people (collective of individuals), process (emotional, cognitive, and behavioral aspects), and the place. Among them, the place is the most significant one that is less studied than the other two. Also, thanks to the heavy heritage of community studies on community attachment (Lewicka, 2010a), the social dimension of the place has been examined more compared to the physical aspect and the built environment.

A review of the studies that have subjectively assessed the impact of physical and environmental factors on perceived attachment to neighborhoods shows that neighborhood attachment is significantly greater with quiet and buildings' aesthetic pleasantness (Bonaiuto, Perugini, Bonnes, and Ercolani, 1999), lack of pollution and disorder (Harlan et al., 2005), access to the nature, housing and neighborhood quality, sense of safety, municipal services (Fried, 1982), presence of greenery (lewicka, 2010b; Bonaiuto et al., 1999). In contrast, neighborhood attachment is significantly lower with lack of opportunities, the inadequacy of cultural activities and meeting places (Bonaiuto et al., 1999), and size of buildings (Lewicka, 2010b; Gifford, 2007). Also, a study on a retirement community shows physical features that influence place attachment indirectly are close walking distance to the central activity building, small functional distance to neighbors, and access to a shared, enclosed outdoor garden (Sugihara and Evans, 2000). This study draws upon the physical dimension of place in order to probe into the relationship between the built environment from the virwpoint of walkability and the people's psychological connection with the neighborhood.

b) *Walkable neighborhoods*

Walking is the most accessible and the most affordable form of mobility (Southworth, 2005), the

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primary, the oldest, and the most natural form of moving around for the people (Pakzad, 2005). The walkability of cities and neighborhoods came to the spotlight in the late 1960s, concurrent with growing criticisms and urban problems caused by car-oriented policies. Promotion of walking and walkable communities emerged in activities of pioneering theorists like Jacobs (1961), Cullen (1971), Ghel (1971), Alexander (1977), White (1980), and Appleyard (1980), and developed into movements such as Smart Growth, New Urbanism, Transit-Oriented Development (TOD), activities of international organizations, and manifestos issued like "Towards an Urban Renaissance, Final Report of the urban task force" (2005), "Planning and Design for Sustainable Urban Mobility" (2013), "Streets as Public Spaces and Drivers of Urban Prosperity" (2013), "The Future We Want, The City We Need" (2014), and global movements such as Walk21. Likewise, a large number of research studies on walkability are carried out in several disciplines and various fields of knowledge, including urban planning and design, transport planning, and public health.

As demonstrated in Table 1, the definition of walkability does not draw merely upon increasing residents' walking in the urban environment. It is also described as a form of sustainable mobility and capabilities of the built environment which provide high-quality walking experience. Thus, the quality of walking experience as being safe, easy, and enjoyable is emphasized in the definition of walkability. To Forsyth and Southworth (2008), walkability encompasses certain features such as short distance to a destination, barrier-free and traversable routes for all, safety, provision of sufficient pedestrian facilities and infrastructures, and upscale environment.

Table 1: Definition of Walkability

Reference	Year	Definition
Seilo	2004	A measure of the urban form and the quality and availability of pedestrian infrastructure within a defined area.
Southworth	2005	The ability of the place to connect people with varied destinations within a reasonable amount of time and effort, and to offer visual interest in journeys throughout the network.
Abley	2005	The extent to which the built environment is walking friendly.
Steve	2005	The extent to which walking is readily available as safe, connected, accessible, and pleasant mode of transport.
Leslie et al.	2007	The extent to which characteristics of the built environment and land use may or may not be conductive to residents in the area walking for either leisure, exercise or recreation, to access services, or to travel to work.
Nosal	2009	The extent to which the built environment is friendly to the presence of people living, shopping, visiting, enjoying or spending time in an area.
American Planning Association	2010	A place in which residents of all ages and abilities feel that it is safe, comfortable, convenient, efficient, and welcoming to walk, not only for recreation but also for utility and transportation.
Litman	2011	The quality of walking conditions in an urban space which is inclusive of comfort, safety, connectedness and permeability (inclusiveness of neighborhood design).
Un-Habitat	2015	The extent to which the built environment is friendly to people moving on foot in an area.

Walkability facilitates and encourages pedestrian mobility (Lee and Talen, 2014). Moudon et al. (2006) hold the belief that walkability is not merely a motion pattern but is a type of sociability among neighbors that would eventually affect the physical, mental, and spiritual health of members of the community. Designing and planning such neighborhoods has received a considerable amount of attention. According to the study carried out by the World Health Organization (2008), walking may improve the life quality and mental health of people and prevent obesity, ailment, and disability by increasing their daily physical activity. It also lowers the stress level, and thus, helps lift people's spirits and strengthens the sense of social community, which brings about increased satisfaction among residents. In fact, walkable neighborhoods promote a certain lifestyle, which not only improves the physical and mental health of people but also entails the development of local communities. Hence, walking is both a physical and social activity (Gemzøe, Kirknæs, and Søndergaard, 2006). As found by various researches, neighborhood walkability increases physical activity (Frank et al., 2010) that in turn has health benefits for residents, ease social, economic, and environmental tensions (Giles-Corti and Donvan, 2002; Handy, Boarnet, Ewing, and Killingsworth, 2002; Pucher and Dijkstra, 2003; Vojnovic, Jackson-Elmoore, Holtrop, and Bruch, 2006), make neighbors meet and know each other, build trust among neighbors, and increase their social involvement (Dong, 2017).

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On the one hand, a walkable neighborhood provides a safe environment for its inhabitants. The safety of walking increases the number of pedestrians, promotes the culture of walking, reduces the speed of motor vehicles, and puts pedestrians at the top of the transportation hierarchy. Also, a decrease in the number of injuries resulted from the lower speed of motor vehicles creates a safe environment for everyone and particularly for children. On the other hand, the absence of pedestrians in neighborhood spaces and decreased walkability would reduce safety, security, and social ties, and would give rise to environmental problems such as air and noise pollution, deteriorated public health, lack of identity and sense of belonging, and boredom. The undesirable effect of impaired neighborhood walkability on the sense of community is considered to be one of the gravest problems in every country (Rezazadeh, 2011).

i. *Principles and criteria of neighborhood walkability*

The degree of neighborhood walkability depends on several factors. A strand of literetaure attempts to identify the criteria and principles for the built environment that facilitate walking. As inferred from past research, the walkability has three main criteria, namely proximity (Gori, Nigro, and Petrelli, 2014; Schlossberg, 2006), connectivity (Schlossberg, 2006; Frank et al., 2006; Lee and Moudon, 2008; Mouden et al., 2006; Gori et al., 2014), and quality of spaces (Gori et al., 2014; Litman and Blair, 2011; Schlossberg, 2006).

Proximity is the ability of street networks to facilitate pedestrian access to local destinations (Gori et al., 2014; Brookield, 2017). Access to daily needs within an acceptable amount of time and effort (Southworth, 2005) is the main issue in the proximity criterion. Versatile, small, and fine-grain blocks may shorten the distance between the residents and local services. A convenient walking distance is set to be between 365 to 610 meters long or may last between 5 to 10 minutes.

Owen et al. (2007) define connectivity as accessibility, choice of mobility methods, and continuity of the path to various local destinations. As specified by the American Planning Association (2010), multiple route connections do not make pedestrians take lengthy detours to reach their destinations. Connectivity and continuity of paths also require carefully-designed midblock crossings with curb extensions, median refuges, and other features to ensure pedestrian safety. Connectivity of routes is of high significance as it affects both time and distance of walking, and as a result, people's tendency to walk.

However, Ghel (2010) believes that the quality of the path people walk through may change the sense of desirable distance for users of the space. He goes on to explain that attractive and comfortable routes that offer rich experiences make users forget the remoteness and enjoy experiences as they happen. Scholars list various components such as safety, security, and delightfulness as indicators of quality for paths and spaces. Southworth (2005) names the width of pathways, paving, landscaping, signing, and lighting as the main principles to assess the excellence of paths. Sufficient lighting has a highly significant effect on the safety of pedestrians in public spaces (Litman and Blair, 2011). Additionally, paths and spaces need to be safe for everyone, including those physically challenged, the elderly, and children. Shortening distance between junctions and designing well-marked pedestrian crossings help traffic calming and enhance pedestrian safety.

III. Methodology and Model Specification

a) *Introduction to Ekbatan*

With 33 blocks and 15,675 residential units, Ekbatan town in Tehran is the largest residential complex in Iran that was designed and built with foreign investment in the 1960s. Its main goals were to control population growth, redistribute, and accommodate civil servants and the middle-class. Since then, this neighborhood has managed to preserve its original design and form. In terms of municipal administrative divisions, the town has an organization called City Council Assistant (or Shorayari in the local language).

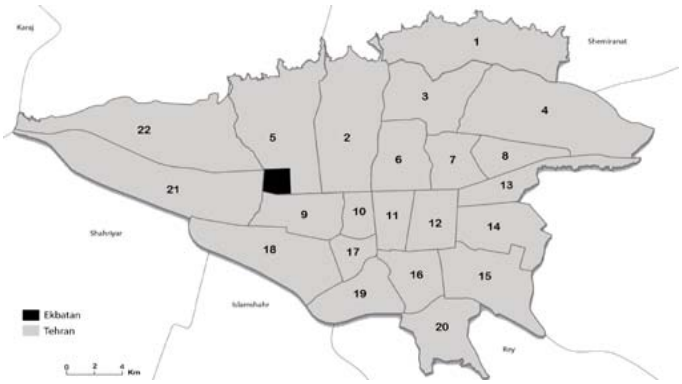


Figure 1: Ekbatan's location in Tehran

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Ekbatan has three separate sets of buildings, each called a phase, and they currently accommodate a population of 44,981 people (Marbaghi et al., 2018). In the total constructed area of the town, the five-to-thirteen-floor buildings and the service usage occupy about 58 percent and 5 percent, respectively. The U-shaped blocks have formed semi-public spaces with diverse green spaces. These open and green spaces make up one of the prominent Ekbatan physical and landscape features. In addition to improving air quality and creating a proper landscape, green spaces are also crucial for a vibrant social life leading to a continued presence of residents in these public spaces. Although the design of these spaces differs in each of the neighborhood's three phases, the green space has high per-capita square meters in all of them. Also, separating pedestrians and vehicle movements in the main public spaces and the semipublic spaces of each block has created a safe and secure feeling for the residents (see Figure 2).

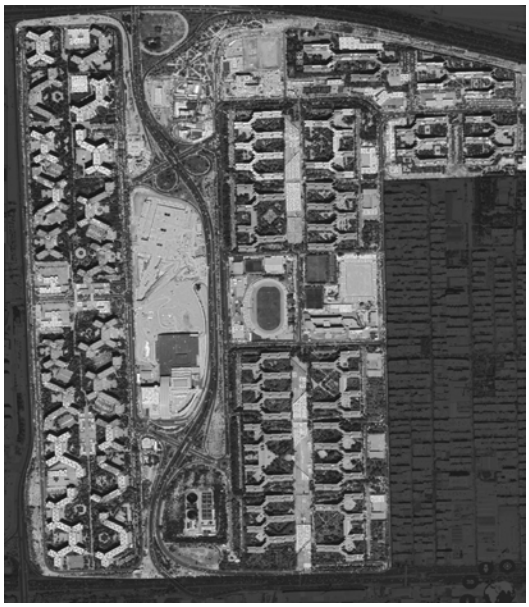


Figure 2: Ekbatan's aerial map

The neighborhood's Phase 1 consists of 10 residential blocks (6,511 residential units), two sports stadiums, one mosque, and 11 local markets or bazaars (see Figure 3). Markets are located in the center of Phase 1 along the north-south axis, and the local services and cultural-recreational spaces are concentrated on this axis (see Figure 4). These markets that are built in three floors integrate modern commercial complexes with traditional bazaars. They also form corridor-like walkways consisting of outdoor and indoor spaces, and at some points, have views to the green spaces of the blocks. This interconnected network of green and open spaces that links the markets of Phase 1 is known as the neighborhood's most active public space. Residents come to this place not only for shopping but also for meeting and greeting neighbors, social interaction, and leisure activities.



Figure 3: Blocks A_5 & B_4 and central market in Phase 1



Figure 4: Phase 1's market as the Ekbatan's prominent public space

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Phase 2 is located in the eastern part of the neighborhood, covering 19 blocks and 7,978 residential units, and comprising three markets, one public library, one mosque, and six schools (see Figure 5). The pecular layout of blocks in this phase creates a green pedestrian corridor in the middle, which is called the Health Road by the residents (see Figure 6). Due to its open spaces, Golha Commercial Complex is also used as another public space in the neighborhood. MegaMall Commercial Complex with a city-wide function, which includes facilities such as a cinema campus, hypermarket, reputable retailers, and brands, is located in Phase 2.



Figure 5: Phase 2's aerial map



Figure 6: Phase 2's walking path called Health Road

Phase 3, consisting of 4 blocks and covering 2,086 residential units, is located in the northern part of the neighborhood and has been in operation since 1991 after the construction of Phases 1 and 2 (see Figure 7). Offering its services to beyond the Ekbatan residents, Sarem Hospital, which is a well-known center for infertility treatment, is located in this phase. There is also a local market with 40 shops, one mosque, one local park, and two schools in Phase 3. Further, the Ekbatan neighborhood community center, which is called Saraye Mahallah, and city council assistant of the neighborhood are both located in this phase.



Figure 7: Phase 3's aerial map

Ekbatan is bounded by the Tehran-Karaj highway on the north, Shahid Lashgari highway on the south, Sattari highway on the west that provide vehicle access to the neighborhood. Ekbatan is located close to Line 4 of Tehran underground, and an underground station serves its residents. Moreover, the proximity of the neighborhood to Azadi Square, a prominent Tehran landmark, and its numerous public transport terminals and several taxi stations in all phases of the neighborhood facilitate people's accessibility to public transport. Each block of Ekbatan has an independent board of directors elected by the block's residents. The members of board of directors that are also members of the town's board, based on internal regulations, have the responsibility to monitor local business activities, accessibility, and availability of services and infrastructures.

b) Sample data

This paper uses the survey method and questionnaires to collect data. Assuming a population proportion of 0.5 and a confidence level of 95 percent, Krejcie and Morgan (1970) suggest that the sample should comprise 384 respondents. We distributed close-ended questionnaires among three phases in

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Ekbatan using the stratified random sampling. Our sample data consists of questionnaires that are filled in by 384 Ekbatan residents.

c) *Research variables and their quantitative measurements*

The two major research variables are neighborhood attachment and neighborhood walkability, the former as the dependent variable and the latter as the explanatory variable. The quantification and measurement of these theoretical concepts are based on methods reviewed in the literature. As explained in the previous section, neighborhood attachment is a psychological bond between people and the neighborhood and comprises three aspects, namely emotional-cognitive, functional, and behavioral. Place identity is emotional and cognitive side, place dependency is functional aspect, and residential stability and social support are behavioral criteria.

Measurement of the place attachment in quantitative studies utilizes survey methods and self-report scales. In this paper, a one-to-five scale of 20 different items is used to measure how Ekbatan residents perceive cognitive-emotional, functional, and behavioral dimensions of attachment in their town (see Table 2). These items that we apply to prepare questionnaires are extracted from some previous studies such as Williams and Roggenbuck (1989), Hidalgo and Hernandez (2001), Williams and Vaske (2003), and Lewicka (2005).

Table 2: Measuring Neighborhood Attachment

Components		Items
Emotional and cognitive bonds	Place identity	10 items including the following: Memories come to my mind when I am in various spaces in Ekbatan./ I have knowledge of Ekbatan history./ Ekbatan is a unique and special place to me./ I am proud of living in Ekbatan./ I like Ekbatan and feel attached to it./ Living in Ekbatan brings me peace of mind./ I define part of my identity by being an Ekbatan resident./ Ekbatan has become part of me. Ekbatan complies with my lifestyle which is based on my beliefs, tastes, tendencies, values, and orientations./ Residents of Ekbatan are homogeneous as for lifestyle, culture, and religious beliefs.
	Place depencency	2 items including the following: Ekbatan is a neighborhood that caters well to the needs of its residents./ Ekbatan caters to the needs of its residents better than other neighborhoods in Tehran.
Behavioral consequences	Residential stability	3 items including the following: Even if I can afford to live in other neighborhoods, I would continue residing in Ekbatan./ I would feel very sad and desolated if I am forced to leave Ekbatan./ How long have you lived in Ekbatan?
	Social support	5 items including the following: So far, whenever there was a form of objection to undesired alterations in Ekbatan, I have collaborated with other residents to prevent or stop it (e.g. Writing and signing petitions, protests, etc)./ I take part in management of the block in which I am living./ I wish to take part in decision-making procedures and other issues pertaining to Ekbatan./ In case I spot someone vandalizing the public spaces and facilities of Ekbatan, I would warn them or try to stop them.
Reference: Authors		

The literature review points out two general approaches in measuring the walkability of neighborhoods. The first approach employs application software to quantify objectively the influence of the built environment on walking behavior (Leslie, Butterworth, and Edwards, 2006; frank et al., 2006; Cole, Leslie, Bauman, Donald, and Owen, 2006; Rutt and Coleman, 2005). In contrast, the second approach measures neighborhood walkability subjectively by identifying opinion and perception of users with reference to aforesaid three principles of walkability (Burton, Turrell, Oldenburg, and Sallis, 2005; De Bourdeaudhuji, Teixeira, Cardon, and Deforche, 2005; Hooker, Wilson, Griffin, and Ainsworth, 2005; Plaut, 2005; Spence et al., 2006; Van Lenthe, Brug, and Mackenbush, 2005; Suminski, Poston, Petosa, Stevens, and Katzenmoyer, 2005).

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Table 3: Measuring Neighborhood Walkability

Components		Items
Proximity		9 items including the following: I normally walk to reach markets and other services in Ekbatan./ I spend most of my leisure time inside Ekbatan and enjoy leisure facilities provided./ How satisfied are you with accessibility of leisure and entertainment facilities in Ekbatan?/ How satisfied are you with accessibility of playgrounds for children?/ How satisfied are you with accessibility of schools and educational institutions in Ekbatan?/ How satisfied are you with accessibility of local markets and green grocers?/ How satisfied are you with accessibility of sports facilities and fields in Ekbatan?/ How satisfied are you with accessibility and number of extent parks and green spaces?
Continuity		2 items including the following: How satisfied are you with pedestrian accessibility of public transport inside Ekbatan?/ How satisfied are you with fast and easy access to streets and highways outside Ekbatan?
Spatial quality	Security	2 items including the following: I feel secure while walking around open and green spaces in Ekbatan./ How satisfied are you with lighting of passageways and public spaces in Ekbatan?
	Environmental desirability	3 items including the following: Open and green spaces in Ekbatan are delightful and I enjoy being around them or walking in them./ How satisfied are you with hygiene and cleanliness of open and public spaces in Ekbatan?/ How satisfied are you with visual beauty and landscaping of green spaces in Ekbatan?
	Safety	3 items including the following: Open and public spaces in Ekbatan are safe and proper for walking./ Open and public spaces in Ekbatan are safe and proper for children's walking./ Open and public spaces in Ekbatan are safe and proper for senior citizens' walking.
Reference: Authors		

The present article adopts the latter to indirectly measure walkability in Ekbatan by surveying the perception of residents about the walkability of their neighborhood using the inquiry method and questionnaire. The theoretical definition of neighborhood walkability also has three criteria including proximity, connectivity of the local road network, and spatial quality that itself has three sub-criteria of safety, security, and desirability. It might be noted that accessibility and reaching local services on foot are measured under proximity aspect. Connectivity measures the ease of access to other means of transportation both inside and outside the Ekbatan, including city transport networks. Spatial quality is measured by three sub-categories of safety, security, and environmental desirability. The safety of walkways and the security of spaces for movement of various age groups are rated by pedestrians' sense of safety and proper lighting of pathways. Also, desirability is evaluated according to pathways' beauty, cleanliness, and delightfulness. Similarly, walkability is measured using close-ended questions with answers according to a Likert scale. Respondents assessed each criterion by answering questions designed for specific items using a five-point scale (see Table 3).

According to validity and reliability tests implemented for neighborhood attachment, Cronbach's alpha is 0.921, composite reliability is 0.857, and the AVE value is 0.611. These statistics for neighborhood walkability are 0.925, 0.874, and 0.703, respectively. Given that acceptable values for Cronbach's alpha and composite reliability are bigger than 0.7 and for the AVE are larger than 0.5, the reliability and validity of the structure for these two research variables are confirmed. Also, when the coefficients of Cronbach's alpha are calculated upon the elimination of any items in these two variables, there are no significant changes in Cronbach's alpha. Thus, it is not deemed necessary to exclude any of them.

d) Correlation and regression analyses

We examine the relationships between neighborhood attachment and neighborhood walkability using correlation and regression analyses. The summary statistics of research variables, correlation coefficients, regression models, results, and their interpretations are reported in the next section.

IV. Empirical Analyses

a) Demographic characteristics of respondents

Demographic characteristics of 384 survey participants are as follows. 49 percent are female, and 51 percent are male. 90 percent were born outside Ekbatan, and 72 percent spent their childhood in places

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other than Ekbatan. The average age is 41. About 20 percent are aged below 30. About 40 percent are aged below 50, and the remainder are more than 50 years old. The most frequent age group is 50-60. 30 percent are single, 11 percent are married with no children, and 59 percent are married with children. Furthermore, 76 percent are homeowners, and the remainder are tenants. 25 percent have postgraduate degrees, 35 percent hold bachelor's degrees, and the remainder have lower educational levels.

b) Summary statistics

As reported in Table 4, the average rates respondents have given to both neighborhood attachment and neighborhood walkability are significantly larger than 3 on a one-to-five scale. It means that, on average, survey participants have high or very high attachment to their town and assess Ekbatan's walkability as desirable or very desirable. Among indicators of neighborhood attachment, residential stability has the highest score, and social support is the only exception that is not rated high or very high in the neighborhood. Also, among walkability indicators, residents rated the spatial quality of the town higher than others. Among the three sub-indicators, it is quality safety that has received the highest score from residents.

Table 4: Summary Statistics

Variables			Average rate	Standard deviation	Skewness	Kurtosis
Neighborhood attachment			3.584	0.841	-0.526	2.880
Indicators	Place identity		3.379	1.013	-0.484	2.394
	Place dependency		3.882	1.035	-0.889	3.429
	Residential stability		4.063	1.258	-0.420	2.356
	Social support		3.011	1.060	-0.317	2.806
Neighborhood walkability			3.780	0.792	-0.925	4.144
Indicators	Proximity		3.606	0.878	-0.695	3.675
	Continuity		3.832	1.024	-1.050	4.271
	Spatial quality		3.902	0.912	-1.164	4.398
	Sub-indicators	Security	3.728	1.022	-0.732	2.963
		Environmental desirability	3.893	0.893	-0.934	4.138
		Safety	4.085	1.190	-1.934	6.787
** and ** denote statistically significant at 5 percent and 1 percent, respectively.*						

c) Correlation analysis

Then, the correlation analysis is applied to measure the co-movement between two variables of walkability and neighborhood attachment in Ekbatan. We use Kendall's tau-b to estimate the direction and strength of the concordance between each pair of variables. As reported in Table 5, Kendall's correlation coefficients among all components of walkability and neighborhood attachment are positive and significant. These findings indicate that perceptions of walkability and neighborhood attachment change in tandem among Ekbatan residents.

Table 5: Kendall's Tau-b Correlation Coefficients

Variables		Neighborhood attachment	Place identity	Place dependency	Residential stability	Social support
Neighborhood walkability		0.37**	0.36**	0.41**	0.24**	0.20**
Proximity		0.42**	0.41**	0.43**	0.29**	0.22**
Continuity		0.26**	0.25**	0.30**	0.17**	0.16**
Spatial quality		0.35**	0.34**	0.39**	0.21**	0.18**
Sub-indicators	Security	0.32**	0.30**	0.34**	0.18**	0.20**
	Environmental desirability	0.39**	0.38**	0.45**	0.25**	0.18**
	Safety	0.28**	0.26**	0.32**	0.18**	0.15**
** and ** denote statistically significant at 5 percent and 1 percent, respectively.*						

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d) Regression analysis

As shown in Table 6, there exists a significant positive relationship between walkability and neighborhood attachment in Ekbatan. It means that higher walkablity leads to stronger neighborhood attachment and vice versa. The slope coefficients for walkability are positive and statistically significant. The coefficient of determination, R^2, estimates that walkability accounts for 32 percent of variations in neighborhood attachment. Significant F statistics mean that both intercept and slope coefficients of regression models are jointly significant. Also, significant ADF statistics imply that regression residuals have no unit roots, and hence, they are stationary.

Table 6: Impact of Walkability on Neighborhood Attachment

The regression model $Y_i = \alpha + \beta X_i + \varepsilon_i$ is estimated five times. In all five regression models reported, the explanatory variable is neighborhood walkability. The dependent variable in each of five regression models is mentioned below.

Regression parameters	Dependent variable				
	Neighborhood attachment	Place identity	Place attachment	Residential stability	Social Support
α	1.307** (0.234)	0.910** (0.282)	1.237** (0.283)	2.045** (0.350)	1.035** (0.300)
β	0.602** (0.057)	0.653** (0.070)	0.700** (0.069)	0.534** (0.085)	0.523** (0.080)
F	180.97**	134.67**	153.11**	48.56**	68.69**
R^2	0.32	0.26	0.29	0.11	0.15
ADF	-16.60**	-18.48**	-18.70**	-16.14**	-16.25**

Figures in parantheses are heteroskedasticity-and-autocorrelation consistent (HAC) standard errors;
ADF stands for Augmented Dickey-Fuller test statistic calculated for regression residuals;
** and ** denote statistically significant at 5 percent and 1 percent, respectively.*

Having detected a positive relationship between walkability and neighborhood attachment in Ekbatan, we then move to investigate this causal relationship in more detail. To this end, we extended our regression model into a multivariate equation in which the neighborhood attachment and its four indicators are individually regressed on five main components of walkability, namely proximity, continuity, security, environmental desirability, and safety. The results from these linear regression models enable us to see which component of walkability has stronger influence on neighborhood attachment and its four indicators.

Table 7: Impact of Walkability on Neighborhood Attachment

The regression model $Y_i = \alpha + \beta_1 X_{1i} + \beta_2 X_{2i} + \beta_3 X_{3i} + \beta_4 X_{4i} + \beta_5 X_{5i} + \varepsilon_i$ is estimated five times. In all five regression models reported, explanatory variables are indicators of walkability. Hence, X_{1i} is proximity, X_{2i} is continuity, X_{3i} is security, X_{4i} is environmental desirability and X_{5i} is safety. The dependent variable in each of five regression models is mentioned below.

Regression parameters	Dependent variable				
	Neighborhood attachment	Place identity	Place dependency	Residential stability	Social support
α	1.284** (0.193)	0.891** (0.223)	1.190** (0.271)	2.081** (0.312)	0.972** (0.272)
β_1	0.471** (0.072)	0.574** (0.082)	0.390** (0.089)	0.654** (0.146)	0.266* (0.125)
β_2	-0.015 (0.058)	-0.078 (0.067)	0.036 (0.072)	-0.085 (0.076)	0.067 (0.071)
β_3	0.146* (0.059)	0.205** (0.071)	0.094 (0.078)	0.295** (0.104)	0.012 (0.088)
β_4	0.290** (0.074)	0.432** (0.078)	0.432** (0.128)	0.323** (0.113)	-0.029 (0.106)
β_5	0.018 (0.034)	-0.050 (0.046)	-0.045 (0.047)	-0.051 (0.069)	0.218** (0.057)
F	48.59**	41.84**	38.31**	16.33**	16.68**
R^2	0.39	0.36	0.34	0.18	0.18
ADF	-14.98**	-17.40**	-17.97**	-15.06**	-10.74**

Figures in parantheses are heteroskedasticity-and-autocorrelation consistent (HAC) standard errors;
ADF stands for Augmented Dickey-Fuller test statistic calculated for regression residuals;
** denotes statistically significant at 5 percent; and*
*** denotes statistically significant at 1 percent.*

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The results are reported in Table 7. Among the theoretical components of walkability, only two of them, namely proximity and environmental desirability, are the significant drivers of neighborhood attachment in Ekbatan. Therefore, it might be concluded that a close distance to leisure facilities, parks, markets, and other local amenities improves attachment among Ekbatan residents. Similarly, green spaces, hygiene, and cleanness enhance people-place bond in the town. Security is the third significant factor that strengthens the sense of neighborhood attachment. However, it has a smaller effect on neighborhood attachment compared to proximity and environmental desirability.

Since all regression variables are quantified using the 1-5 Likert scale, the absolute value of slope coefficients allows us to determine which variable has the biggest impact on neighborhood attachment. Among the three significant variables of proximity, environmental desirability, and security, the first one has the largest significant impact, and the third one has the smallest significant effect on neighborhood attachment among Ekbatan residents. These three variables may account for 39 percent of variations in neighborhood attachment. Other components of walkability do not seem to have a significant effect on neighborhood attachment. The findings are similar for every four components of neighborhood attachment. In the cases of place identity, place dependency, and residential stability, the results show that proximity, environmental desirability, and security are still the main drivers. The social support is the only exception among components of neighborhood attachment. The proximity and safety are the driving factors for the self-reported perception of social support among Ekbatan residents.

V. Concluding Remarks

The neighborhood attachment is a positive psychological bond that has emotional, cognitive, and behavioral aspects with benefits for the individual and the community. These benefits include the social capital, residence stability, and social unity. Impairment of emotional bonds between people and the neighborhood and residence instability may lead to a decline in the social capital and wealth and has negative impacts on the social participation of residents, turning them into passive citizens.

Studying the influence of social and physical features of the neighborhood on residents' attachment may guide urban planners and designers to manage psychological bonds between people and the neighborhood through appropriate urban development plans. In line with prior place attachment studies in neighborhood scale, this paper examines the relationships between walkability as the capacity of the built environment and the spatial features of the town in encouraging and supporting enjoyable pedestrian mobility in a safe and secure space in Ekbatan. People's perception of walkability is assessed by three physical aspects of a neighborhood, i.e., proximity, connectivity, and spatial quality.

The survey results point out that Ekbatan residents have a positive assessment of walkability in their neighborhood and have high or very high attachment to their residence. Evidence also confirms high correlations between walkability and neighborhood attachment in Ekbatan. Thus, increased walkability may enhance neighborhood attachment. Besides, results from multiple linear regression models show that walkability indicators are significant factors to explain changes in neighborhood attachment. The estimated coefficient of determination implies that walkability accounts for 39 percent of changes in neighborhood attachment in our sample data. It is also evident that among the defined indicators for walkability, three of them, namely proximity, safety, and environmental desirability, are the significant predictors of neighborhood attachment. Among these three factors, proximity has the largest impact on neighborhood attachment.

The results of this study are similar to those of Sugihara and Evans (2000). They find proximity and short walking distance to community service centers are the major factors which affect the elderly's attachment to the local community. Our findings generalize these facts to all age groups above 18. Further, the results are in line with Sugihara and Evans (2000) that show social support as having a positive relationship with smaller functional distances and proximity to central buildings. Similarly, other studies such as Harlan et al. (2005), Fried (1982), Lewicka (2010b), and Bonaiuto et al., (1999) show that environmental desirability in terms of green spaces and low pollution have a positive effect on neighborhood attachment.

Therefore, it could be inferred that a proper design for local services and amenities and locating them within walkable distances and building pedestrian spaces of high quality with proper lighting, which bring about a sense of safety among the users, have improved the sense of place attachment among Ekbatan residents. Likewise, providing an enjoyable experience of walking in these pathways by building green spaces, increasing visual delightfulness, and regular cleaning has raised neighborhood attachment in the neighborhood. These are practical implications that could be used in preparing urban planning and design guidelines and checklists.

The results also give some insights into further research avenues. Future studies may examine the impact of walkability and each of its indicators on place attachment at a different spatial scale, for example, in the city range. Also, this study could be conducted in neighborhoods with lower levels of attachment to allow comparisons of findings in different levels of neighborhood attachment. Also, some researchers,

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such as Félonneau (2004), counter-argue that people who are more attached to their neighborhood tend to perceive its physical characteristics as more pleasant. Accordingly, by designing and measuring objective indicators to evaluate neighborhood walkability, we obtain some evidence that could be contrasted with those of perception-based assessments.

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