# NEARBY NATURE AND MENTAL WELLBEING:

# A DESIGNER'S PERSPECTIVE

by

**Sara Hadavi**

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Doctoral Committee:

Associate Professor MaryCarol Hunter, Chair
Professor Robert Grese
Professor Rachel Kaplan
Associate Professor Larissa Larsen
Professor William C. Sullivan, University of Illinois, Urbana Champaign

*To my loved ones*

*and all who have contributed to who I am today*

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# ABSTRACT

The beneficial role of nearby nature settings in mental wellbeing is particularly important in the urban context where residents are dealing with numerous distractions and sources of stress in their daily life. Given the key role of planners and designers as decision-makers in creating urban outdoor environments, this dissertation aims to investigate a) urban residents' preferences for outdoor green spaces from a design perspective, and b) the mechanisms through which planning/design-related aspects of the environment may affect mental wellbeing.

Three studies were conducted in a residential area in Chicago, IL. A qualitative approach was used in Study I with a focus on the preferred qualities of nearby nature in terms of environmental affordances and design characteristics in urban neighborhoods. In a multi-step interview context using photos depicting common landscape design elements of outdoor scenes, 53 individuals were asked to identify their preferences. The findings from this participant-generated photo grouping approach illuminate interconnections between environmental affordances and design attributes that address participants' needs and preferences. This study offers evidence of the preference for small green spaces that provide opportunities for both socializing and growing plants.

The other two studies presented in this dissertation draw on a survey with a random sample of 434 residents. Using both photographs and verbal items and a five-point rating scale, the participants were asked questions about perceived proximity to different types of green spaces, quality of such spaces, neighborhood satisfaction and use, barriers to neighborhood use and sense of mental wellbeing. Study II explored the associations between physical aspects of the environment and participants' neighborhood satisfaction and use patterns. The results of multiple linear regression modeling demonstrate that satisfaction with quality of public spaces, amount of affordances provided by them, and neighborhood comfort are strongly influenced by the physical structure and content of the environment. The findings also show that perceived landscape structure and walking-distance proximity to green and social spaces are very strong predictors of satisfaction with the quality of public spaces and frequency of use of green and social spaces.

Drawing on the strongest relationships found in this study, Study III focused on the direct and indirect relationships between the physical environment and mental wellbeing, with satisfaction and use pattern as the mediating factors. The mediation analyses conducted in this study support the hypothesis that satisfaction with quality of public space and frequency of use of green/social spaces have significant mediating role in the relationship between the physical aspects of the environment and mental wellbeing.

This dissertation offers contributions and extensions to the current literature by examining needs and preferences for outdoor green spaces with a specific focus on planning/design-related aspects of the environment, neighborhood satisfaction, use patterns and mental wellbeing. The contributions include a practical tool for broadening the scope of preference studies by using participant-generated photo grouping, addressing environmental affordances, and drawing on linkages among disciplines (landscape architecture, urban planning and environmental psychology). In addition, examination of detailed relationships between physical attributes of the environment and multiple aspects of satisfaction and forms of use sheds light on how outdoor spaces could be changed in order to meet users' preferences and needs in urban neighborhoods. Furthermore, this research contributes to the conceptual understanding of human-landscape interactions by examining both *direct* and *indirect* relationships between environmental factors and sense of mental wellbeing through neighborhood satisfaction and use. The three studies offer samples of translational design approach by providing place-based pragmatic planning and design recommendations.

# CHAPTER I
## Introduction

Sense of peacefulness and being able to function effectively are central to mental wellbeing for urban residents who are dealing with numerous distractions and sources of stress in their daily life. The focus of this dissertation is on the role played by both environment-related factors (physical attributes of the environment) and people-related factors (neighborhood satisfaction and use patterns) in improving urban residents' mental wellbeing. Specifically, the purpose of this study is to gain an understanding of people's preferences for small-scale nature settings at neighborhood level, and how proximity to such spaces and their design attributes affect the residents' sense of peacefulness and effective functioning.

Human effectiveness is strongly associated with the capacity to use one's attention. As S. Kaplan (1995) pointed out, directed attention is a limited resource. Its decline – a major source of mental fatigue – is an important element in inefficiency, human error, irritability, impatience, helplessness and damage to social relationships (Kaplan and Kaplan 1989; Kaplan, Kaplan, and Ryan 1998). Directed attention, however, is essential not only for dealing with the demands of crowded urban areas full of distractions and stressors, but also for the many complex tasks of increasing specialization in the modern world. In other words, the opportunities for mental fatigue are abundant (Grahn et al. 2010; Kaplan and Kaplan 1989; Kaplan 2001b). Thus, providing situations that facilitate restoration from mental fatigue and improve peacefulness in urban areas is of considerable importance.

A large body of research has documented that the physical attributes of the environment affect the level of mental wellbeing (Hunter 2011; Hur and Nasar 2014; Hur, Nasar, and Chun 2010; Kaplan 2001a; Kweon et al. 2010; Lee et al. 2008; Peschardt and Stigsdotter 2013; Scopelliti and Giuliani 2004). Despite the significant effects of the physical design of urban environments on people's wellbeing and their behavior in outdoor settings (Matsuoka and Kaplan 2008), planners and designers have only in recent years focused on the health problems

arising from cityscapes that fail to support people's needs or restore their mental wellbeing. This dissertation aims to investigate the effects of physical attributes of the environment on mental wellbeing from a planning/design perspective.

### *Restorative environments*

Research in environmental psychology over the past decades has provided a large body of knowledge in the human-environment interrelations and the mechanisms of the effects on mental wellbeing. Attention restoration theory (ART) (Kaplan 1995), in particular, offers a unique approach to identifying and restoring a cognitive mechanism which results in recovery from mental fatigue and sense of peacefulness. According to ART, interacting with environments rich with fascinating stimuli that do not require directed attention, moderately call upon involuntary attention that allows directed attention mechanisms to recover (Berman, Jonides, and Kaplan 2008). In other words, ART is based on the premise that directed attention is more likely to recover if it is allowed to rest. One of the means to allow it to rest can be to utilize involuntary attention in order to avoid use of directed attention (Kaplan and Berman 2010).

A sizeable body of research has shown that natural environments are the most restorative environments among different outdoor settings as compared to different urban settings (Berman, Jonides, and Kaplan 2008; Hartig et al. 2003). It is thus plausible that providing ready access to natural environments will facilitate recovery from mental fatigue and improve people's level of effective functioning and sense of peacefulness. In large, crowded and densely populated cities, however, the opportunity to have daily contact with natural environments is generally rare. This highlights the importance of considering all possible pieces of urban open space for their potential as restorative environments.

Urban landscape has the potential to function as a spatial framework for health improvements such as attention restoration, stress recovery, and developing positive emotions, as well as physical outdoor activities, and social integration (Abraham, Sommerhalder, and Abel 2010). In order to promote health, landscapes need to have certain characteristics that influence human well-being directly or indirectly which turn them into "good places" for health (Frumkin 2003). Given the limited opportunities for contact with nature in urban areas, it is essential for

planners and designers as decision-makers to gain practical knowledge about possible ways to create outdoor spaces that facilitate restoration and improve the residents' mental wellbeing. One approach to gain such practical knowledge, as this study presents, is to investigate the detailed mechanisms through which the planning/design-related attributes of the environment affect mental wellbeing.

### *Preferences and needs*

Theories and models of human–environment relationships suggest that human perception is essential for understanding the interrelations between humans and landscapes, particularly, in urbanized areas (Lee et al. 2008). As a key element of preference, environmental perception is an active process of interaction between human and the environment (Kaplan and Kaplan 1982) that incorporates both the content of a setting and a very quick unconscious assessment of what it is possible to do in the setting (Kaplan and Kaplan 1989). Preferred environments are thus implicitly linked to basic concerns and needs; for an environment to be preferred over others, it must thus afford the functions and activities that are important and meaningful to the individuals (Clark and Uzzell 2006). Without their awareness, people are more likely to use the settings that have the potential to offer desired affordances.

One of the key characteristics of restorative environments is their potential to meet people's needs and preferences. The urban environments that fail to support preferences seem to have characteristics such as crowding, confusion, pressure and noise which may result in a considerable deterioration of communication, trust and helpfulness, and increased level of stress (Kaplan and Kaplan 1982). Coping with such circumstances requires use of more attentional resources that in the long run results in metal fatigue. On the contrary, being in preferred environments that are experienced as pleasurable makes it easier to confront uncertainty and confusion and reduces the need for directed attention. The preferred environments are thus assumed to permit resting one's directed attention, improve peacefulness, and therefore are likely to be restorative (Kaplan and Kaplan 1989). Urban settings that meet human needs and preferences will result in healthier, more effective, and more socially involved urban inhabitants (Jackson 2003).

Research has shown that design experts' and professionals' perception of and preferences for visual landscapes are different from the general public (Brush, Chenoweth, and Barman 2000; Herzog et al. 2000; Scott 2002). Therefore in order to improve the quality of outdoor spaces in terms of restorativeness, the decision-makers need to consider users' preferences rather than relying solely on their own expertise and taste. Despite the well-documented role of planning/design decisions in people's wellbeing and behavior, it is difficult for design professionals to identify what approaches might be more helpful to extract people's preferences and translate them into design that could help them create better health-supportive environments. This study addresses these issues, including proposing an approach to investigate the design-related characteristics of outdoor spaces that are most preferred by the residents and offer affordances that are most appreciated by them in an urban residential neighborhood.

### *Neighborhood satisfaction and use*

Perception permits rapid assessment of whether a specific setting is likely to be supportive of one's needs (Kaplan and Kaplan 1982; Kaplan and Kaplan 1989). People's perception of the environment is the basis of their decisions about the extent to which the environment affords meeting their needs, satisfaction with the environment, and preferences. Therefore, a useful way of investigating people's needs and preferences in urban settings is to examine neighborhood satisfaction and use patterns. A large body of research shows that the physical attributes of the environment strongly affect the level of satisfaction with the neighborhood (Hur and Nasar 2014; Hur, Nasar, and Chun 2010; Kaplan 2001a; Kweon et al. 2010; Lee et al. 2008; Sirgy and Cornwell 2002) and the frequency of use of outdoor spaces (Grahn and Stigsdotter 2003; Macintyre, Macdonald, and Ellaway 2008; Shackleton and Blair 2013; Wright Wendel, Zarger, and Mihelcic 2012). It has also been shown that neighborhood satisfaction has a significant role in the wellbeing of residents (Fernandez and Kulik 1981; Kweon et al. 2010; Miller et al. 1980; Vemuri et al. 2009).

Although the significance of nearby nature settings in people's satisfaction and wellbeing has been well-documented (Ellis, Lee, and Kweon 2006; Kaplan and Kaplan 1989; Ward Thompson and Aspinall 2011), it is still not clear how different kinds of outdoor green spaces and different types of landscape structure may better improve neighborhood satisfaction and

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mental wellbeing, and how various perceived barriers to use of outdoor spaces may negatively influence them. Furthermore, it is not clear how each of these specific aspects of the environment may affect various dimensions of neighborhood satisfaction or different types of use of outdoor spaces. Further in-depth research is needed to examine the detailed associations between these aspects in order to help planners and designers find practical solutions for urban residents' mental wellbeing. This dissertation addresses these issues by investigating the mechanisms through which environment-related *and* people-related factors are interrelated. Specifically, this study hypothesizes the mediating role of neighborhood satisfaction and use between the physical attributes of the environment and mental wellbeing, based on the three sets of strong associations found in the current literature: a) physical attributes of the environment and mental wellbeing, b) physical attributes of the environment and neighborhood satisfaction and use, and c) neighborhood satisfaction and use and mental wellbeing.

### *Overview of the chapters*

A moderately dense residential area in Chicago was chosen to conduct a set of studies with respect to landscape preferences, neighborhood satisfaction, use patterns and sense of mental wellbeing. The following three chapters address the  key issues listed in the previous paragraph using both qualitative (Chapter II, semi-structured interview) and quantitative (Chapter III & IV, photo questionnaire survey) methods. The first study (Chapter II) investigates people's preferences for design-related aspects of neighborhood outdoor spaces. Using images of urban landscapes, interview participants indicated their preferences by selecting and grouping images of their choice. Their responses led to an analysis of perceptions of and preferences for the attributes and affordances of outdoor settings. The participant-generated photo-grouping approach proposed in this study illuminates possible ways to extract people's needs and preferences through perceived environmental attributes and affordances (see Figure 1-1).
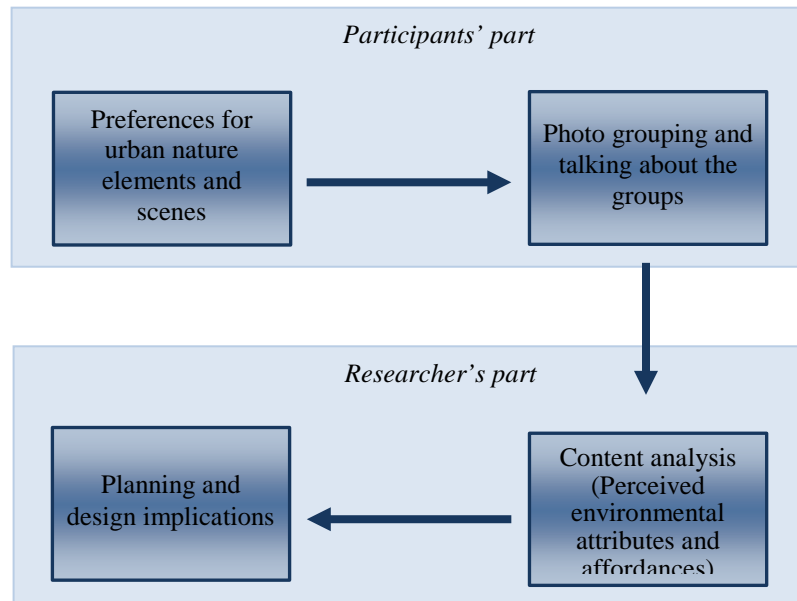
Fig.1-1 Study procedure presented in Chapter II- Participant-generated photo grouping

The second study (Chapter III) investigates the associations between the physical aspects of the environment, neighborhood satisfaction, and use patterns through quantitative survey data analyses, addressing two specific questions (see Figure 1-2):

- To what extent different components of <u>neighborhood satisfaction</u> and <u>use patterns</u> are interrelated?
- To what extent perceived <u>proximity of nature to home</u>, <u>nearby landscape structure</u> and <u>barriers to neighborhood use</u> affect <u>neighborhood satisfaction</u> and <u>use patterns</u>?

The detailed investigation of the effects of each planning/design-related physical attribute of the environment on neighborhood satisfaction and use patterns in this study provides insights into the design characteristics of the spaces that are preferred by the participants and are more likely to meet their needs.
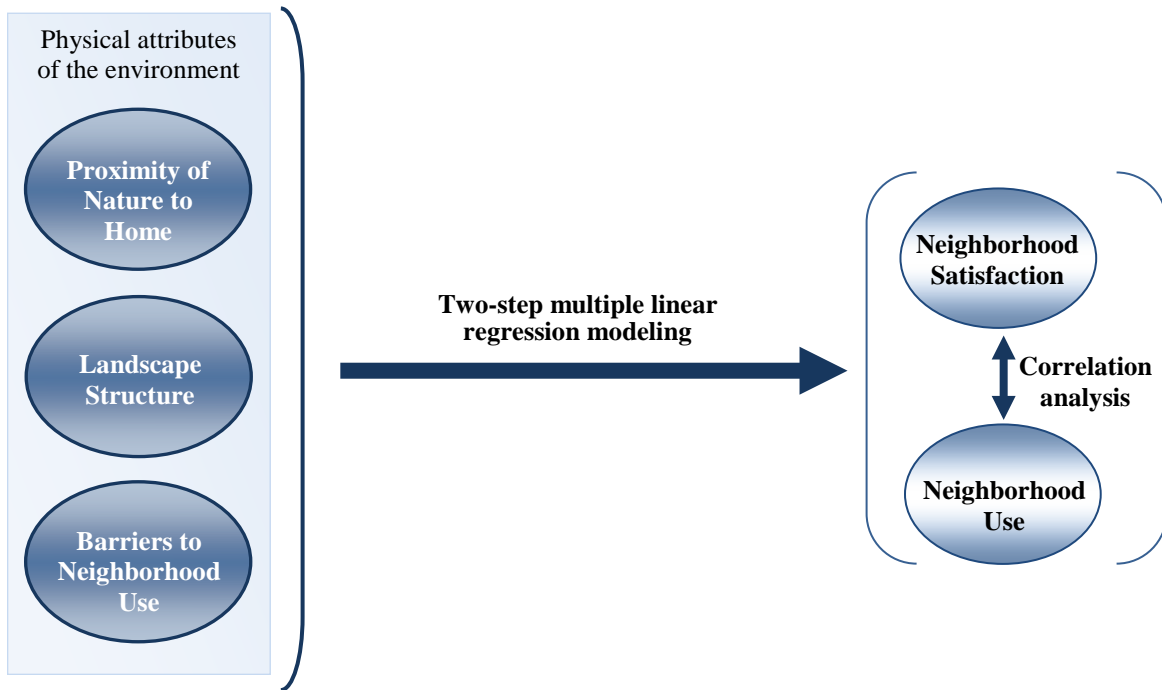
Fig.1-2 Research constructs and data analysis methods presented in Chapter III

Building upon the results of this study, Chapter IV investigates the effects of the physical aspects of the environment having the most significant associations with neighborhood satisfaction and use patterns, on mental wellbeing. Specifically, this study addresses the following questions to understand the mechanisms through which the planning/design-related aspects of the environment affect mental wellbeing (see Figure 1-3):

- How are perceived <u>proximity to green/social spaces</u>, <u>open lawn with trees</u> and <u>building-dominated spaces</u> as well as <u>perceived barriers to neighborhood use</u> associated with mental wellbeing?
- To what extent is the association between each of the physical attributes of the environment and mental wellbeing mediated by <u>satisfaction with quality of public space</u> and <u>frequency of use of green/social spaces</u>?

By exploring the mediating role of people-related factors in the associations between environmental attributes and mental wellbeing, this study makes linkages between two areas of research that have been previously investigated separately: a) the association between the physical attributes of the environment and neighborhood satisfaction and use, and b) the associations between neighborhood satisfaction and use and mental wellbeing.
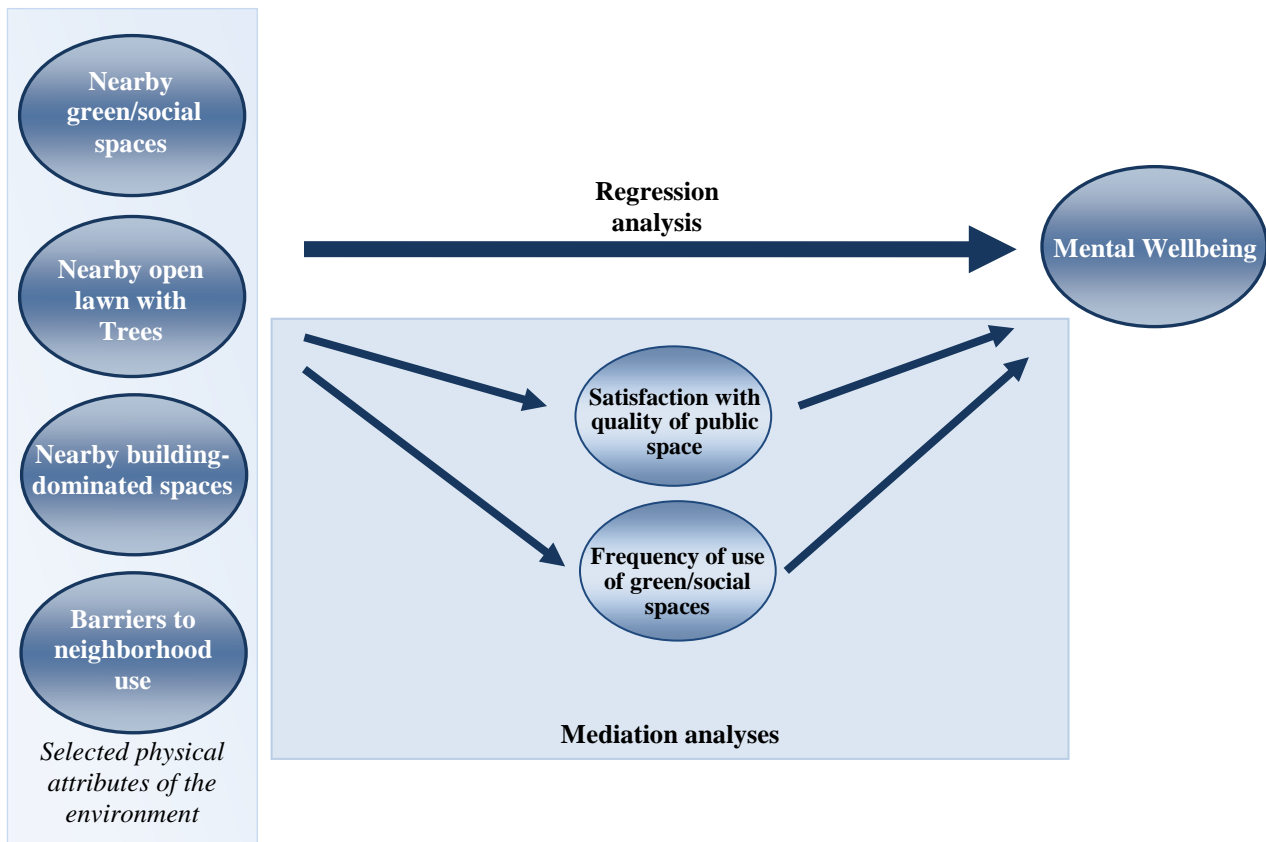


Fig.1-3 Research constructs and data analysis methods presented in Chapter IV

The concluding chapter (Chapter V) summarizes the research contributions of this work and offers insights about translational design of public outdoor spaces. It also provides recommendations for practitioners. Visions for future work and the bigger picture of this research have been presented as the concluding sections of this chapter.

This dissertation offers a variety of contributions and extensions to the current literature by examining needs and preferences for outdoor green spaces with a specific focus on aspects of the environment, neighborhood satisfaction, use patterns and mental wellbeing that are amenable to change through design and planning efforts. The research contributions also include a practical tool for broadening the scope of preference studies by using participant-generated photo grouping, addressing environmental affordances, and drawing on linkages among disciplines of landscape architecture, urban planning and environmental psychology.

Further, examination of detailed relationships between physical attributes of the environment and the various aspects of satisfaction and forms of use sheds light on how physical environments could be changed in order to meet the users' preferences and needs in urban neighborhoods. This research also contributes to the conceptual understanding of human-landscape interactions by examining both *direct* and *indirect* effects of environmental factors on mental wellbeing through neighborhood satisfaction and use.

While highlighting the significance of the users' perception of the environment, the results of this study provide substantial support for the premise that both environment-related and the people-related factors matter in terms of their effects on mental wellbeing. By putting users in the center of focus asking how they perceive and respond to nearby nature, focusing on planning/design-related aspects of the environment, investigating the mediating role of neighborhood satisfaction and use, and suggesting planning/design recommendations, this study offers an evidence-based approach to planning and design of outdoor spaces that has the potential to improve mental wellbeing.

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# CHAPTER II
## Environmental affordances: A practical approach for design of nearby outdoor settings in urban residential areas[1]

*Abstract*

While daily contact with nature is essential in large cities, such opportunities are often limited, thus reducing chances for psychological restoration. Even if available, however, such places will not be used if they fail to meet residents' needs and preferences. This study focuses on the preferred qualities of nearby nature in terms of both environmental affordances and design characteristics in urban neighborhoods. The study was conducted in the Logan Square Neighborhood in Chicago, IL, and involved 53 individuals. The research instrument was a set of 93 photos arranged in columns, depicting a variety of commonly used landscape design elements and urban outdoor scenes. Participants selected their preferred scenes and grouped them based on what they considered meaningful. The findings offer evidence of participants' preference for small green spaces that provide opportunities for both socializing and growing plants.

This study illuminates interconnections between environmental affordances and green space design attributes that address participants' concerns and expectations. It uncovers the importance of environmental affordances in green space preference studies, a topic that is largely missing from existing work on landscape preference. Further, it showcases a novel method - the use of participant-generated photo grouping to better understand the basis of preferences. The method emerged from pragmatic application of the Environmental Affordances Theory from Environmental Psychology to the landscape planning and design process. Finally, the results were used to create a set of useful recommendations to help urban planners and designers create more livable spaces in dense urban areas.

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## 2-1. Introduction

There is a large body of research on the significance of nearby nature in terms of its positive effects on wellbeing (Hartig et al., 2011; Kaplan & Kaplan, 1989; Kaplan, 1995; Ward Thompson, 2011). In large crowded cities, however, the opportunity to have daily contact with nature is generally infrequent. This highlights the importance of considering all possible pieces of urban open space for their potential as restorative environments for residents. Such places, though will not be used if they do not meet residents' needs and preferences. It is thus advisable to investigate the residents' needs and preferences before making decisions on planning and design of public outdoor spaces in order to create nature settings that encourage people to use them more frequently. While there is a substantial literature on environmental preference (Han, 2010; Herzog, 1989; Kaplan, 1973; Schroeder & Orland, 1994; Van den Berg, Hartig, & Staats, 2007), relatively few empirical studies (e.g., Nordh & Østby, 2013) have focused on preferred qualities of the nearby nature in terms of the design characteristics of such spaces in urban residential neighborhoods. The key concern of this study is to explore the interconnections between residents' perception of and preferences for the physical qualities of nearby outdoor environments. It tests an approach for interpreting preferences by focusing on environmental attributes and affordances as a tool to extract practical design solutions for outdoor green spaces in urban areas.

Furthermore, as Brown and Corry (2011) suggest, landscape architecture needs to move towards an evidence-based profession in terms of social and cultural components of design, and use scholarly evidence in making decisions about the use and shaping of the land. Evidence-based design process bridges the gap between scholars and practitioners in landscape architecture and related fields. During this process scholarly information is transformed and interpreted for direct application by design practitioners. Drawing on linkages between the disciplines of environmental psychology and landscape architecture, the analytical approach used in this study demonstrates the translation and interpretation aspects of evidence-based design. By virtue of the methods selected in this research to study the nature of preference for landscape characteristics, our outcomes offer direct applications in support of a people-oriented design.

*Environmental preference and affordances*

Drawing on previous experience, preference judgments are based on perceptions (Kaplan & Kaplan, 1989) and are linked to basic concerns and needs. As a key element of preference, perception is defined as the process of achieving awareness and comprehending sensory information (Bell, 1999), incorporating both the content of a scene and a very quick unconscious assessment of what it is possible to do in the setting (Kaplan & Kaplan, 1989). Gibson (1979) proposed that people recognize opportunities for action in the environment by perceiving the affordances of either objects within the environment or the environment itself. According to Gibson's affordance theory, for an environment to be preferred over others it must afford the functions that are important and meaningful to individuals, and might also afford activities that other environments do not support (Clark & Uzzell, 2006). According to this approach, even pleasure and beauty can be considered as environmental affordances (Grahn & Stigsdotter, 2010) because they reflect an assessment of the environment in terms of its compatibility with human needs and purposes, which affects effective human functioning in the settings (Kaplan & Kaplan, 1989). We can explore the environmental affordances and attributes through preference research to learn about those that are more important and meaningful to people.

Over the last four decades a large experimental literature has focused on preference studies using slides or photographs as an instrument to investigate people's preferences (Hartig & Staats, 2006; Herzog, 1985; Herzog, 1989; Kaplan, 1973; Korpela, KyttÄ, & Hartig, 2002). It has been shown that photographs can be used with confidence in preference judgments and perceptual studies as surrogates for actual landscapes (Coeterier, 1983; Kaplan, 1985; Shuttleworth, 1980). These studies generally used a 5-point rating scale of preference as the dependent variable, tried to sample widely in terms of the range of scenes presented within a certain type of environment. The studies have varied in the types of environments considered, including both the built and the natural environments (Hartig & Staats, 2006; Herzog, 1989; Kaplan, 1987), specific types of natural spaces (Balling & Falk, 1982; Han, 2010), forest environments (Herzog, 1984; Kearney & Bradley, 2011) and waterscapes (Bulut & Yilmaz, 2009; Herzog, 1985). However, a substantial number of studies have focused on preferences for urban nature settings (Kaplan & Kaplan, 1989). For instance, some studies focused on urban environments with a variety of natural elements in conditions from well-maintained to neglected (Herzog, 1989); some focused

on parks (Payne, Mowen, & Orsega-Smith, 2002) and some investigated preferences for specific landscape styles such as desert landscapes (Larsen & Harlan, 2006).

The few preference studies that have focused on environmental affordances of urban settings as the predictor of preference (Clark & Uzzell, 2002; KyttÄ, 2002; Min & Lee, 2006), have tended to be limited to specific age groups such as children and adolescents. The fundamental assumption of most of these studies is that preference for a place relates to the function and use of the place by children and adolescents; in other words, liking a place is associated with its social, physical and emotional affordances (Clark & Uzzell, 2006; Heft, 1988; Roe & Aspinall, 2011). These studies provide illuminating results in terms of the significance of social, physical and emotional affordances of the environment. However, they do not address the design attributes of the spaces and thus do not make the linkages between the findings and planning and design processes. In one of the few examples of linkages between affordances and design attributes, Nordh and Østby (2013) asked participants to indicate the types of activities they could imagine doing in the parks presented in a set of photos. The study's focus on activities differs from the aim of the current study, which is to examine preferences for urban nature settings. Although we focus on environmental attributes and affordances as a tool to link adults' preferences with planning and design considerations, the participants are not directly asked about affordances. It should be acknowledged that the role of environmental affordances as a critical aspect of landscape preferences emerged during the process of data analysis, thus leading to organizing the presentation of the results in terms of both affordances and attributes.

### *Perception of affordance-attribute interactions*

Although it is easy for participants in preference studies on outdoor spaces to make judgments, they are generally unable to explain their choices in terms of the reasons behind their judgments (Kaplan, 1987). Many preference studies have explored the way people perceive the environment by statistically extracting perceptual categories based on the participants' preference ratings of photos or slides. The groupings identified across a great diversity of studies provide some insights into the significant aspects of environmental perception (Kaplan & Kaplan, 1989), but they are not intended to link directly to specific environmental affordances or affordances. Rather than using preference ratings of individual images, the study presented here examined preference judgments by asking the participants to pick the pictured scenes that they prefer relative to other scenes. Participants were then asked to group the selected scenes into

personally meaningful groups and describe each group in a few words. The preference and categorization task provides the basis for examining the interconnections between perceived attributes and affordances of the depicted environment. These in turn illuminate place-based practical design implications that can help designers create outdoor spaces that are more attuned to what people need and appreciate.

## 2-2. Methods

### 2-2-1. Photo set

A hundred photos depicting a variety of commonly used landscape design elements and urban outdoor scenes typical of the style found in the Chicago neighborhoods under study were downloaded from the web. To avoid the possible effects of familiarity on preference judgments, it was decided to use internet images instead of real images of Chicago. Photos were selected to represent variety in plant materials, form, color, texture (both in natural and built elements), and in types of outdoor spaces (ranging from natural and semi-natural, to built with some nature elements, wide open space, and small garden space). The chosen photos were resized to 1.12" x 1.5" to fit on a support board for comfortable use in public settings without losing legibility, and printed out in color. Seven photos were eliminated at the early stage of the study due to lower image quality or lack of clarity of the details. Table 2-1 shows the frequency of photo contents in the 93 photos used in the study based on the dominant visual elements of the photos such as gardens, playgrounds, water features or benches. The frequency of topical content reflects what was found in relatively dense residential neighborhoods under study in Chicago. Thus scenes with single trees or small green spaces had greater representation, and relatively few scenes included water features or wide open spaces.

Table 2-1 Frequency of various photo contents in the photoset

| Photo theme | Ornamental garden/ flowerbeds | Seating areas with social aspect | Vegetable garden | Single benches | Single trees | Playgrounds | Coniferous trees and shrubs | Group trees | Water | Open lawn w/out trees in the background | Seasonal colors |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Number of photos | 14 | 12 | 11 | 11 | 10 | 9 | 8 | 6 | 4 | 4 | 4* |

* Four additional scenes, included in other categories, also had seasonal colors.

To facilitate conducting the study in public settings, the photos were arranged on an easily movable board (18" x 13") in ten columns. In order to ensure equal representation of themes in each column, the photos were first grouped based on the dominant visual features (presented in Table2-1) and then the photos of each group were randomly assigned to the ten columns to avoid bias across columns. The columns thus consisted of nine or ten equivalent mix of photo contents including trees, shrubs, flowers, seats, pathways, gardens, playing facilities, gazeboes, and water features (see Figure2-1). The photos were arranged identically for all participants. The photo set was used as a means to help participants express what they would like to do in what kind of space, thus revealing their preferences and perceptions.



Fig.2-1 Photos depicting landscape elements and scenes

### 2-2-2. Participants

The study was conducted at a busy coffee shop in a neighborhood (Logan Square, Chicago, IL) that was part of a larger four-neighborhood study about nearby nature and mental wellbeing. This indoor setting, equipped with tables and chairs and located at the core of a well-known

community area, gave us the opportunity to contact with people from diverse backgrounds who visited the café for different purposes including working individually, business group meetings, meeting friends, and just ordering and carrying out food. Initial observations showed that the number and diversity of people in the café was higher in the afternoons and evenings as compared to mornings. Individuals sitting either alone or in small groups of two or three were randomly approached between mid-June and early August 2012, in the afternoons and evenings, and asked if they are willing to participate in a brief interview about people's preferences for nearby green spaces. Of the 63 approached, 55 individuals agreed to participate. However, two were eliminated because of incomplete answers. The final sample includes 29 males and 24 females and their ages range between 18 and 57. As Table 2-2 shows, more than 80 percent of the participants are between 18 and 35 years old. About 80 percent of participants resided in the Logan Square community area and most of the others resided in nearby neighborhoods such as Humboldt Park and Avondale. The vast majority (79.3%) of the participants are employed, while 13.2% are students, and 7.5% are in between jobs or unemployed. Of those who are employed about 14 percent hold an art-related job such as graphic design, interior design or set design and about the same percentage work at restaurants, coffee shops or bakeries. Roughly 9.5 percent are employed as teachers or coaches, 9.5 percent are web developers, and another 9.5 percent are in retail sales. Other jobs included social work, programming, radio producing, real state, financial engineering, audio engineering, nursing, and consulting. Although the sample is appropriate from a number of perspectives, given the age range and data collection site it cannot be assumed to be representative of the general population of Chicago residents or those living within the study area.

Table 2-2 Sample characteristics (%)

| Gender | | Age | | | Work status | | |
|---|---|---|---|---|---|---|---|
| Male | Female | 18-24 | 25-35 | 36-57 | Employed | Between jobs/unemployed | Student |
| 54.7 | 45.3 | 41.5 | 43.4 | 15.1 | 79.3 | 7.5 | 13.2 |

### 2-2-3. Procedure

To assess preferences based on the photographs, participants were asked to pick two photos from each of the ten columns to represent:

*"your preferred elements and scenes to have in your neighborhood green space."*

Repeating the scene selection process for each of the columns gave participants the opportunity to pick what they preferred from a wide range of choices. In order to gain insight into how they perceive the selected scenes, the participants were then asked to group the photographs they selected "*in terms of whatever they consider meaningful categories*" and to identify their groups in a few words. The participants were able to remove their preferred photos from the photoset and physically group them. The two individuals who grouped all their scenes into a single grouping were excluded from further analyses, leaving a total of 53 participants. In one instance, the participant mentioned that she was not good at grouping and she liked all of them, while the other one remarked, "*They are all good and romantic to look at or good to be there*." Each interview took around 12 to 15 minutes, and no stipend was offered to the participants.

This approach may seem similar to the F-sort technique that has been extensively used to measure cognitive structure in educational studies (Kearney & Kaplan, 1997), as the participants define their categories without direction from the researcher. Unlike the F-sort technique, however, the procedure used here permitted participants to choose their preferred items before sorting them. In this respect, the proposed method is similar to Conceptual Content Cognitive Map (3CM), in which the participants are first asked to pick the concepts that are important to them regarding a specific topic, and then group them (Kearney & Kaplan, 1997). However, since 3CM does not address preferences the task posed for the participants in this study is totally different. The participant-generated grouping of preferred scenes used here does not appear to have been used previously in landscape preference studies. It tells us how they perceive the environments presented in the scenes and what their concerns and expectations are with respect to their nearby nature.

### 2-3. Results and Data Analysis

A data-driven approach was applied for analyses in this study based on descriptive statistics and frequency measures. Content analysis was used to evaluate the frequency and significance of

words and phrases in the body of raw data in order to identify keywords and repeated ideas. In addition to word counts, content analysis allowed us to identify attributes of keywords and other semantic elements, such as synonyms and related words and phrases.

### 2-3-1.  Most favored scenes

Of the 93 scenes 20 were selected by more than one-third of the participants, and five of these were selected by more than 50 percent of the participants (See Figure2-2). The top 20 photos include between one and three scenes from each of the ten columns, reflecting the relatively even distribution of photo contents in the photoset. The dominant content, reflected by seven of the top twenty photos is trees, including a corridor of trees, single or grouped large trees, and massive forest-like trees. Five of the most favored photos are distinct because of their ephemeral quality as conveyed by vegetables, flowers or seasonal color of trees (Photos ranked 4, 5, 7, 10, and 17). The four photos among the top 20 that show vegetable gardens include both regular and relatively manicured planting styles. Four photos represent seating areas, three of which encourage socializing (e.g., picnic benches), and one is a single wooden bench in the shade of a tree (Photos ranked 1, 11, 16, and 20). The photos ranked 6 and 8 depict water features (small ponds), and two other photos represent flowerbeds with either naturalistic or manicured planting styles. Other than the seating areas, none of the top 20 scenes include built structures although these were included in each column of the photo array.
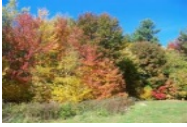
Fig.2-2 Top twenty photos picked by the participants

## 2-3-2. Scene groupings and categorization

The content of the selected scenes suggests what participants would prefer in their neighborhoods. However, a desire to have a particular environment may not be the primary reason a scene was chosen. While participants were not asked to explain their selection, their grouping of the preferred scenes and the words they subsequently supplied about those groupings indicated some salient themes. As Table 3 shows, the vast majority of participants (83%) arranged their scenes in three to five groups, meaning that on average each participant provides four different descriptions of their preferred scenes. Each person had 20 photos to group, and a total number of 218 groups were provided by the participants. Owing to the small sample size, differences in gender and ethnicity were not included in the analysis.

Table 2-3 Number of photo groups provided by participants

| Number of groups provided by the participants | 2 | 3 | 4 | 5 | 6 | 7 | Total | 218 |
|---|---|---|---|---|---|---|---|---|
| Number of participants | 4 | 13 | 15 | 16 | 4 | 1 | | 53 |

The names participants provided for their groups often went beyond a simple label to reflect a rationale. Participants identified many common themes although the scenes included in a given theme varied by participant. To better understand the nature of the 218 photo groups and interpret participants' perceptions of what they prefer to have in their neighborhood, content analysis and dimension reduction were performed to categorize the groups primarily based on the group names provided by the participants (See Figure 2-3). The procedure began by sorting the words/phrases provided by participants into topically-related categories, then assigning each category a name based on the most encompassing theme (Tables 2-4 and 2-5). To test the reliability of this categorization, the process was reviewed by three people who were unassociated with the project but practiced in content analysis. There was inter-coder consensus and one recommendation that the Rest and Restoration categories be merged. At this point, the categories were divided into two major domains, attributes and affordances, according to the conceptual meaning of the themes. In this study the word 'grouping' refers to the participants' taxonomy, while the word 'categorization' indicates the researcher's taxonomy. In a few instances more than one photo group provided by a participant was included in the same category. For example, the groups '*Shaded resting areas*' and '*Peaceful spaces*' described by a particular participant both accrued to the "*Rest/Restoration*" category. Six of the 218 photo groups were excluded from further analysis because the descriptions (e.g., '*miscellaneous*', '*like my hometown*', or '*don't know what to call it*') lacked specificity.

The process generated 15 categories, which can be divided into two major domains. One is largely place-based, focusing on the physical attributes of the space, while the other is affordance-based, relating more closely to what one might do in the space, that is, the potential use of the setting. Figure 2-3 depicts the process of dimension reduction applied during the content analysis. It should also be noted that the category titles are drawn from the participants' frequently used words, some examples of which are shown in tables 2-4 and 2-5.

23
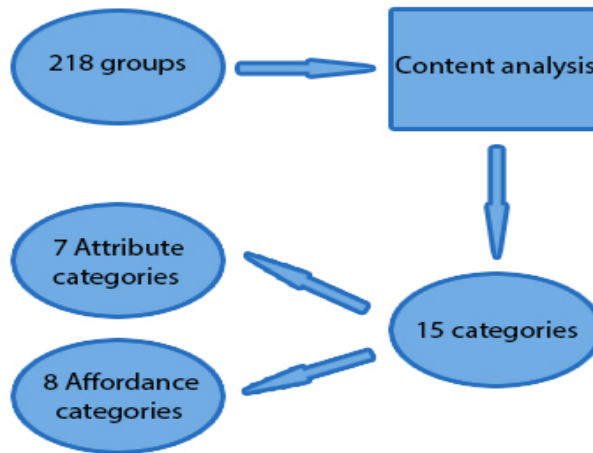
Fig.2-3 The process of content analysis and categorization of photo groups

*Attribute categories*

Many of the groupings focus on particular attributes of the scene or place. These are presented in Table 2-4 along with the number of participants' groups included in each category. The most commonly identified attribute categories were "*Man-made/Manicured*" spaces (16 photo groups), "*Natural*" and "*Open space/Park-like*" spaces (15 photo groups each) and *trees* (13 photo groups).

Table 2-4 Categorization of attribute groups

| Categories in ATTRIBUTE domain | Number of groups | Examples of group descriptions provided by the participants |
|---|---|---|
| *Man-made/ Manicured* | 16 | "designed", "well-kept green space", "structured and manicured", "wild and also manicured", "maintained areas", "park plantings", "small and manageable", "organized", "more landscaped and man-made", "boxy and structured flower gardens", "landscaped areas with built environment" |
| *Open space/ Park-like* | 15 | "big park", "wide open space", "landscaped with individual trees", " trees in open space", "open green space", "open space with few trees" |
| *Natural* | 15 | "just nature", "overrunning nature", "trees and natural growth that feels like wilderness", "nature-like trees and flowers", "natural scenes", "wild", "with rural feel", "planned but very organic" |
| *Trees* | 13 | "trees," "individual trees," "forest like", "woods" |
| *Plants other than trees* | 8 | "flowers," "bushes," "shrubs," "plants" |
| *Water* | 8 | "water", "more personal interest and source of life", "ponds" |
| *Other Place-based groups* | 6 | "private property", "public property", "yards", "Suburban areas, someone's residence", "neighborhood space", "more individual space" |
| Total | 81 | |

24

As shown in the table, the highest number of groups (16) falls under the "*Man-made/Manicured*" category. Across these 16 groupings, each of the scenes in Figure 2-4 was included by at least 5 participants.



Fig.2-4 Scenes included in "man-made/manicured" category by five or more participants

While the attribute categories are clearly distinct, they often share underlying commonalities, and specific photos can fall into more than one attribute category based on the participants' groupings (See Figure 2-5). For illustration consider the "*Water*" category. Although both scene 6 and 8 in Figure 2-2 include water, only scene 6 was interpreted as 'water' by eight participants and accordingly placed in the "*Water*" category, while scene 8 was included in the "*Natural*" category by seven participants.
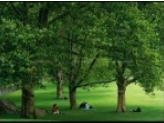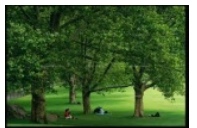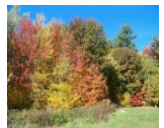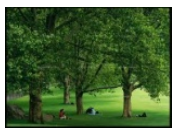
| Natural | | | | | |
|---|---|---|---|---|---|
| (8) | (7) | (7) | (5) | (5) | - |
| **Open space/Park-like** | | | | | |
| (9) | (8) | (6) | (5) | (5) | (5) |
| **Trees** | | | | | |
| (8) | (7) | (7) | (6) | (5) | - |

Fig.2-5 Scenes included in most frequently picked categories by five or more participants

*Affordance categories*

While the attributes of the scenes played an important role in participants' scene groupings, more often it was the potential use of the setting that was the dominant characteristic of the

group. In other words, participants' naming of their groups attended to affordance more often than to attribute (131 versus 81 photo groups). Table 2-5 includes the categories of these affordance-based photo groups. As their personal themes suggest, participants considered a wide range of ways the pictured spaces might be used. Among these categories, "*Gardens/Community gardens*" (36 photo groups) was by far the most frequent, while four other repeatedly seen affordance-based categories were roughly equivalent in frequency: "*Social activities*", "*Seating areas*" (19 photo groups each), "*Beautifying*" (17 photo groups) and "*Rest/Restoration*" (16 photo groups).

Table 2-5 Categorization of affordance groups

| Categories in AFFORDANCE domain | Number of groups | Examples of group names |
|---|---|---|
| *Garden/ Community garden* | 36 | "garden", "active human involvement", "productive value and working together", "food related", "gardening and community work", "sustainable resources and gardening", "vegetable garden", "flower garden", "community-based, conserving the environment", "community gardens", "vegetables", "planting", "home gardens", "outdoor spaced created for food" |
| *Social Activities* | 19 | "gathering", "entertaining or socializing value", "community oriented", "private but communal", "get together area", "gathering places with children", "community activities", "community spaces to hangout", "places to sit with people", "picnic areas", "good for community building", "nice public gathering spaces" |
| *Seating* | 19 | "sitting areas and shade", "basic sitting which could go anywhere", "conveniences for sit down and rest with nature component", "architectural", "benches", "public/outdoor seating", "more developed spaces with benches" "structures", "developments for staying away" |
| *Beautifying* | 17 | "beauty", "aesthetic value", "green and good to look at", "interesting", "random beauty spots", "accents and man-made materials to make a park pretty", "open view to the end which is nice", "water as a specific natural beauty", "natural beauty", "bright, colorful and messy in a nice way", "nice little pond", "beautifying", "scenery", "unique, pleasing, and taken care of", "aesthetically pleasing", "pleasurable scenery" |
| *Rest/Restoration* | 16 | "relaxation value", "sanctuary", "resting", "a serene place to read a book", "feel safe and secured by being in touch with nature", "isolating places to be alone", "large green space with opportunities of shade and sitting by them", "necessary for recreation and relaxing" |
| *Active Recreation* | 11 | "playing", "exercise value", "athletic and play", "fun, playing and workout", "outdoor kids' stuff", "convenience for people with children", "recreational space for children", "playgrounds", "kids' play" |
| *Walking/Running* | 8 | "passive space with paths to enjoy the space", "sufficient green space to walk around with paths to enjoy", "road to walk", "integrated pathways and greenery", "places to take a walk or run", "good to walk along the streets" |
| *Other activity-based groups* | 5 | "functional", "trees that act a boundaries", "walking and seating areas", "shaded resting areas", "have man-made things to be used" |
| Total | 131 | |

As with the attribute categories, particular scenes were included in different affordance categories. For instance, the most favored photo (rank 1 in Figure 2-2) was incorporated under six affordance categories, the most frequently selected of which are "*Seating", "Social activities", "Garden/Community garden"*, and "*Rest/Restoration"*. However, one category – *Garden/Community garden*—had very little overlap and was the dominant affordance category. Figure 2-6 includes six scenes that were placed in the "*Garden*" category by two-thirds or more of the participants who selected them. In their description of this category, participants commented on aspects such as productive and food-related value, sustainability and conserving the environment, and community-based activities. These descriptors indicate not only the participants' preferences for having spaces such as community gardens in their neighborhoods, but also the potential of these spaces (their affordances) to facilitate desirable activities.
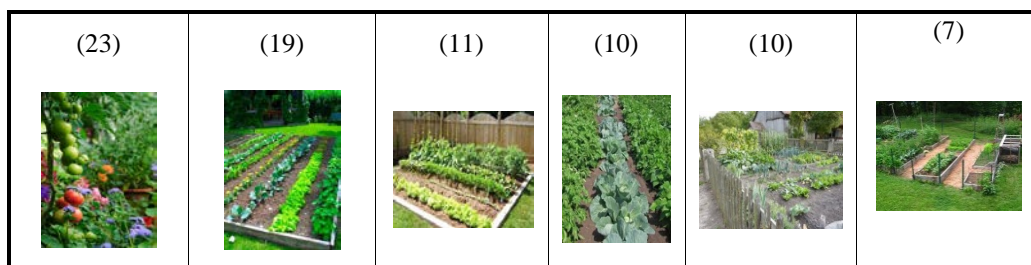


Fig.2-6 Scenes consistently included in "Garden/Community garden" category; the number of participants shown in parentheses

The "*Social activities*" and "*Seating*" categories under affordances show both distinctiveness and overlap. Figure 2-7 includes examples of this continuum, with the first scene (selected by 43% of the sample) included under "*Seating*" by 11 participants and only once under "*Social*" category. The next two scenes in Figure 2-7 were considered equivalent in terms of categorization as "*Social*" and "*Seating*", and the final two scenes are instances where the social aspect outweighs the seating. Likewise, the seating scenes in Figure 2-7 show a continuum in the number of people that might be accommodated from few to many.

| | | | | |
|---|---|---|---|---|
| (11-1) | (10-8) | (6-6) | (3-7) | (3-8) |

Fig.2-7 Examples of seating and social affordances; given parenthetically: the number of participants identifying scene affordance for Seating and Social Activities, respectively

While the single seat (first scene in Figure 2-7) was one of the most frequently selected photos, many others that included a single bench were rarely selected. As shown in Figure 2-8, these include neatly polished single benches that are made of metal or a combination of wood and metal or concrete, surrounded by little greenery. In fact the last scene in Figure 2-8 was not selected by any of the participants.



Fig.2-8 The least favorite seating areas

Figure 2-9 shows the scenes and their perceived features most often included in the "*Beautifying*" category. These scenes vary considerably in terms of both content and style, including water feature, flowerbed, tree corridor, vegetable garden and lawn.

Looking at all categories the water feature has been assigned to, indicates that water is mainly favored for its aesthetic value. The manicured planting style of three of these scenes indicates that regular and symmetrical forms and spaces are more likely to be considered as beautiful scenes. The corridor of large shade trees, by contrast, is likely categorized as aesthetic because of the sense of enclosure with open view to the end as described by the participants.

Fig.2-9 Scenes included in the "beautifying" category by five or more participants

The preferred scenes most frequently included in the "*Rest/Restoration*" category contained shade trees as the dominant feature; these were also frequently categorized in terms of attributes such as "*Trees*" and "*Park-like*". The three scenes ranked 1, 2 and 19 in Figure 2-2 were included in this affordance category by five or more participants. In describing the groups, participants used phrases such as '*shaded space', 'a serene place to read a book*' and a place with '*relaxation value*' (for the first-ranked photo), '*larger trees with opportunities of shade and sitting by them*,' and '*very open space-based necessary for relaxing*' (for the second-ranked scene) and '*recreation and relaxing*', '*shaded resting area*,' and '*a place to be alone*'(for the ranked 19 in Figure 2-2).

## 2-3-3.  Least favorite scenes

The least favored scenes, just as with the most preferred, show variability with respect to content. Scenes selected by fewer than 5 (10%) of the participants (Figure 2-10) include seats, trees, shrubs, flower beds, playgrounds and shelters.
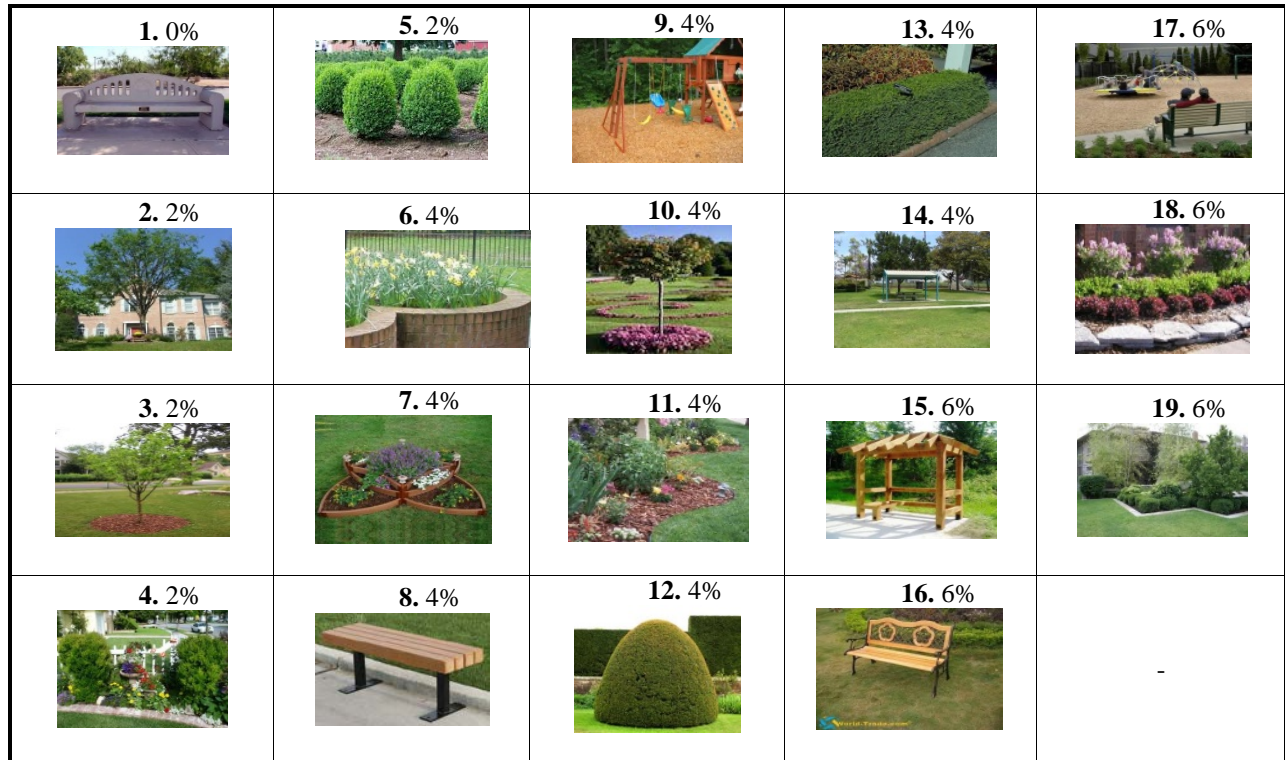


Fig.2-10 Least frequently selected scenes

The less frequently selected tree scenes in Figure 2-10 are either small, non-shade trees, or those planted in massive, irregular or non-functional ways (2, 3, 10, and 19). The less favored flowerbeds include solid planters that are more visible than the flowers they contain (6 and 7). Also noteworthy is that the distinguishing characteristic is not whether the design is linear or meandering. However, symmetrical plantings seem to be less preferred for flowerbeds. In addition to the planters, nine photos among the least favored scenes have some kind of structures in the content such as building in the background, benches and playing facilities (2, 4, 8, 9, 14, 15, 16, 17 and 19 in Figure 2-10).

## 2-4. Discussion

The data analysis has led us to some interesting findings that are worth discussing, because they highlight the significance of considering preferred attributes and affordances in the planning and design process. This section focuses on the interrelations between attributes and affordances, interrelations among attributes, key affordances, and preferred small spaces and elaborates on how the findings connect to the current literature.

### 2-4-1. Attribute-Affordance interrelations

The most preferred scenes are favored for a wide variety of reasons according to the respondents' groupings, cutting across many traditional categories describing the outdoor environment. Analysis of participants' groupings of these preferred scenes provides insights into their perceptions of open spaces. These perceptions, in turn, reveal the diverse perceived benefits of the nearby setting. As Clark and Uzzell (2006) have concluded, affordances are defined in relation to both the attributes of the environment, the attributes of the individual such as needs and intentions, as well as the characteristics of the individual. Since needs and intentions are not static, perceptions of environmental attributes and affordances are likely to vary as circumstances change. For example, the study participants who picked playgrounds among their preferred affordances had children. If the study were conducted among a wider age spectrum with more detailed demographic information, it likely would reflect some different patterns.

Categorization of the participants' groupings based on affordances accounted for 68 percent of the total number of groups, suggesting that what the participants can do in outdoor settings is more important to them than the attributes and elements. While this is basically in accordance with the *affordance theory* proposed by Gibson (1979), it does not accurately reflect the strong interplay between these two characterizations.

The frequent overlaps of attributes and affordances for many preferred scenes reflect the significant role played by both the function and features of the environment. Figure 2-11 includes example of scenes that were included in groupings under both attribute and affordance themes at least ten times. This example demonstrates how the differences in the individuals' concerns and needs influence their perceptions of the physical attributes and affordances of the environment. This is consistent with previous research findings (Chiesura, 2004; Jim & Shan,

2013; Matsuoka & Kaplan, 2008) showing that people of various ages and socio-economic status perceive and use natural urban landscapes in very different ways. Furthermore, it reinforces the significance of content in preferences (Kaplan & Kaplan, 1982) and the notion that the affordances are dependent on the attributes and their organization. This is in line with current literature considering the physical aspects of the environment as "building blocks" of the environmental affordances (Clark & Uzzell, 2006). The strong interrelations between perceived attributes and affordances of preferred settings found in this study provide insights into design characteristics of the preferred outdoor spaces that can be considered by urban planners and designers. By investigating and considering people's perception of attributes and affordances of favored spaces and the interrelations between them, designers would be better able to provide spaces that are attuned to the users' concerns and needs in outdoor spaces.
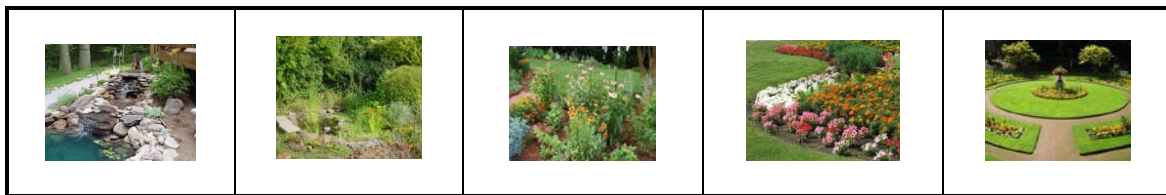


Fig.2-11 The scenes that go under both affordance and attribute domains ten times or more

### 2-4-2. Interrelations among attributes

Examination of the attributes provides insight regarding preferences and perceptions of outdoor settings as either natural or man-made. Despite the general presumption of a preference for natural spaces over the man-made ones (Bratman, Hamilton, & Daily, 2012; Hartig & Staats, 2006; Hartig et al., 2011), participants' categorization of their favored scenes included both natural and man-made spaces, clearly indicating that these are not a determinant of preference. As can be seen in Figure 2-12, spaces categorized as "*Natural but Not Man-made*" mostly include single trees with special seasonal color in wide open spaces. On the other hand, the scenes that fall in the "*Man-made but Not Natural*" category generally include garden spaces with geometric forms and regular straight rows of planting, in addition to green spaces with seating structures. The last row in Figure 2-12 shows scenes that were categorized as both "*Natural and Man-made*" by the participants who picked them as preferred scenes; these include

small ponds, flowerbeds with organic planting style and meandering forms, garden spaces with plants among the pavers, and the tree corridor. Particularly noteworthy is that all but one (the fourth scene) of the seven scenes that were included under both "*Natural*" and "*Man-made*" categories, are among the top 20 photos depicted in Figure 2-2. In other words, most favored landscape scenes are not necessarily considered as natural scenes; they may be considered as either natural or man-made by different groups of people and still be favored by both groups. These results suggest that the participants mostly would like to have relatively small open spaces surrounded by green, with a mix of natural and man-made elements.
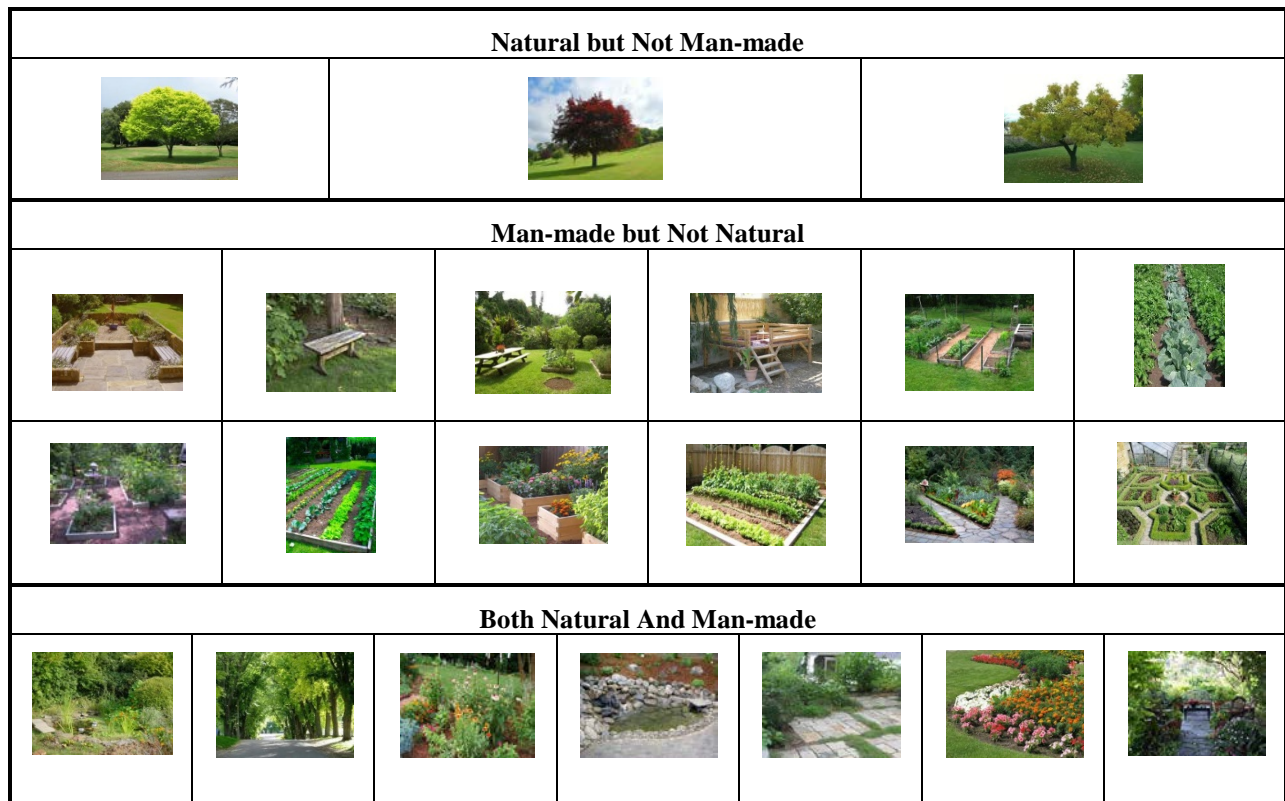


Fig.2-12 Scenes depicting distinctions and overlaps across Natural and Man-made categories

The interrelation among attributes shown by the strong overlap among the "*natural*", "*trees*" and "*open space/park-like*" categories presented in Figure 2-5, is important to consider in people-oriented planning and design decisions. The results suggest that participants not only care about trees, they also perceive them as the key elements in shaping either natural or park-like

spaces, which they prefer to have in their neighborhood. The trees in these overlapping categories display a wide range of arrangements from single and small group of shade trees to a corridor of trees, and also densely planted trees. The preferences for these scenes indicate participants' sensitivity to the arrangement of trees and the spatial characters for urban spaces that they define. This is consistent with previous research findings suggesting no significant overall effect of tree arrangement on preference (Kuo, Bacaicoa, & Sullivan, 1998). However, there are some exceptions in the literature (e.g., studies mentioned in Kaplan and Kaplan' (1989) that show preference for more formal, structured geometries for tree arrangements in certain urban settings such as public housing areas).

### 2-4-3. Key affordances

#### *Garden/Community Garden*

Gardens and community gardens are noteworthy as specific types of landscapes fitting into the network of urban open spaces because of their potential for significant effects at both individual and social levels on issues such as neighborhood attachment (Comstock et al., 2010), perception of safety (Ober Allen et al., 2008), restorativeness (Hale et al., 2011), and neighborhood satisfaction (Alaimo et al., 2010; Clayton, 2007). This category has the largest number of groups and the least amount of overlap with other categories. Most of the scenes placed in this category depict vegetable gardens designed in regular and manicured planting styles with narrow paths among the plants. The preferred ornamental gardens, however, have either naturalistic or regular planting styles but with less symmetrical forms. Meandering plantings with either flowers or small shrubs are specifically preferred.

Regular planting style of vegetable gardens shows that the preferred garden spaces seem neat and being cared for. As Nassauer (2011) has pointed out, care is a deep, widespread western cultural norm usually provoking a quick aesthetic response and such spaces in a neighborhood may also convey the desirability of the residents as responsible neighbors. Further, care invites human involvement in changing and maintaining nearby landscapes, which is perceived to be beneficial for all in the neighborhood (Gobster et al., 2007). Such landscapes also evoke the perception of "continuous human presence" (Gobster et al., 2007, p. 967), which provides informal social control, and perhaps can be considered an indicator of safety, especially in urban

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residential areas. This is consistent with previous research findings suggesting that community gardens can decrease fear of crime (Ober Allen et al., 2008).

The descriptions of the "*Garden/Community garden*" category provided by the participants go beyond visual attractions, and mainly focus on meaningful community-based activities. Preference for community work and conserving the environment were highlighted in the participants' descriptions, revealing that the environmental affordances need to be addressed by planners, who are involved in improvement and redevelopment projects. In this regard, according to Kaplan and Kaplan (2005, p. 289), community gardens are special activity-based nature spaces in their "daily promise of growth and change" that call for "action, responsibility and nurturing". Such spaces thus can be considered as significant examples of opportunities for meaningful action. This seems to be one of the most important reasons for the participants' high preference for community garden spaces according to their descriptions. The results are also in line with the findings of many other studies on the significance of community gardens (e.g., Clayton, 2007; Kaplan & Kaplan, 2005; Milburn & Vail, 2010), suggesting that participants prefer to have some small public spaces near their residence that offer opportunities to either involve directly with nature or at least to visit and observe what is growing.

### *Seating areas*

"*Seating areas*" are also an affordance category frequently included in the participants' groupings. Most of the selected seating areas promoted socializing as opposed to isolated opportunities for sitting. This is in accordance with Clark and Uzzell's (2006) idea that individuals perceive the social and physical aspects of the environment holistically, rather than separately. The preferred seating areas mainly include relatively small spaces with rounded arrangements of benches, picnic benches, and gazebos surrounded by green that encourage small gatherings. This supports the current literature on the significance of design and arrangements of seating elements in public spaces (Campbell & Campbell, 1988; Gehl, 1987; Huang, 2006; Nordh & Østby, 2013; Zhang, 2009). Gehl (1987) pointed out that among public space attributes, seating structure is the most important in fostering social function. The results of this study support the necessity of community design to improve social interaction and provide a variety of ways of meeting this need, including proximity of benches in concave forms (e.g., Huang, 2006), picnic benches that evoke facial contact, and gazebos.

*Beautifying*

The "*Beautifying*" category includes 17 photo groups representing a wide range of contents. However, the common characteristic of the scenes most frequently assigned to this category (Figure 2-9) is the presence of well-defined edges separating different materials, which create clear boundaries and make the scenes easier to read. This also gives the appearance of a space being neat and well-maintained. Of all the affordance categories this one is least clear-cut in terms of the notion of what one can do in the setting. Yet as Grahn and Stigsdotter (2010) pointed out, pleasure and beauty entail judgments of how a place can fit with one's needs. Aesthetic places suggest that one will be able to function well in the setting (Kaplan & Kaplan, 1989). Thus, it is plausible to find beautifying among the most preferred environmental affordances.

## 2-4-4. Small spaces and safety concerns

Considering all the preferred landscape scenes under the affordances and attributes categories brings an interesting point into focus. Although the participants are residents of a fairly urban neighborhood in Chicago where public safety may be an important concern in their minds, it is striking that they preferred the landscape scenes that represent relatively small enclosed spaces surrounded by rather dense vegetation. Usually in such dense urban neighborhoods the guidelines used by programs such as the Crime Prevention Through Environmental Design (CPTED) are applied (Geason & Wilson, 2013) as a reason for removing shrubs or other space-defining vegetation to provide open sight-lines and high visibility in public spaces.

Although many studies have proposed the opposite conclusions, and rejected the vegetation removal for crime prevention (Kaplan & Talbot, 1988; Kuo et al., 1998; Kuo & Sullivan, 2001), many studies have suggested maximizing visibility and openness in order to increase the sense of safety in moderately dense urban areas. A study in Detroit, for example, has shown less preference for outdoor urban settings with dense vegetation, while high density of widely spaced trees, which do not block views, has been favored (Kaplan & Talbot, 1988). Another noteworthy example is a study conducted in Chicago (Kuo et al., 1998), suggesting that within the urban residential context the shorter the view distance, the less safe the participants feel. Again, this study demonstrates high preference for the maximum density of trees with maximum of view

distance. Kuo et al. (1998) have focused on trees in this study without addressing preferences for shrub plantings; however, according to the above mentioned findings, densely planted shrubs which can build visual barriers and shorten the view distance may not be preferred. Despite the research findings that support maximizing view distance to reduce safety concerns, an overall look at the preferred landscape scenes in the present study demonstrates contradictory results. Evidently, many participants seek relatively small spaces that provide some sense of enclosure and privacy surrounded by moderately dense vegetation within public spaces in residential neighborhoods.

## 2-5.  Implications and conclusions

The role of affordances in preference judgments has been largely neglected in most preference studies. This study applies Gibson's Affordances Theory in a novel way to investigate perceived attributes and affordances and their interrelations as a tool to explore preferences for the physical aspects of urban nature spaces and planning and design considerations. By asking participants to select photos from a large number of urban nature settings and group their preferred scenes in terms of what is meaningful to them, this study has provided insights into interconnections between environmental affordances and attributes that address people's concerns and expectations. Although further investigations using greater demographic diversity, different study contexts, and larger sample size are needed, the results of this study have key implications for both design and research methods.

### 2-5-1.  Design implications

The findings highlight residents' sensitivity to qualities that can improve the beauty and functionality of outdoor spaces, particularly with respect to the significance of small green spaces that facilitate meaningful activities such as socializing and gardening. The complex interplay within and among the affordance and attribute categories suggests that residents appreciate nearby nature settings for a variety of reasons. Taking these affordance-attribute interrelations into account, as well as the most and least favored affordances and attributes, lead us to a set of simple, yet far-reaching recommendations to help urban planners and designers create more livable spaces through meeting the residents' concerns and needs in dense urban areas (See Table 2-6). Pragmatic planning and design implications extracted from the content

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analysis can be considered as a step towards an evidence-based design approach, linking research findings with planning and design solutions (Brown and Corry, 2011).

As shown in Table 2-6, the content analysis offers consistent evidence that participants particularly appreciate small green spaces that provide opportunities for socializing and for growing vegetables and ornamental plants. It is important to note that vegetable gardens are generally planted and maintained by community members. Therefore, the significant role of community members and their views in creating such spaces should be acknowledged. As this example illustrates, for successful planning and design of such small green spaces, design decisions need to incorporate the views of residents in the community. Even outdoor spaces considered to be aesthetically and ecologically well-designed by professionals, must also meet users' needs and preferences and become part of their lives. The practical approach presented here for examining user preference provides a new way for the post-occupancy evaluation of design success. It expands on available methods by examining the nature of preference in terms of the design's physical attributes and capacity for a desired use. It should also be acknowledged that the design recommendations presented here are specific to place. The approach for making recommendations, however, can be applied in any context. The expectation is that physical and cultural context will generate different place-specific design solutions.

Table 2-6 Design implications based on the results of content analysis of participant-generated photo groups

| Affordance-based most favored spaces | Design attributes/ elements | Design recommendations based on people's preferences |
|---|---|---|
| *Small garden spaces* | *Garden types* | - Both vegetable and ornamental garden spaces are preferred.<br>- From the environmental affordance point of view, it would be more effective to have vegetable gardens integrated with small ornamental garden plots to meet a wider range of preferences. |
| | *Planting style* | - Vegetable garden plots are preferred to be planted in regular manicured rows, which strengthen both functionality and the perception of well-maintained communal spaces.<br>- Ornamental garden spaces are preferred to be planted either naturalistic or manicured (but not symmetrical); specifically, meandering plantings are well-preferred.<br>- It is recommended to align the styles of regularity and manicured; create aesthetic interest and visual flow through a vegetable garden by planting ornamental plants around the borders of regular vegetable plots or inserting them into the regular rows in ways that increase fascination to the garden throughout both the growing season and in winter. |
| | *View/ Observation* | - It is preferred to be able to observe garden spaces nearby<br>- If the garden spaces are fenced, it is most preferred that the fences do not block the view from outside.<br>- It is recommended to provide some small sitting areas in community gardens for those who prefer to just enjoy observing the communal spaces without being directly involved with gardening. |
| *Small gathering areas* | *Plants* | - Single shade trees or small groups of large trees are preferred if they offer the opportunity for resting near or under their canopy; either a bench next to them or their placement in the lawn can provide a place to rest in the shade.<br>- Trees and shrubs with natural forms and seasonal color are most favored.<br>- Trimmed shrubs and small and non-shade trees with regular forms are less preferred.<br>- Small coniferous shrubs are appreciated if they function as a border or along paths as long as they do not create visual barriers. |
| | *Benches* | - Generally, the seating areas that are surrounded by green, especially trees, are more appreciated than others.<br>- Benches that are designed and arranged to encourage socializing are most preferred.<br>- In terms of material and finished form, wooden and roughly designed benches seem to be preferred over metal and concrete benches with solid forms that are neatly polished and manicured. |
| | *Gazebos* | - As a significant feature of small gathering spaces, gazebos are appreciated.<br>- To be preferred they should be surrounded by green, have a naturalistic design style, be large enough to accommodate sitting and socializing, and be made of wood or nonmetal materials that resemble wood. |

## 2-5-2. Research methods implications

In addition to supporting and expanding upon previous research findings, this study sheds light on an important research perspective –the role of affordances in preferences. Ignoring affordances in drawing conclusions from preference studies may be shortsighted since affordances play an important role in affecting preference. As demonstrated, the approach used in this study offers creative tools for broadening the scope of preference studies by using participant-generated photo grouping, addressing environmental affordances, and drawing on linkages among disciplines.

### *Participant-generated photo grouping*

Preference research has tried to ascertain not only what people do and do not like, but also to understand the perceptual patterns that derive from their experiences associated with preferences. In the rapid and largely unconscious decision makings regarding environmental preferences, there is an assessment of the space and its qualities (Kaplan & Kaplan, 1989). This rapid assessment of the spaces is reflected in the way participants grouped their preferred scenes in this study, suggesting that participant-generated photo grouping offers a useful tool for furthering our understanding of the qualities people would like to have in their neighborhood nature settings. Asking individuals to then talk about their own groupings of preferred scenes provides them an opportunity to express their perception of what is significant to them. At the same time it offers a greater opportunity to planners and designers to make better people-oriented decisions. In addition to being effective in eliciting information, the tools were considered easy and fun to use by the participants. It can also be readily applied in other settings, in which decision-makers are interested in redevelopment or improvement of the outdoor spaces in order to support evidence-based design. Importantly, evidence-based design can emerge when the designers make linkages between design attributes of the preferred scenes and the affordances uncovered through participants' explanations.

### *Application of environmental affordances*

According to the literature, the rapid assessment of the spaces that underlies preference judgments is deeply influenced by the perceived potential for functioning in the setting (e.g., Kaplan, 1987). This work has tried to identify the environmental affordances and attributes that

are the perceptual foundation for preference judgments. The strong agreements among the participants in this study on the preferred scenes and environmental affordances lend confidence in consistency of this process and applicability of the approach.

This study also offers a practical approach to meaningful participation in the decision-making process for residents' nearby nature spaces, and suggests some ways to translate the findings into planning and design recommendations that can be implemented. Few if any previous studies have applied the environmental affordance approach to link function and preference in adult populations. Nor has prior research linked affordances and the design process. This work thus offers several contributions to our understanding of environmental affordances with the potential to lead to better design solutions for outdoor spaces in residential neighborhoods.

### *Linkages of disciplines*

Borrowing some principles from cognitive psychology techniques such as F-sort and 3CM (Kearney & Kaplan, 1997), our new practical approach to examine preferences contributes innovative and useful information to the context of landscape preference studies. The present study demonstrates an interdisciplinary perspective by looking at the concepts and techniques in environmental psychology through the lens of landscape architecture. It offers a practical way to link research findings in environmental psychology with design and planning goals. Environmental psychology helps us develop a people-oriented design process through learning about people's environmental perceptions, needs and preferences and taking them into account at the time of decision-making for public nature settings. Using this type of people-oriented design process, landscape architects and urban planners can be responsive to what users need and appreciate in residential areas, and thereby encourage the residents to use urban nature settings and be exposed to nature more frequently. This is in line with the ultimate goal of creating effective restorative environments in urban settings to improve people's wellbeing.

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# CHAPTER III
# Neighborhood satisfaction and use patterns: Effects of proximity, landscape structure and barriers to use

*Abstract*

Research in environmental psychology and public health has yielded valuable findings demonstrating that urban nature settings promote mental wellbeing and life satisfaction. However, the mere presence of nature seems to be insufficient. Even if green spaces are in close proximity to residents' home, they may not have the expected impact on life satisfaction and wellbeing if residents do not perceive the spaces as accessible, fail to use them, or have low satisfaction with their neighborhood. It is thus worthwhile to investigate the relationships among perception of neighborhood green structure and its proximity, use of neighborhood outdoor spaces and neighborhood satisfaction.

This study was conducted in a residential area in Chicago covering portions of four community areas. A random sample of 434 residents participated in a survey, in which they were asked questions based on a five-point rating scale about perceived proximity, amount and quality of nearby green spaces, general neighborhood satisfaction, frequency of use of outdoor spaces, the type of activities done in such spaces and barriers to use of neighborhood outdoor spaces. The results of multiple regression modeling demonstrate that satisfaction with quality of public spaces, amount of affordances provided by them, and neighborhood comfort are strongly influenced by the physical structure and content of the environment. More specifically, perceived landscape structure and walking distance proximity to green and social spaces are very strong predictors of satisfaction with the quality of public spaces and frequency of use of green and social spaces.

Understanding residents' perception of the physical attributes of the environment through evidence-based approach can significantly contribute to experts' more effective decisions, leading ultimately to fewer gaps between what people need and what is offered to them in

outdoor settings. This approach, a step towards translational design of public spaces, is highly significant in landscape architecture and related fields.

## 3-1. Introduction

Neighborhood satisfaction has a significant role in satisfaction with life and wellbeing of residents (Fernandez and Kulik 1981; Kweon et al. 2010; Miller et al. 1980; Vemuri et al. 2011). Research on neighborhood satisfaction has investigated a relatively wide range of contributing factors including socio-demographics (Kweon et al. 2010; Sallis et al. 2009), housing ownership (Rohe, Van Zandt, and McCarthy 2013; Basolo and Strong 2002), and safety (Burby and Rohe 1989; Cook 1988). Particularly pertinent to the current study is research showing that physical attributes of the environment strongly affect the level of satisfaction with the neighborhood (e.g., Hur and Nasar 2014; Hur, Nasar, and Chun 2010; Kaplan 2001; Kweon et al. 2010; Lee et al. 2008; Sirgy and Cornwell 2002). Research has also shown that use of the urban settings that offer an experience of nature promote both neighborhood satisfaction and wellbeing among urban dwellers (Ellis, Lee, and Kweon 2006; Kaplan and Kaplan 1989; Ward Thompson and Aspinall 2011). Further, an analysis of studies done over the past few decades confirms that the physical design of urban landscapes strongly affects the well-being of residents and their behavior in outdoor spaces (Matsuoka and Kaplan 2008). Therefore, a deeper understanding of ways that the physical aspects of the environment affect neighborhood satisfaction can be leveraged by designers and planners to improve people's wellbeing.

Research on the role of physical aspects of the environment with respect to neighborhood satisfaction has varied widely in the choices of physical components under study and how they are measured. A few studies have examined neighborhood satisfaction in relation to some aspects of landscape structure (Lee et al. 2008; Crow, Brown, and De Young 2006), proximity (Kearney 2006), barriers (Hur and Nasar 2014) and use of outdoor spaces (Kearney 2006; Kaplan 2001), and only a few of these (e.g., Kearney 2006) have examined the combined effects of any of these. No studies, however, have investigated the combined effects of these factors on both neighborhood satisfaction and use patterns. The current study addresses both neighborhood satisfaction and neighborhood use patterns, relative to physical attributes of the environment. Three aspects of outdoor spaces which are of great relevance to planning and design are

examined: perceived proximity of nature to people's home, landscape structure, and barriers to neighborhood use (see Figure 3-1).

Insights about the role of landscape structure on neighborhood satisfaction and use patterns can be examined for planning and design implications, and recommendations for urban design that is more favored by users and encourages them to spend more time in outdoors. The research is thus seen as a step towards *translational design of public spaces,* a focus that despite its significance, is not receiving enough empirical attention in todays' landscape architecture and related professions. Since the success of completed projects is seldom evaluated to see if they achieved their stated goals, mistakes are usually repeated in these fields (Brown and Corry 2011). Such perpetuating errors are often particularly costly with respect to the social aspects of design, resulting in the creation of spaces that are underused and not preferred by residents. Understanding residents' perception of the physical attributes of the environment can significantly contribute to experts' more effective decisions, leading ultimately to fewer gaps between what people need and what is offered to them in outdoor settings. The *Translational Design* approach offers pragmatic knowledge through scholarly evidence, upon which planning and design decisions could be based.

The purpose of this study is to examine two main research questions. First we study the interconnections between neighborhood satisfaction and use patterns of nearby outdoor environments. Then we investigate the extent to which perceived proximity of green spaces to people's homes, nearby landscape structure, and barriers to neighborhood use affect both neighborhood satisfaction and use patterns (See Figure 3-1). The broader aim is to discuss the design implications of the findings for landscape architecture and urban planning as an example of the *translational design* approach.
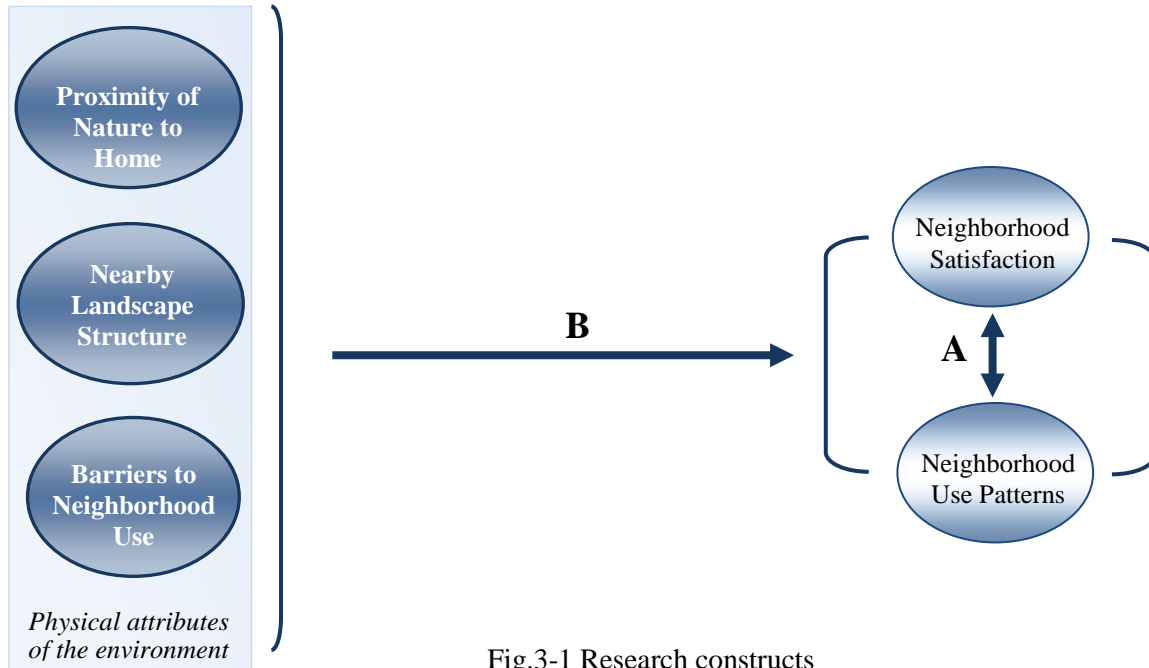
Fig.3-1 Research constructs

### 3-1-1. Neighborhood satisfaction and use patterns

The research literature shows that there is an association between neighborhood satisfaction and the ways people use their outdoor spaces (Kearney 2006; Kaplan 2001). Measures for these factors have been defined in various ways. For example, use pattern has been examined through different measures such as walking in the neighborhood (Ball et al. 2001; Humpel, Marshall, et al. 2004), physical activity (Ward Thompson 2013), park use (Tinsley, Tinsley, and Croskeys 2002), social activity (Hur and Morrow-Jones 2008) and community gardening (Kaplan 2001). Similarly, the focal measure of neighborhood satisfaction has varied across previous studies, including overall satisfaction (Galster and Hesser 1981), neighborhood appearance and attractiveness (Gruber and Shelton 1987; Parkes, Kearns, and Atkinson 2002), and neighborhood safety (Cook 1988; Lovejoy, Handy, and Mokhtarian 2010). Based on the prior work and concerns for translational design, this study examines four components of neighborhood satisfaction encompassing aspects of amount and quality of nearby green space in the neighborhood. The study also investigates characteristics of the physical environment and three types of use of outdoor spaces based on the purpose of walking in the neighborhood.  In related investigations, most research (e.g., Kaplan 2001; Kearney 2006) identifies use of outdoor spaces as the predictor of

satisfaction level, meaning that the more people use their nearby outdoor spaces, the more they are satisfied with their neighborhood. Nonetheless, it is also plausible to expect that the more people are satisfied with their nearby outdoor spaces, the more likely they are to use them. In this study, we investigate the correlations between different dimensions of neighborhood satisfaction and use patterns and recognize that these factors can reinforce each other.

### 3-1-2. Perception of proximity to nature

Research shows that nearby nature has a positive effect on neighborhood satisfaction (Crow, Brown, and De Young 2006; Kaplan 1985; Kaplan and Austin 2004; Sugiyama, Thompson, and Alves 2009; Ward Thompson and Aspinall 2011) and the frequency of use of outdoor spaces (Macintyre, Macdonald, and Ellaway 2008; Shackleton and Blair 2013; Sugiyama, Thompson, and Alves 2009; Ward Thompson and Aspinall 2011; Wright Wendel, Zarger, and Mihelcic 2012). This means that the more the nature elements and green spaces are perceived to be close to the resident's homes, they are more satisfied with their neighborhood and are likely to use outdoor spaces more frequently. Even to have a nature view from the window makes the residents' feelings towards their neighborhood more positive (Kaplan 2001; Kearney 2006). As many preference studies have revealed, people like outdoor settings depending on the extent to which the settings meet their needs (Kaplan and Kaplan 1982). Having nearby nature can be also a potential response to many basic needs (Kaplan, Kaplan, and Ryan 1998) and is thus, associated with neighborhood satisfaction and use. However, further research is needed to understand what kinds of proximity to nature (immediate proximity versus walking distance proximity) more significantly affect different aspects of neighborhood satisfaction and encourage the use of green and social spaces or walking in the neighborhood in general. It is also worth studying how residents' perception of the amount of nearby nature affects different aspects of satisfaction. Further investigation is also needed to understand how proximity to other outdoor facilities such as active recreation areas affects different aspects of neighborhood satisfaction and use pattern as compared to proximity to nature spaces.

This study examines perceived proximity in a variety of ways, including both the immediate proximity of the view from the window and the more proximal distances based on a five-minute walk from home. It also incorporates the kinds of environments that are proximal in terms of green and social spaces as well as nearby active recreation facilities. Each of these proximity measures is

examined in terms of potential influences on the four components of neighborhood satisfaction and three types of use in the neighborhood. Such a more fine-grained examination can provide insights into appropriate planning considerations for new urban developments and redevelopment projects.

### 3-1-3.  Perception of landscape structure

The study by Kweon et al. (2010) showed that physical components of the landscape (such as structures, pavements and trees) in neighborhood outdoor spaces have significant effects on neighborhood satisfaction. Other studies have shown that environmental attributes such as aesthetically pleasant natural features and nearby parks are associated with increased likelihood of walking by residents in the neighborhood (Ball et al. 2001; Humpel, Marshall, et al. 2004; Owen et al. 2004). A review (Humpel, Owen, and Leslie 2002) also found consistent evidence that perceived aesthetic attributes and accessibility of facilities and opportunities are associated with walking for various purposes in neighborhoods. The few studies that have focused on the relationships between landscape structure and neighborhood satisfaction and use patterns have measured landscape structure as a single entity. Lee and colleagues (2008) for example, have investigated objective landscape structure as the predictor of neighborhood satisfaction, showing higher neighborhood satisfaction where tree patches were more connected in the neighborhoods at various scales. Crow and colleagues (2006) have studied people's perception of urban landscape, their satisfaction and use through comparing two suburban communities with contrasting landscape structures.

While offering valuable findings, the current literature lacks in-depth investigation of *perceived* landscape structure in residential neighborhoods in terms of its relationships with satisfaction and use of outdoor spaces. What is meant by perceived landscape structure here is whether people consider their nearby outdoor setting as dominated by small-scale green spaces such as gardens, large-scale park-like settings, green corridors or buildings. People not only consider the individual elements of a setting, but also respond to their arrangement which shapes the structure of the setting and ultimately, affects their judgments about what such arrangement makes possible (Kaplan 1985). In other words, perceived landscape structure affects people's judgments about environmental affordances. The extent to which those judgments are in accordance with people's potential needs and preferences is hypothesized to influence their satisfaction and use of the outdoor settings. It is thus, useful to explore the specific ways people

perceive their nearby landscape structure to gain insights into design considerations for neighborhood outdoor spaces that are preferred and used by the residents.

### 3-1-4. Perception of barriers to neighborhood use

Physical access is one of the most commonly measured factors across urban neighborhood studies. With respect to public green spaces, physical access is evaluated in terms of the distribution of such spaces and often includes evaluation of barriers that obstruct access, such as long distances and unsafe routes (Shackleton and Blair 2013). Physical barriers that affect neighborhood satisfaction or frequency of use of outdoor spaces include unattractiveness (Giles-Corti et al. 2005), long distances (Giles-Corti et al. 2005; Wright Wendel, Zarger, and Mihelcic 2012), safety issues (Lee 1981; Ward Thompson and Aspinall 2011) and major roads (Giles-Corti et al. 2005). Given the growing evidence of the importance of accessibility and barriers to use of public spaces, this study examines the extent to which perceived barriers affect each component of neighborhood satisfaction and use patterns.

## 3-2. Methods and Data Analysis

### 3-2-1. Study area

The study area covers 3400 acres of a moderately dense residential area in Chicago, IL that includes portions of four community areas; Logan Square, Avondale, Humboldt Park and West Town (See Figure 3-2). Choice of this area was based initially on analysis of citywide GIS modeling considering criteria comprising median income[1], housing stock type[2], crime rate, and green spaces[3]. The boundary was determined based on field investigations. The study area is characterized by majority of multifamily houses, and residents with median incomes between $25000 and $75000. It includes a variety of public green spaces (large park, small parks, green boulevards, and very small community gardens), with the amount of these spaces ranging from very little green (in Avondale) to a substantial amount (in Logan Square), providing the opportunity for comparative investigations.

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[1] Census data: http://www.socialexplorer.com/tables/ACS2009_5yr/R10591609; Census tract boundaries: http://www.census.gov/geo/www/tiger/
[2] Source: Landuse inventory 2005; http://www.cmap.illinois.gov/land-use-inventory
[3] https://data.cityofchicago.org/browse?tags=gis
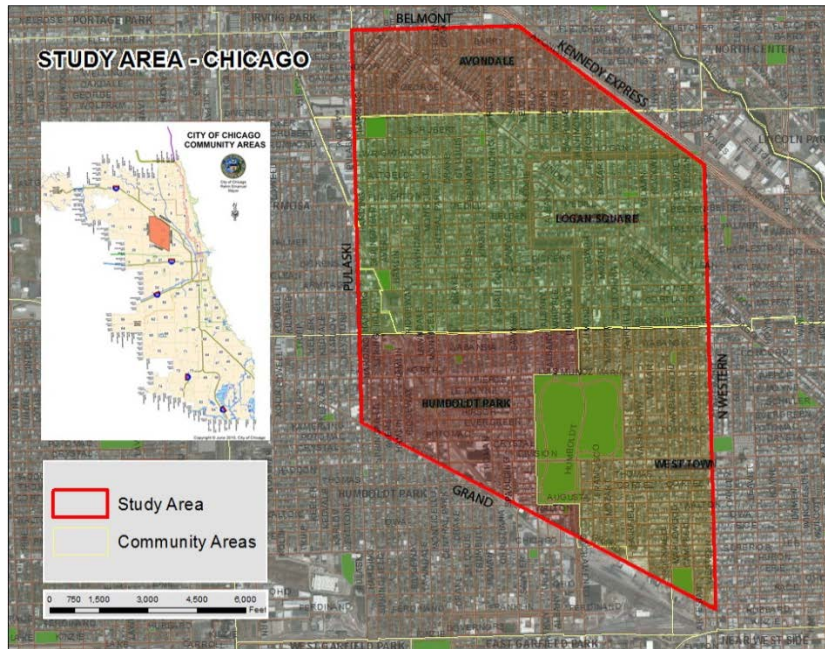
Fig.3-2 Study site including community areas

### 3-2-2.  Research instrument

A survey with a five-point rating scale was used for assessing a number of variables including perceived proximity to green, nearby landscape structure, barriers to use of outdoor spaces, neighborhood satisfaction, and use pattern. Demographic information was also collected. The six-page questionnaire was color printed in a letter-size booklet format which included two pages of landscape scenes taken in the study area. A web link to the survey was enclosed in the cover letter for those who preferred to participate online.

### 3-2-3.  Independent variables

Perception of green space availability was assessed in terms of both the nature view from the window and nearby nature in a 5-minute walking distance from home. The latter was tapped both by the inclusion of verbal items and through the photographs which were used as a way to identify perceived landscape structure. Survey items also included questions about potential barriers to using outdoor spaces. Table 3-1 shows questionnaire items used as the basis for constructing the independent variables.

Table 3-1 Survey questions on independent variables[*]

| Walking distance proximity to nature | |
| --- | --- |
| How likely are you to see each of the following within a 5-minute walk from your home? | Green vacant lot |
| | Community garden |
| | Boulevard |
| | Park-like square |
| | Playlot/playground |
| | Sports fields |
| | Park with large trees |
| | Outdoor gathering/picnic area |
| How much do you have each of these within a 5-minute walk from your home? | Large trees |
| | Shrubs and bushes |
| | Flower beds |
| | Lawns |
| | Vegetable gardens |
| | Sports fields |
| | Children playlots/playgrounds |
| | Sitting areas |
| | Outdoor gathering areas |
| **Immediate proximity to nature** | |
| How likely are you to see each of the following in your view from windows where you live? | Tree canopies |
| | Shrubs and bushes |
| | Flower beds |
| | Green backyard |
| | Unused green vacant lot |
| | Community garden |
| | Houses or apartment buildings |
| | Quiet street |
| | Busy street |
| | Parking lot |
| **Barriers to neighborhood use** | |
| How much do each of these discourage you from pursuing activities in your neighborhood? | Traffic |
| | Major roads |
| | Distance |
| | Safety concerns |
| | Unpleasant open spaces |
| | Low maintenance |
| | Fences |
| | Lack of information about availability |
| | Lack of walkable sidewalks |
| | Lack of sense of community |

[*]scale: 1= not at all, 2= a little, 3= somewhat, 4= quite a bit, 5= very much

Learning about people's perception of landscape structure calls for visual images rather than verbal descriptors. The survey thus included 20 photos representing a variety of available landscape structures –ranging from small scale to large scale and from nature-dominated to building-dominated—in the study area. Participants were asked to rate how similar the pictured

content is to what they see nearby. Table 3-2 shows the photo questionnaire on landscape structure.

Table 3-2 Landscape structure photo questionnaire[*]

| **Landscape structure** |
| --- |

| How similar is each scene to what you see while walking near your home (no more than five minutes away)? |  |

[*]scale: 1= not at all similar, 2= a little, 3= somewhat, 4= quite a bit, 5= very much similar

## 3-2-4.  Dependent variables

Table 3-3 shows the items included to assess each of the dependent variables. In terms of satisfaction with the neighborhood, one question focused on overall satisfaction with the neighborhood and the other one emphasized satisfaction with the amount of specific nature features and spaces in the neighborhood. Three separate questions were included to tap a variety of patterns of outdoor space use.

Table 3-3 Survey questions on dependent variables

| **Neighborhood satisfaction** | |
| --- | --- |
| Thinking about your nearby environment, how do you feel about the amount of the following? | Public green spaces<br>Large trees<br>Shrubs and bushes<br>Lawns<br>Flower beds<br>Vegetable gardens<br>Sitting areas<br>Outdoor gathering/picnic areas<br>Children's play areas<br>Opportunities for positive interactions with neighbors |

scale: 1= much too little, 2= too little, 3= about right, 4= too much, 5= much too much

| | |
| --- | --- |
| How satisfied are you with the nearby neighborhood in terms of these? | Overall appearance<br>Amount of open space<br>Variety of the green spaces<br>Street lighting<br>Farmers market<br>Sense of community<br>Peacefulness<br>Safety for walking during the day<br>Safety for walking at night<br>Opportunities for outdoor community/friends gathering |

scale: 1= not at all satisfied, 2= a little, 3= somewhat, 4= quite a bit, 5= very satisfied

| **Neighborhood Use patterns** | |
| --- | --- |
| How often do you walk within your neighborhood? | For pleasure<br>To visit someone<br>To visit a green space<br>To walk a dog<br>To make a purchase<br>To get to a metro/bus stop<br>To go to recreational areas/clubhouse/coffee shop/restaurant<br>To reach a specific destination (e.g., church, school, work) |
| How often do you visit/use each of the following in your neighborhood? | Community garden<br>Boulevard seating areas<br>Park-like square<br>Playlot/playground<br>Sports fields<br>Park with large trees<br>Outdoor gathering/picnic areas |
| How often do you do each of these in your neighborhood? | Outdoor sitting and watching<br>Running<br>Biking<br>Outdoor community/friends gathering<br>Picnicking<br>Resting on the lawn<br>Garden at a community garden |

scale: 1= never or rarely, 2= a little, 3= occasionally, 4= often, 5= very often

### 3-2-5.  Characteristics of the sample population

The first phase of data collection was conducted through a mail survey. A stratified random sample was drawn based on proximity of the multi-family houses to green spaces, with one category including buildings within a block from large green spaces, and the second restricted to buildings located at least four blocks from a large green space. To select the random sample of 1250 housing units from each category the target population (total of 5309 eligible households) was stratified by nine-digit zip codes. From a randomly selected starting point, addresses were selected using the mathematically determined interval—the total eligible households (5309) divided by sample size (2500). An initial invitation postcard was sent to the sample by the end of July 2013 indicating that a survey would be coming, followed by the survey a week later. The response rate of the mail survey was very low, 4.9%, (111 mail returns plus 12 online responses).

The second phase of data collection was on-site. Between August 24 and September 30, 2013, the researcher approached individuals in the study area during various summer events such as farmers' market, music festivals, kids' activity tents, and community gatherings, as well as in outdoor spaces of a few coffee shops in the study area. When individuals showed interest in filling out the survey, they were asked to find their home on a simple sketched map to make sure that they were residents of the study area. Two neighborhood organizations, Avondale Neighborhood Association (ANA) and Logan Square Neighborhood Association (LSNA), also agreed to share the online survey link with their members via email. In this phase, the total number of participants who lived in the study area was 311 (264 on-site survey plus 47 online survey participants). The total number of participants was 468, but 34 could not be used due to either incompleteness or being outside of the study area. Therefore, the total sample size used in this study is 434.

Demographic information collected through the survey is shown in Table 3-4. In relevant cases demographic data from U.S. Census Bureau for Chicago city (2012) is also shown to allow comparison with the sample data. The study sample is younger and more educated than the Chicago population. Responses to survey items about the participants' daily commuting habits

and familiarity with their neighborhood also indicate the sample does not reflect the general population in a number of respects. As shown in Table 3-4, more than half of the sample use public transportation (bus or train) to get to work which is twice the percentage of people who do the same in Chicago, and about three times as many walk to work than is the case for the Chicago population. It is also worth noting that nearly 60 percent of the sample population has lived in the neighborhood for more than three years, meaning that the majority of the participants are quite familiar with the neighborhood.

Table 3-4 Sample characteristics

|  | Study sample (%) | Chicago city in 2012(%)[*] |
|---|---|---|
| **Gender** | | |
| Female | 59.6 | 52.4 (Population 25 years old and over) |
| Male | 40.4 | 47.6 |
| **Marital status** | | |
| Married or with partner | 52.5 | 34.3 |
| single | 46.3 | 65.6 |
| **Children** | | |
| No | 71.7 | |
| Yes | 27.2 | |
| **Education level** | | |
| Less than high school | .9 | 18.0 |
| High school | 2.1 | 25.0 |
| Technical degree | 1.6 | 5.2 |
| Some college | 13.1 | 18.2 |
| College degree | 45.6 | 20.3 |
| Post-graduate degree | 35.9 | 13.3 |
| **Work status** | | |
| Work full-time | 69.1 | |
| Work part-time | 15.0 | |
| Student | 10.8 | |
| Homemaker | 7.8 | |
| Retired | 3.9 | |
| Volunteer work | 4.4 | |
| **Total household income ($)** | | |
| <25,000 | 15.2 | 29.9 |
| 25,000-34,999 | 8.6 | 10.5 |
| 35,000-49,999 | 15.5 | 13.0 |
| 50,000-74,999 | 19.5 | 16.2 |
| 75,000-100,000 | 16.7 | 10.4 |
| 100,000+ | 24.5 | 19.9 |
| **Amount of time to get to work/school (Minutes)** | | |
| <15 | 10 | |
| 15-30 | 40 | |
| 30-45 | 20 | |
| 45+ | 15 | |
| N/A | 15 | |
| **How to get to work/school** | | |
| Walk | 15.4 | 6.6 |
| Car | 39.6 | 59.3 |
| Bus | 18.0 | 26.8 (Bus+Train) |
| Train | 36.2 | |
| Bike | 22.6 | 2.9 (Bike&other means) |
| N/A | 11.8 | |
| **Amount of time living in the neighborhood (Years)** | | |
| <1 | 13.6 | |
| 1-2 | 17.3 | |
| 3-5 | 27.0 | |
| 6-10 | 21.4 | |
| 10+ | 9.9 | |

[*] Source: http://factfinder2.census.gov/faces/nav/jsf/pages/download_center.xhtml

### 3-2-6. Data analysis

All statistical analyses in this study were conducted using SPSS version 22. In preparing raw data for analysis, only one variable had to be recoded to enable comparison with others. Answers to the question about satisfaction with the amount of green elements and spaces were recoded to produce a range from least to most satisfied (number in parenthesis is original response): 1 = much too little(1) and much too much(5); 3 = too little(2) and too much(4); and 5 = about right (3).

First, Exploratory Factor Analysis (EFA) was used to determine each of the dependent and independent variables. Principal Components, with Varimax rotation and a maximum of 25 iterations for convergence, was followed for each of the constructs. Only the loadings with absolute values greater than 0.50 were included in the analysis. The larger double loader was selected if it was at least 0.05 greater than the alternative; otherwise the item was eliminated from the final solution. Factor means were calculated and saved as latent variables. Cronbach Alpha was calculated for each factor to test for reliability and only factors with Alpha coefficients greater than .73 were retained.

After defining distinct latent variables, Pearson correlations were used to determine the extent of relationship between the two sets of dependent variables –neighborhood satisfaction and use patterns because use may be affected by satisfaction, *and* satisfaction could be influenced by use. Then Standard Linear Regression modeling was carried out to examine the significance of the relationships between independent and dependent variables. This was done in two steps. First, each component of the dependent variables was regressed on the three sets of independent (exploratory) variables separately (See Table 3-12). In the second step, each component of the dependent variables was regressed on *all of the significant predictors* resulting from the first step (See Table 3-13).

## 3-3. Results and Discussion

### 3-3-1. Components of dependent variables (neighborhood satisfaction and use patterns) and their relationships

Exploratory Factor Analysis (EFA) was used to construct distinct measures for each of the two main dependent variables, Neighborhood Satisfaction and Neighborhood Use Patterns. Four

latent variables emerged for neighborhood satisfaction: satisfaction with the Amount of Affordances, Amount of Green Features, Quality of Public Space, and Neighborhood Comfort. Three latent variables emerged for different types of outdoor use: frequency of Green/Social Space Use, Active Use (such as use of playgrounds, sports fields and gardening), and Walk to Non-nature Destinations (such as walking to bus stop or to make a purchase).

### *Neighborhood satisfaction measures*

Separate EFA was conducted for the two major questions (See Table 3-3) regarding neighborhood satisfaction. Four distinct measures explaining different aspects of neighborhood satisfaction emerged as presented in Table 3-5. The first two factors concern satisfaction with the quantity of the nearby nature features. Amount of Affordances (Cr $\alpha = 0.84$) reflects the extent to which the participants are satisfied with the amount of public green spaces that are intended for doing meaningful activities such as sitting, picnicking, socializing and playing. By contrast, Amount of Green Features (Cr $\alpha = 0.77$) indicates the extent to which the participants are satisfied with the amount of trees, shrubs, flowers and lawns. The third factor, Quality of Public Spaces (Cr $\alpha = 0.88$), represents the extent to which the participants are satisfied with their neighborhood in terms of overall appearance, the variety of green spaces and socializing opportunities. The final factor, Neighborhood Comfort (Cr $\alpha = 0.76$), includes safety issues and peacefulness. The "farmers market" also emerged as part of this factor although it is more specific than the other items in the factor. Two items, "amount of vegetable gardens" and "street lighting," had low loadings (<.5) and were dropped from further analysis. Also, the item "sense of community" was eliminated because of almost equal double loadings on factors 3 and 4.

The mean values (Table 3-5) of latent variables suggest a moderate degree of satisfaction with evaluated aspects of participants' neighborhoods. The results show that participants are far more satisfied with the *amount* of green features (3.75) than with the *quality* of the public spaces (3.20). Single item means show that satisfaction with the amount of sitting areas is the lowest (2.93) among the examined affordances, and is below the average for satisfaction with the amount of affordances (3.33). While satisfaction with the amount of trees and shrubs are above the average (3.75), the participants show less satisfaction with the amount of flowerbeds (2.26). Another item that shows low level of satisfaction is related to the feeling of safety at night (2.97)

which is slightly different from the average level of satisfaction with neighborhood comfort (3.51).

Table 3-5 Neighborhood Satisfaction factors and factor loadings

| | Item (Mean) | F1[*] Amount of Affordances | F2[*] Amount of Green Features | F3 Quality of Public Space | F4 Neighborhood Comfort |
|---|---|---|---|---|---|
| | Thinking about your nearby environment, how do you feel about the <u>amount</u> of the following? | | | | |
| Amount of Affordances | Outdoor gathering/picnic areas (3.46) | .848 | | | |
| | Sitting areas (2.93) | .809 | | | |
| | Public green spaces (3.51) | .723 | | | |
| | Children's play areas (3.46) | .705 | | | |
| | Opportunities for positive interactions with neighbors (3.29) | .628 | | | |
| Amount of Green Features | Shrubs and bushes (4.10) | | .789 | | |
| | Lawns (3.74) | | .769 | | |
| | Large trees (3.94) | | .717 | | |
| | Flower beds (2.26) | | .676 | | |
| | How satisfied are you with the nearby neighborhood in terms of these? | | | | |
| Quality of Public Space | Amount of open space (3.22) | | | .908 | |
| | Variety of the green spaces (3.05) | | | .898 | |
| | Opportunities for outdoor community/friends gathering (3.15) | | | .706 | |
| | Overall appearance (3.36) | | | .662 | |
| Neighborhood Comfort | Safety for walking during the day (4.09) | | | | .814 |
| | Safety for walking at night (2.97) | | | | .790 |
| | Peacefulness (3.12) | | | | .680 |
| | Farmers market (3.87) | | | | .566 |
| | Cronbach's Alpha based on standardized items | 0.84 | 0.77 | 0.88 | 0.76 |
| | Total Variance explained (%) | 31.67 | 25.95 | 32.80 | 30.22 |
| | Mean | 3.33 | 3.75 | 3.20 | 3.51 |
| | Standard Deviation | 1.21 | 1.09 | 1.03 | 0.86 |

[*]EFA is based on the recoded scale

### *Neighborhood use pattern measures*

Three distinct use pattern measures emerged from EFA are Green/Social Space Use, Active Use, and Walk to Non-nature Destinations (Table 3-6). Three items – "running," "biking," and "dog walking" –had loadings lower than the 0.5 criterion and were eliminated from further analysis. Table 3-6 shows the contents and the loadings of each measure. The first of these measures, Green/Social Space Use, with alpha coefficient of 0.91, incorporates a variety of passive uses of green outdoor spaces such as resting, picnicking, sitting and watching as well as

specific nearby nature-based destinations. The mean for this measure is at mid-scale, but some of the single item means such as picnicking (2.23) and use of boulevard sitting areas (2.66) are below the mean of this measure as opposed to the means for use of parks and park-like squares that are considerably above the mean.

The four items of the 'Active Use' measure (Cr α = .76), include community gardens, play areas for younger children, and sports. The low mean (1.87) for this measure suggests that most participants only participate in these activities "a little." The five items comprising the final measure (Cr α = .76) all entail non-nature based reasons for walking and thus are designated as Walking to Non-nature Destinations. The mean, 3.92, indicates participants walk in the neighborhood "quite a bit" to run errands and reach needed destinations.

Table 3-6 Neighborhood Use Patterns factors and factor loadings

| Item (Mean) | F1 Green/Social Space Use | F2 Active Use | F3 Walk to Non-nature Destinations |
|---|---|---|---|
| Park-like square (3.25) | .807 | | |
| Outdoor gathering/picnic areas (2.90) | .752 | | |
| Park with large trees (3.53) | .750 | | |
| Resting on the lawn (2.72) | .726 | | |
| To visit a green space (3.42) | .723 | | |
| Boulevard seating areas (2.66) | .687 | | |
| Outdoor community/friends gathering (2.99) | .680 | | |
| Outdoor sitting and watching (3.25) | .673 | | |
| Picnicking (2.23) | .644 | | |
| Walk for pleasure (3.72) | .625 | | |
| Garden at a community garden (1.56) | | .841 | |
| Community garden (1.76) | | .818 | |
| Playlot/playground (2.33) | | .632 | |
| Sports fields (1.82) | | .570 | |
| Walk to make a purchase (4.17) | | | .715 |
| Walk to a metro/bus stop (4.03) | | | .711 |
| Walk to a specific destination (e.g., church, school, work) (3.79) | | | .661 |
| Walk to recreational areas/clubhouse/coffee shop/restaurant (4.11) | | | .639 |
| Walk to visit someone (3.53) | | | .566 |
| Cronbach's Alpha based on standardized items | 0.91 | 0.76 | 0.76 |
| Total Variance explained (%) | 26.3 | 11.9 | 11.8 |
| Mean | 3.08 | 1.87 | 3.92 |
| Standard Deviation | 0.98 | 0.94 | 0.87 |

The left-side row-group labels: Green/Social Space Use, Active Use, Walk to Non-nature Destinations.

*Relationships between Neighborhood Satisfaction and Use Pattern measures*

All satisfaction measures are significantly correlated with Green/Social Space Use and Walk to Non-nature Destinations. The highlighted area in Table 3-7 presents correlations between all examined components of Neighborhood Satisfaction and Neighborhood Use. only one of the correlations is greater than 40%, indicating that the latent variables reflect distinct relationships. The correlation between Green/Social Space Use and satisfaction with the Quality of Public Space (.63), accounts for about one-third of common variance.

Table 3-7 Correlations between components of neighborhood satisfaction and use pattern (Pearson Correlation, 2-tailed significance test)

| | | Neighborhood satisfaction | | | | Neighborhood use patterns | | |
|---|---|---|---|---|---|---|---|---|
| | | Amount of Affordances | Amount of Green Features | Quality of Public Space | Neighborhood Comfort | Green/Social Space Use | Active Use | Walk to Non-nature Destinations |
| Neighborhood satisfaction | Amount of Affordances | 1 | | | | | | |
| | Amount of Green Features | .537** | 1 | | | | | |
| | Quality of Public Space | .565** | .278** | 1 | | | | |
| | Neighborhood Comfort | .292** | .196** | .618** | 1 | | | |
| Neighborhood use patterns | Green/Social Space Use | .365** | .141** | .633** | .386** | 1 | | |
| | Active Use | .058 | .013 | .263** | .082 | .480** | 1 | |
| | Walk to Non-nature Destinations | .178** | .096* | .355** | .344** | .429** | .132** | 1 |

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

*Discussion*

This study investigates the participants' perceptions about both the amount and the quality of outdoor green spaces. Exploring people's satisfaction in a more detailed manner in this study allows us to decipher more about their preferences and needs in terms of multiple attributes and affordances of a complex environment. Two of these measures are directly related to the nature component of outdoor spaces, and the other two address the activities afforded by outdoor spaces

with nature components and the degree of neighborhood comfort. Instead of investigating neighborhood satisfaction as a single entity or focusing on one specific aspect of it, this study offers an opportunity to learn how people perceive, prefer and appreciate urban green space in a more inclusive way. Similarly, with respect to neighborhood use, the scope of this work goes beyond the consideration of frequency of use of outdoor spaces. Being outdoors for any purpose exposes the residents to both nature and non-nature elements of the outdoor environments, which affect their perception of the neighborhood. It is thus relevant to include various reasons to be outdoors while investigating the effects of physical aspects of the environment on neighborhood use. In this study, we have explored the frequency of outdoor activities, the type of space used (including green, social and recreational spaces), and the type of activities involved (nature/non-nature-related) in order to learn how each dimension is related to neighborhood satisfaction or could be affected by the physical aspects of the environment.

The association between use of outdoor spaces and neighborhood satisfaction in general has been shown in many studies, where frequency of use has been investigated as the predictor of satisfaction (e.g., Kearney 2006). While confirming previous findings, this study also highlights that these two factors reinforce each other in many aspects. In other words, sometimes satisfaction may be the predictor of the frequency of use, meaning that it is not always clear which one comes first. With a focus on nature-related aspects, this study shows that satisfaction with quality of public space and frequency of use of green and social spaces are highly correlated (Table 3-7) in multiple ways: the more the residents are satisfied with the overall appearance of the neighborhood, the variety of green spaces, the amount of open space, and the opportunities for socializing, the more likely they are to use their green/social spaces and walk for pleasure in the neighborhood, and vice versa. Acknowledging these interrelations is helpful in terms of understanding the multi-dimensional effects of physical attributes of the environment on both neighborhood satisfaction and use patterns.

### 3-3-2. Components of Independent variables (Proximity, landscape structure and barriers)

Exploratory Factor Analysis (EFA) was applied to each of the independent variable constructs following the same procedures and criteria as for the dependent variables. Factors

representing proximity of nature to home, landscape structure and barriers to neighborhood use are described in this section.

### *Proximity of nature to home*

Perceived proximity of nature to people's homes was assessed both with respect to a five-minute walk from home (perceived walking distance proximity) and the more immediate view from the window (perceived immediate proximity). Table 3-8 presents the three factors based on perceived walking distance proximity: Nearby Green/Social Space, Amount of Nearby Green Features, and Nearby Active Recreation. Two items –"availability of community garden" and "availability of green vacant lot" –were excluded from further analyses because of loadings lower than .5. The high Cronbach Alphas (.91, .80, and .84, respectively) for the three walking distance proximity factors confirmed the reliability of the scales. Based on the 5-point scale, the means for the first two factors (3.87 and 4.05, respectively) show that on average, the participants' perception of the availability of green and social spaces and the amount of nature elements is relatively high, indicating a perception that there is quite a bit of nature close to home. However, the single item means show that among different nature elements, the perceived amount of vegetable gardens is below the average (3.22). By comparison, the mean for Nearby Active Recreation (3.39) is closer to mid-scale, indicating somewhat lower availability of playgrounds and sports fields in walking distance. Among these active recreation items, the perceived amount of nearby sports fields is even lower than the average (2.95).

Table 3-8 Walking Distance Proximity factors and factor loadings

| | Item (Mean) | F1 Nearby Green/Social Space | F2 Amount of Nearby Green Features | F3 Nearby Active Recreation |
|---|---|---|---|---|
| **Nearby Green/Social Space** | Availability of park-like square (4.08) | .821 | | |
| | Availability of boulevard (4.23) | .798 | | |
| | Availability of outdoor gathering/picnic area (3.70) | .779 | | |
| | Amount of nearby outdoor gathering areas (3.73) | .768 | | |
| | Amount of nearby sitting areas (3.49) | .722 | | |
| | Availability of park with large trees (3.96) | .682 | | |
| **Amount of Nearby Green Features** | Amount of nearby flower beds (3.95) | | .811 | |
| | Amount of nearby shrubs and bushes (4.48) | | .730 | |
| | Amount of nearby lawns (4.05) | | .701 | |
| | Amount of nearby vegetable gardens (3.22) | | .665 | |
| | Amount of nearby large trees (4.56) | | .646 | |
| **Nearby Active Recreation** | Availability of sports fields (3.10) | | | .861 |
| | Amount of nearby sports fields (2.95) | | | .853 |
| | Amount of nearby children's playlots/ playgrounds (3.57) | | | .736 |
| | Availability of playlot/playground (3.91) | | | .623 |
| | Cronbach's Alpha based on standardized items | 0.91 | 0.80 | 0.84 |
| | Total Variance explained (%) | 24.3 | 18.4 | 17.3 |
| | Mean | 3.87 | 4.05 | 3.39 |
| | Standard Deviation | 1.20 | 0.85 | 1.29 |

In terms of the view from a resident's window, Table 3-9 shows a coherent "Nature view from window" factor, with Cronbach Alpha of .78, which encompasses plant materials, a green backyard and a quiet street. The scale mean of 3.64 shows that on average, the participants are fairly likely to see nature elements from their window. Several non-nature based items formed a factor with a very low Cronbach Alpha (.25) which was dropped from further analysis. Two other items –"houses or apartment buildings" and "community garden" –were eliminated due to low loadings (<.5).
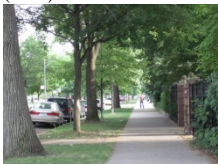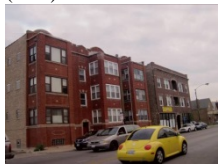
Table 3-9 Nature Window View factors and factor loadings

| Item (Mean) | F1 Nature Window View | F2 - |
|---|---|---|
| Flower beds (3.46) | .849 | |
| Shrubs and bushes (4.02) | .800 | |
| Green backyard (3.44) | .710 | |
| Tree canopies (3.84) | .678 | |
| Quiet street (3.44) | .587 | |
| Busy street | | .695 |
| Parking lot | | .634 |
| Unused green vacant lot | | .520 |
| Cronbach's Alpha based on standardized items | 0.78 | 0.25 |
| Total Variance explained (%) | 28.2 | |
| Mean | 3.64 | |
| Standard Deviation | 1.06 | |

*Landscape structure*

EFA of perceived landscape structure resulted in four discrete factors, named Garden Space, Open Lawn with Trees, Green Corridor, and Building-dominated Space. Table 3-10 shows the scenes comprising each factor. The first factor, Garden Space (Cr α= .87) includes all small-scale green space scenes that provide a place to sit. The second factor, Open Lawn with Trees (Cr α = .87), mostly entails wide open spaces, covered with lawn, and with irregular layout of trees in the background. The main attributes of the scenes in the third landscape structure factor, Green Corridor (Cr α = .77), consist of street and sidewalk corridors mostly dominated by tree lines and a strip of lawn or shrubs. By contrast, the fourth factor, Building-dominated Space (Cr α = .74), comprises street scenes dominated by buildings and hard surfaces, with relatively few nature elements. The relatively low mean (2.54) for the first factor indicates that the participants are only somewhat likely to see garden spaces and sitting areas in their walking distance. By contrast, the 3.91 mean for Green Corridors suggests that these are seen quite a bit in the participants' walking distance. The means for the other two factors indicate that both Open Lawns with Trees (3.59) and Building-dominated Spaces (3.42) are somewhat similar to what they have nearby.

Table 3-10 Perceived nearby Landscape Structure factors and factor loadings[*]

| | F1 Garden Space | F2 Open Lawn w/ Trees | F3 Green Corridor | F4 Building-Dominated Space |
|---|---|---|---|---|
| | (2.69) .826 | (3.20) .796 | (4.13) .798 | (3.46) .779 |
| | (2.52) .784 | (3.74) .779 | (4.31) .677 | (3.49) .742 |
| | (2.55) .782 | (3.65) .777 | (4.32) .588 | (3.70) .683 |
| | (2.49) .738 | (3.51) .769 | (3.77) .580 | (3.03) .647 |
| | (2.43) .602 | (3.83) .573 | (3.62) .557 | |
| | | | (3.35) .526 | |
| Cronbach's Alpha | 0.87 | 0.87 | 0.77 | 0.74 |
| Total Variance explained (%) | 17.9 | 17.7 | 14.5 | 12.2 |
| Mean | 2.54 | 3.59 | 3.91 | 3.42 |
| Standard Deviation | 1.13 | 1.17 | 0.78 | 0.98 |

[*]. Item means in parentheses

*Barriers to neighborhood use*

Two distinct factors for barriers to neighborhood use emerged through EFA (Table 3-11). The first factor, named Varied Perceived Barriers (Cr α = 0.85), included physical attributes of the neighborhood such as fences, unpleasant appearance and lack of walkability, as well as individual feelings about the neighborhood such as lack of information, safety and sense of community. By contrast, the second factor, Transportation Barriers (Cr α = .81) included "major roads", "traffic" and "distance". The low means for both barrier factors (2.09 and 2.34, respectively), indicate that, on average, the participants consider the barriers to use of the outdoor spaces of relatively lower significance.

Table 3-11 Barriers to Neighborhood Use factors

| Item (Mean) | F1 Varied Perceived Barriers | F2 Transportation Barriers |
|---|---|---|
| Low maintenance (2.23) | .738 | |
| Unpleasant open space (2.18) | .728 | |
| Lack of information about availability (2.35) | .717 | |
| Lack of walkable sidewalks (1.55) | .695 | |
| Fences (1.85) | .682 | |
| Lack of sense of community (2.11) | .668 | |
| Safety concerns (2.36) | .607 | |
| Major roads (2.33) | | .940 |
| Traffic (2.36) | | .916 |
| Distance (2.31) | | .524 |
| Cronbach's Alpha based on standardized items | 0.85 | 0.81 |
| Total Variance explained (%) | 36.0 | 23.5 |
| Mean | 2.09 | 2.34 |
| Standard Deviation | 0.86 | 1.10 |

### 3-3-3. Effects of physical aspects of the environment on neighborhood satisfaction and use patterns: first-step analysis

In the first-step standard linear regression modeling each component of the dependent variables (neighborhood satisfaction and use patterns) was regressed on each of the three sets of independent variables (proximity, landscape structure and barriers) separately. The results presented in Table 3-12 show various degrees of significant associations between the examined physical attributes of the environment and different dimensions of neighborhood satisfaction and use.

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*Proximity*

The regression model summary in Table 3-12 shows that walking distance proximity, defined in terms of three latent variables, played a significant role with respect to neighborhood satisfaction and use(p<0.001). Jointly the three measures of walking-distance proximity account for a relatively substantial amount of variance with respect to satisfaction with Quality of Public Space ($R^2$=.44), satisfaction with the Amount of Affordances ($R^2$=.32) and Green/Social Space Use ($R^2$=.35).

*Nearby Green/Social Space:* As shown in Table 3-12, proximity to Green/Social Spaces was the single strongest predictor of neighborhood satisfaction, as measured by satisfaction with Amount of Affordances (β=0.51) and Quality of Public Space (β =0.56), and the strongest predictor of neighborhood use, as measured by Green/Social Space Use (β =0.49). Nearby Green/Social Space played a significant though lesser role as a predictor of Neighborhood Comfort (β =.36) and frequency of Walking to Non-nature Destinations in the neighborhood (β =.29).

*Amount of Nearby Green Features:* The perception of a greater amount of green features close to home predicted greater satisfaction with the amount of nearby green features (β =.33). While it was not a significant predictor of satisfaction with Amount of Affordances, this proximity measure was also a significant predictor for two other satisfaction measures- Quality of Public Space and Neighborhood Comfort, but played a lesser role in association with Green/Social Space Use and Walking to Non-nature Destinations. It should be also noted that the Amount of Nearby Green Features does not have a significant effect on Active Use of the neighborhood.

*Nearby Active Recreation:* Proximity to active recreation spaces (i.e., sports fields and playgrounds) was a significant predictor of Active Use (β =.33) but not of Green/Social Space Use. Nearby Active Recreation has almost equal negative effects on the frequency of Walking to Non-nature Destinations (β =-.16) and Neighborhood Comfort (β =-.15, p<.005). Walking-distance active recreation spaces do not have significant effects on the other three measures of neighborhood satisfaction as shown in Table 3-12.

*Nature Window View:* The perceived availability of nature in the view from home played a significant role with respect to each of satisfaction and use measures but one (see Table 3-12).

The perceived nature window view was positively related to the perceived quality of nearby public space ($\beta$ =0.31), satisfaction with the amount of green features ($\beta$ =0.31), the use of green and social spaces ($\beta$ =0.24), and a sense of neighborhood comfort ($\beta$ =0.24); for all slopes p<0.001).

### *Discussion*

This analysis demonstrates the substantial effects of nearby nature on different aspects of neighborhood satisfaction and use patterns. The results point to both the widespread role that proximity to nearby nature plays with respect to participants' satisfactions and use patterns as well as more specific, nuanced ways in which it has impacts. Both the amount and the nature of nearby green features within walking distance predict multiple dimensions of satisfaction and use patterns. Together they explain a substantial amount of the variance in participants' satisfaction with the quality of the public spaces in their neighborhood and their likelihood of using such spaces. However, a close examination of these results suggests that the availability of green and social spaces within walking distance of home is the most important contributor to participants' satisfaction and use of their nearby environment. Apparently, the presence of such spaces improves the perception of what the outdoor environment affords to the residents in terms of favored activities as well. While having a greater *amount* of nearby green features is certainly an asset, it is the *availability* of green/social spaces in walking distance that plays the major role as our model shows.

Our results confirm the previous findings regarding the positive effects of the presence of nearby nature settings on walking frequency (Giles-Corti and Donovan 2002; Macintyre, Macdonald, and Ellaway 2008; Shackleton and Blair 2013; Tinsley, Tinsley, and Croskeys 2002; Ward Thompson and Aspinall 2011). Neighborhood comfort, defined here as feeling of peacefulness and safety, is also shown to be interrelated with use of green and social spaces and is influenced by walking-distance proximity to such spaces. These results support earlier findings about the positive impact of proximity to nature settings on sense of peacefulness (e.g., Kaplan and Austin 2004) and the association of perceived safety with use of green spaces (e.g., Ward Thompson and Aspinall 2011).

Our findings highlight the significance of the social component of nearby nature settings in terms of availability of opportunities for gathering and socializing, which encourages people to

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use such spaces more frequently and to feel more satisfied with the neighborhood. Perhaps use of such green/social spaces is related to a sense of community and social ties in the neighborhood. This is in line with the growing body of research indicating the positive association of nearby nature with stronger social ties in the neighborhood (e.g., Holtan, Dieterlen, and Sullivan 2014).

The results also show that the nearby nature areas play a different role than the nearby recreational areas. Proximity to active recreation areas is found to have no significant effect on neighborhood satisfaction, which is consistent with previous research (Kaplan and Kaplan 1989). It is worth noting that proximity to nearby active recreation facilities (e.g., sports fields) is not perceived as contributing positively to participants' sense of safety and peacefulness or their inclination to walk to purpose-based local destinations. Understanding these findings calls for further research not only with respect to different age groups but also in terms of the character of the nearby recreation opportunities.

In line with Kaplan's (2001) findings, our results demonstrate that view of tree canopies, shrubs and flowerbeds from the window has a significant influence on people's perception of the amount of green features in the entire neighborhood and their satisfaction with it. Given the positive effects of nature window view on all the four examined components of neighborhood satisfaction in this study, and the strong correlations between neighborhood satisfaction and use, it is not surprising that view of nature from home improves the likelihood of using outdoor spaces. It may be also because of the positive effects of nature window view on feelings of peacefulness and safety, which is in line with previous findings (Groenewegen et al. 2006; Kuo and Sullivan 2001). In other words, availability of nature in the view from the residents' home window generates more positive feelings towards the neighborhood in terms of opportunities for outdoor activities, the quality of public spaces, amount of green spaces, safety and peacefulness, and ultimately these positive effects may result in higher frequency of use of outdoor spaces. Although nature view from the window (explaining up to 10 percent of the variance) is not as strong as walking-distance green/social spaces (explaining up to 44 percent of the variance) in terms of predicting neighborhood satisfaction and use, its important role cannot be overlooked.

### *Landscape structure*

The four factors comprising perceived landscape structure were evaluated for relationship with each individual measure of neighborhood satisfaction and use. As shown in Table 3-12, in

all cases, regression models yielded significant results (p<0.001). Perceived landscape structure showed the greatest association with satisfaction with the Quality of Public Space ($R^2$ =.38) and Green/Social Space Use ($R^2$ = .36). This physical attribute of the environment was found to be a less significant predictor of satisfaction with the amount of affordances provided by nearby green spaces ($R^2$=.19), satisfaction with aspects of neighborhood comfort such as sense of safety and peacefulness ($R^2$=.13), and the frequency of using places intended for active outdoor pursuits such as playgrounds and sports fields ($R^2$=0.13).

*Nearby Garden Space:* Not surprisingly, the presence of nearby small-scale garden spaces was most strongly related to Active use which includes getting actively involved with nature through community gardening (β= .38). It has also relatively strong relationship with the frequency of more passive activities such as sitting, picnicking, walking for pleasure and socializing (Green/Social Space use, β=.28). Nearby small-scale garden spaces also had an association with how often the residents walked in the neighborhood for non-pleasure purposes such as walking to work or to make a purchase (β =.17). According to our results, presence of such spaces also have positive relationship with the residents' perception of the quality of public space (β =.17) and the amount of affordances offered by neighborhood outdoor spaces (β =.14).

*Nearby Open Lawn with Trees:* The presence of lawn-covered spaces with trees in walking distance from home was a strong predictor of the residents' satisfaction with the quality of public space (β =.40) and the frequency of use of green/social spaces (β =.37) in the neighborhood. This factor also played a significant though lesser role as a predictor of satisfaction with Amount of Affordances (β =.28) and Neighborhood Comfort (β =.18). By contrast, this type of landscape structure did not show any significant association with satisfaction with the Amount of Green Features, Active Use or Walk to Non-nature Destinations.

*Nearby Green Corridor:* It is not unexpected to see that proximity to green street corridors has its strongest influence on satisfaction with the Amount of Green Features (β =.24), while being a less significant predictor of Neighborhood Comfort (β =.15). What is interesting is that nearby green street corridors have no significant relationship with either the frequency of Walking to Non-nature Destinations or satisfaction with the Quality of Public Space, and have negative association with Active Use (β= -.12).

*Nearby Building-dominated Space:* The spaces perceived to be building-dominated, have negative relationship with all components of neighborhood satisfaction in addition to Green/Social Space Use. Not surprisingly, the strongest negative relationships are with satisfaction with the Quality of Public Space and Neighborhood Comfort ($\beta$ =-.30 and -.27 respectively). This factor plays almost equal roles as a predictor of the two other satisfaction measures ($\beta$ =-.20, -.21) while having a smaller effect on Green/Social Space Use ($\beta$ =-.16). Interestingly, proximity to building-dominated spaces has no significant bearing on the frequency of Walking to Non-nature Destinations.

### *Discussion*

The results provide substantial support for the important role played by nearby landscape structure in neighborhood satisfaction and use patterns (Lee et al. 2008; Crow, Brown, and De Young 2006; Ball et al. 2001; Humpel, Owen, et al. 2004; Owen et al. 2004). One of the advantages of this study in terms of investigating landscape structure is the use of images as a tool to understand how people perceive the components of outdoor spaces that form different types of landscape structure. As previous studies demonstrate, photographs can be used with confidence in perceptual studies as surrogates for actual landscapes (Coeterier 1983; Kaplan 1985; Shuttleworth 1980). By visualizing different types of nature settings, we helped the participants to more easily envision the kinds of landscape they have nearby.

Among the four types of perceived landscape structure investigated, the availability of open lawn with trees is the most important to neighborhood satisfaction and use. Proximity to such open green landscapes plays a substantial role in participants' satisfaction with the quality of public space and their likelihood of using green and social spaces. Landscape components such as tree canopies, open spaces and structures have been shown to be important factors in neighborhood satisfaction (Holtan, Dieterlen, and Sullivan 2014; Kaplan 2001; Kweon et al. 2010; Vemuri et al. 2011). It has been also shown that the salience of trees and openness of green space simultaneously generate positive feelings towards the outdoor environment (Zhang and Lin 2011). Open lawn with trees as identified in this study is a specific type of landscape structure that offers sense of openness while providing enough tree canopies and softening the solidness of the built environment. It is possible that the combination of these qualities generates the perception of a spatial characteristic that positively influences people's satisfaction with

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quality of public space and encourages them to use neighborhood outdoor spaces more frequently.

The presence of such spaces nearby also positively predicts the residents' perception of the amount of affordances in the neighborhood, meaning that availability of open lawn with trees in walking distance is perceived as having potential opportunities for getting involved with a variety of possible activities such as sitting outdoors, picnicking, playing and socializing. This is consistent with previous research findings on environmental affordances indicating that preference for a place relates to the function and use of the place, and liking a place is associated with its affordances (Clark and Uzzell 2006). It is thus plausible to assume that the strongest effect of nearby open lawn with trees on satisfaction with amount of affordances as compared to the effects of other types of landscape structure is because of the variety of affordances it provides. The presence of open lawn with trees nearby also positively affects neighborhood comfort as defined by a sense of safety and peacefulness. This might be because of the structure of such open spaces that allow for more visibility in public spaces which improve sense of safety as previous studies have shown (e.g., Kaplan and Talbot 1988; Kuo, Bacaicoa, and Sullivan 1998).

This study shows that nearby small-scale garden spaces have positive relationships with the likelihood of getting actively involved with the outdoor spaces through gardening and using green and social spaces more frequently. In other words, the availability of garden spaces near to home may increase the participants' likelihood of seeking them as destinations. As earlier studies have demonstrated (Alaimo, Reischl, and Allen 2010; Clayton 2007; Kaplan 2001), permitting this kind of activity near home may improve neighborhood satisfaction, and our findings specifically show the positive associations between nearby garden spaces and satisfaction with quality of public space. The significant relationship found between availability of walking-distance garden spaces and satisfaction with the amount of affordances is also consistent with previous findings regarding the value of community gardening as a meaningful activity that improves neighborhood affordances (Comstock et al. 2010; Hadavi, Kaplan, and Hunter 2015; Kaplan and Kaplan 2005). In general, our results show that availability of small scale garden spaces with seats (as shown in the images in Table 3-10) is a weaker predictor of neighborhood satisfaction as compared to availability of open lawn with trees. However, our data shows

insufficient variability in terms of availability of such garden spaces that prevents us from further analysis and comparisons in this respect.

Unlike the other nature-related landscape structure dimensions, the availability of green street corridors is related to satisfaction with the amount of green features in the neighborhood. In other words those who perceive their neighborhood to include more street trees are satisfied with the greater amount of green features nearby. What is interesting about our results is the lack of significant relationship between the presence of nearby green street corridors and two satisfaction and use measures, satisfaction with quality of public space and frequency of walking through the neighborhood to non-nature destinations. These results are not similar to previous findings regarding the strong relationship between availability of trees and neighborhood satisfaction (e.g., Kweon et al. 2010) or what Holtan and colleagues (2014) suggested in terms of increasing use of neighborhood common spaces and sidewalks by more tree plantings in sidewalk planting strips. A closer look at our results shows that more than 60 percent of the participants perceived to have *quite a bit* of green street corridors nearby, which may have contributed to these results. The insufficient variability in our data regarding the availability of green street corridors, calls for further research with respect to the nature of street corridors and their relationship with use patterns and satisfaction with the overall appearance of the neighborhood. As was the case with the proximity measures, participants seem to view the quantitative aspects (amount of greenness) quite distinctly form the quality of the spaces.

While there is reason to expect building-dominated spaces to be low in preference (Ellis, Lee, and Kweon 2006; Kaplan 2001; Kweon et al. 2010), this study cast a valuable light on the strength of the impact of such scenes with respect to neighborhood satisfaction and use. As the results demonstrate, nearby building-dominated spaces have a strong negative relationship with satisfaction with the quality of public space (e.g., overall appearance and amount of open space) and neighborhood comfort (e.g., sense of safety and peacefulness). They also contribute to lower satisfaction with the amount of affordances in the neighborhood, suggesting that having such spaces nearby makes people perceive that there are fewer opportunities to do different activities in the neighborhood. Given the strong association between neighborhood satisfaction and use, it is not surprising that nearby building-dominated spaces discourage participants from use of green and social spaces in the neighborhood. This can be also concluded from the earlier literature on

the effects of nearby nature settings on use patterns. Previous findings demonstrate that proximity to nature settings strengthens the likelihood of using outdoor spaces (e.g., Macintyre, Macdonald, and Ellaway 2008; Shackleton and Blair 2013). Thus, it is plausible to expect lower likelihood of outdoor space use due to proximity to building-dominated spaces instead of green spaces.

### Barriers to neighborhood use

Both factors comprising barriers to neighborhood use including safety concerns, low maintenance, unpleasant open spaces, lack of walkability and sense of community as well as transportation barriers such as traffic, distance and major roads are shown to have significant negative effects on satisfaction measures as well as the use measures at different levels except for the frequency of use of play fields and community gardening (Active Use) that was not predicted by barriers to neighborhood use. The regression model summary for barriers to neighborhood use (Table 3-12) shows that the largest percentage of variance accounts for satisfaction with Quality of Public Space and Neighborhood Comfort which refers to neighborhood safety and peacefulness ($R^2$=.21, .20 respectively, p<.001). These factors however, account for smaller amount of variance in terms of predicting satisfaction with the Amount of Affordances which refers to the potential activities offered by the neighborhood outdoor spaces to residents ($R^2$=.16).

*Varied Perceived Barriers:* This factor shows considerable negative effects on all four dimensions of participants' satisfaction with their neighborhood as well as their use patterns except for Active Use. The strongest effects of Varied Perceived Barriers (p<.001) are on Neighborhood Comfort (β=-.44), satisfaction with Amount of Affordances (β=-.35), and Quality of Public Space (β=-.33). Green/Social Space Use and satisfaction with the Amount of Green Features are however, less influenced by this factor (β=-.20, -.17 respectively, p<.001). Also this factor loosely predicts the frequency of Walking to Non-nature Destinations (β =-.11, p<.05).

*Transportation Barriers:* This factor has its strongest negative effect on satisfaction with the Quality of Public Space (β = -.20, p<.001), while it weakly predicts satisfaction with the Amount of Green Features (β =-.11, p<.05). The results show that Transportation Barriers are not an issue of significance with respect to neighborhood use patterns.

*Discussion*

In this study many aspects of accessibility to public open spaces were investigated including safety, low maintenance, and lack of a sense of community as well as physical barriers. It is not surprising to find that barriers to use have a negative effect on neighborhood satisfaction and use patterns. What is interesting to note is that transportation barriers were far less likely to influence neighborhood satisfaction and use compared to issues related to safety, low maintenance, and lack of a sense of community as well as physical impassability. When there are interesting, diverse, desirable, safe open spaces and accessible routes in the neighborhood, people are more encouraged to spend time outdoors (Kaplan and Kaplan 2003; Wright Wendel, Zarger, and Mihelcic 2012). Further, accessibility to public open spaces is associated with more frequent walking in the neighborhood (e.g., Giles-Corti et al. 2005; Humpel, Marshall, et al. 2004). In line with these findings, our results show that safety issues, unpleasant open spaces with low maintenance, lack of sense of community and physical barriers such as fences or lack of walkable sidewalks discourage the residents from using green and social spaces or walking in the neighborhood. By contrast, transportation barriers such as traffic, major roads and distance had no significant relationship with any neighborhood use factor or the degree of neighborhood comfort and satisfaction with the amount of affordances. While previous findings demonstrate that major roads negatively affect use of public spaces (Giles-Corti et al. 2005), our results show no significant effect of transportation barriers on any kind of use pattern. Our results also show no significant relationship between varied perceived barriers and the participants' likelihood of visiting neighborhood sports venues or community gardens. The reason for these contradicting results might be because of lack of sufficient variability in our results in terms of perceived barriers to neighborhood use. Our results show that about 70 percent of the participants perceive just *a little or no barriers* (such as safety, maintenance or walkability) to neighborhood use, and similarly more than 60 percent of the participants perceive *a little or no* transportation barriers in the neighborhood.

Table 3-12 First-step regression analysis summary – Testing the effects of the physical attributes of the environment on each measure of neighborhood satisfaction and use patterns

| | Variables | Neighborhood Satisfaction | | | | | | | | Use Patterns | | | | | |
| | | Amount of Affordances | | Amount of Green Features | | Quality of Public Space | | Neighborhood Comfort | | Green/Social Space Use | | Active Use | | Walk to Non-nature Destinations | |
| | | Beta | P | Beta | P | Beta | p | Beta | p | Beta | p | Beta | p | Beta | p |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Proximity of Nature to Home** | Nearby Green/Social Space | .51 | .001 | ns* | | .56 | .001 | .36 | .001 | .49 | .001 | ns | | .29 | .001 |
| | Amount of Nearby Green Features | ns | | .33 | .001 | .20 | .001 | .19 | .001 | .14 | .002 | ns | | .14 | .009 |
| | Nearby Active Recreation | ns | | ns | | ns | | -.15 | .005 | ns | | .33 | .001 | -.16 | .004 |
| | Model summary | $R^{2**}$ .32 | .001 | $R^2$ .10 | .001 | $R^2$ .44 | .001 | $R^2$ .16 | .001 | $R^2$ .35 | .001 | $R^2$ .12 | .001 | $R^2$ .09 | .001 |
| | | F 68.16 | | F 17.31 | | F 113.06 | | F 29.11 | | F 79.50 | | F 21.27 | | F 15.85 | |
| | Nature Window View | .21 | .001 | .31 | .001 | .31 | .001 | .24 | .001 | .24 | .001 | .21 | .000 | ns | |
| | Model summary | $R^2$ .04 | .001 | $R^2$ .10 | .001 | $R^2$ .09 | .001 | $R^2$ .06 | .001 | $R^2$ .06 | .001 | $R^2$ .04 | .001 | ns | |
| | | F 20.02 | | F 46.26 | | F 44.79 | | F 27.31 | | F 27.43 | | F 19.43 | | | |
| **Landscape Structure** | Garden Space | .14 | .015 | ns | | .17 | .001 | ns | | .28 | .001 | .38 | .001 | .17 | .004 |
| | Open Lawn w/ Trees | .28 | .001 | ns | | .40 | .001 | .18 | .002 | .37 | .001 | ns | | ns | |
| | Green Corridor | ns | | .24 | .001 | ns | | .15 | .008 | ns | | -.12 | .028 | ns | |
| | Building-dominated Space | -.20 | .001 | -.21 | .001 | -.30 | .001 | -.27 | .001 | -.16 | .001 | ns | | ns | |
| | Model summary | $R^2$ .19 | .001 | $R^2$ .07 | .001 | $R^2$ .38 | .001 | $R^2$ .13 | .001 | $R^2$ .36 | .001 | $R^2$ .13 | .001 | $R^2$ .06 | .001 |
| | | F 26.56 | | F 8.61 | | F 66.24 | | F 17.48 | | F 61.22 | | F 16.35 | | F 8.35 | |
| **Barriers to Use** | Varied Perceived Barriers | -.35 | .001 | -.17 | .001 | -.33 | .001 | -.44 | .001 | -.20 | .001 | ns | | -.11 | .047 |
| | Transportation Barriers | ns | | -.11 | .042 | -.20 | .001 | ns | | ns | | ns | | ns | |
| | Model summary | $R^2$ .16 | .001 | $R^2$ .06 | .001 | $R^2$ .21 | .001 | $R^2$ .20 | .001 | $R^2$ .06 | .001 | ns | | $R^2$ .02 | .010 |
| | | F 40.65 | | F 14.17 | | F 58.79 | | F 53.91 | | F 15.11 | | | | F 4.65 | |

*. Statistically non-significant
**. Adjusted $R^2$

### 3-3-4. Simultaneous effects of the physical aspects of the environment on neighborhood satisfaction and use patterns: second-step analysis

In order to determine relative relationships among the significant predictors of neighborhood satisfaction and use patterns, a second series of standard linear regression modeling was conducted (see Table 3-13). At this step, the regression analyses included all components of proximity, landscape structure and barriers found to be significant predictors of neighborhood satisfaction and use pattern in the initial step presented. We have thus seven regression models representing the simultaneous relationships of those significant predictors with each individual satisfaction and use measure. The blank areas in each column of the Table 3-13 show the independent variables that have been dropped from further analysis in the second-step due to showing non-significant associations in the first-step analysis. For example, when regressing satisfaction with the Amount of Affordances on independent variables, four latent variables were dropped including Amount of Nearby Green Features, Nearby Active Recreation, Nearby Green Corridor, and Transportation Barriers. In the first-step analysis presented in Table 3-12, all these four eliminated variables had shown to have no significant relationship with satisfaction with the Amount of Affordances.

Although initially some of the examined measure showed significant associations with the dependent variables (Table 3-12), this series of analyses show that these relationships may be changed by the inclusion of other predictors. For instance, while Nature Window View significantly related to both satisfaction with the Amount of Affordances ($\beta$ =.21) and Green/Social Space Use ($\beta$ =.24) in the first-step analysis (see Table 3-12), when considering relative effects of other predictors at the second-step analysis (see Table 3-13), it no longer shows any significant association with these two dependent variables. Despite these changes across all the analyses at this step, each of the independent variables remained as a significant predictor of one or more dependent variables.

Four out of the seven models accounted for a substantial amount of variance including three satisfaction measures and one use measure: satisfaction with Quality of Public Space ($R^2$ =0.56), Amount of Affordances ($R^2$ = 0.38), Neighborhood Comfort ($R^2$ = 0.31) and Green/Social Space Use ($R^2$ = 0.43). In the case of satisfaction measures all three categories of independent variables (proximity, landscape structure and barriers to neighborhood use) where included in the four

final models, but neither of the factors for barriers to neighborhood use remained in the three models for use patterns. The other 3 models, while significant (p<0.001) accounted for less variance and had adjusted $R^2$ values ranging from 0.20 to 0.10.

Comparison between the two model summaries presented in Table 3-12 and 3-13 generates several points worth discussing. With few exceptions, the three measures for walking-distance proximity to home showed very similar results in the two models. The exceptions are that the Amount of Nearby Green features was not a significant predictor of Neighborhood Comfort and Green/Social Space Use in the final model, and as would be expected, the estimated Betas are generally lower when more different predictors are included in the model. By contrast, the role of Nature Window View as a predictor of neighborhood satisfaction and use patterns was highly influenced by other model factors. While in the first-step analysis, as the sole predictor in the model, Nature Window View was significantly related to each of the dependent variables, in the final model it played only a small role in explaining satisfaction with the amount of green features and quality of public space and active use.

Of the perceived landscape structure measures only one – building-dominated space – was largely unaffected by the inclusion of additional variables in the model. Although at a lower strength, the presence of Building-dominated Space remained a significant negative predictor of all satisfaction measures as well as Green/Social Space Use. Each of the other perceived landscape structure measures that are based on green elements in the neighborhood played a significant role in fewer of the satisfaction measures when more factors were included in the models. Specifically, these measures do not show statistically significant role in predicting satisfaction with amount of affordances and neighborhood comfort. By contrast, none of the results with respect to use patterns changed in the second-step models. For example, the final model shows that Garden Space still plays a considerable role as a predictor of Active Use (β=.30) and Green/Social Space Use (β=.20), and Open Lawn with Trees predicts Green/Social Space Use with an estimated Beta of 0.20. The Beta coefficients for the same measures however, have a higher level of strength in the first-step analysis (β= .38, .28 and .37 respectively).

It should also be noted that Open Lawn with Trees is still a significant predictor of satisfaction with Quality of Public Space with an estimated Beta of 0.18 at this step (β=.40 in the

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first-step analysis). Green Corridor is a rather stronger negative predictor of Active Use as compared to the first model.

Although the Varied Perceived Barriers measure drops out as a significant predictor of use pattern measures, it plays a substantial role with respect to each of the satisfaction measures in the final model. By contrast, the Transportation Barriers measure only plays a role, albeit a small one, with respect to Quality of Public Space.

### *Discussion*

Both the initial models and the second-step models confirm the multifaceted roles that the natural environment plays with respect to neighborhood satisfaction and patterns of using the environment. It is useful to examine the specific effects of physical attributes of the environment on neighborhood satisfaction and use patterns separately. However, in order to better understand the mechanisms of environment-perception-behavior in outdoor spaces, it is also important to identify the interrelationships among perceived environmental attributes that collectively contribute to neighborhood satisfaction and use. Our findings in the second-step analysis highlight the most significant attributes of the environment that predict different dimensions of neighborhood satisfaction and use. In other words, the results highlight the most significant dimensions of satisfaction and use that may be affected by changes in the environmental attributes.

The results confirmed the significant role availability of green and social spaces plays in people's satisfaction with the amount of affordances, quality of public space and neighborhood comfort. The findings also demonstrated how greatly the proximity to green/social spaces is related to the frequency of use of such spaces and walking in the neighborhood either for pleasure or to purpose-based local destinations. For each of the four satisfaction measures the significant predictors in the second-step models were drawn from all three different independent variable constructs (perceived proximity, landscape structure, and barriers). In other words, neighborhood satisfaction is influenced by the perceived availability of green elements in the neighborhood, the kinds of environments that are within one's daily encounters, and the difficulties encountered in pursuing one's nearby activities. Surprisingly, the barriers did not predict any of the use pattern measures, but each of these was predicted by both perceived proximity and landscape structure.

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It is also noteworthy that for each of independent variable constructs there was one that played a particularly important role in predicting satisfactions and use patterns. For the perceived proximity grouping that variable is the availability of nearby green/social spaces, which had the highest betas in three of the second-step models. In terms of landscape structures, the persistent role played by building-dominated spaces is highlighted in these results. In the urban context such landscapes may be unavoidable, making it important to offset their negative impact. Similarly, barriers are bound to reduce satisfactions.

While some independent variables played stronger roles in predicting outcomes, it is equally important to note that each of the predictor variables contributed to our understanding of neighborhood satisfaction and use patterns. It is not only the availability of green spaces, but the perceived amount of green features that is part of the equation. For landscape structures, garden spaces, green corridors, and settings with open lawns and trees are all vital, especially in their impact on use patterns.

Table 3-13 Second-step regression analysis summary using all significant predictors from the first-step analysis

| | | Neighborhood Satisfaction | | | | | | | | Use Patterns | | | | | |
| | Variables | Amount of Affordances | | Amount of Green Features | | Quality of Public Space | | Neighborhood Comfort | | Green/Social Space Use | | Active Use | | Walk to Non-nature Destinations | |
| | | Beta | p | Beta | P | Beta | p | Beta | p | Beta | p | Beta | p | Beta | p |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Proximity of Nature to Home** | Nearby Green/Social Space | .43 | .001 | -- | | .32 | .001 | .20 | .002 | .27 | .001 | -- | | .22 | .001 |
| | Amount of Nearby Green Features | -- | | .18 | .001 | .11 | .011 | ns[*] | | ns | | -- | | .12 | .027 |
| | Nearby Active Recreation | -- | | --- | | -- | | -.14 | .007 | -- | | .23 | .001 | -.17 | .002 |
| | Nature Window View | ns | | .15 | .005 | .08 | .044 | .09 | .057 | ns | | .12 | .007 | -- | |
| **Landscape Structure** | Garden Space | ns | | -- | | .07 | .096 | -- | | .20 | .001 | .30 | .001 | .14 | .011 |
| | Open Lawn w/ Trees | ns | | -- | | .18 | .001 | ns | | .20 | .001 | -- | | -- | |
| | Green Corridor | -- | | .13 | .011 | -- | | ns | | -- | | -.15 | .002 | -- | |
| | Building-dominated Space | -.10 | .015 | -.12 | .017 | -.19 | .001 | -.16 | .001 | -.10 | .009 | -- | | -- | |
| **Barriers to Use** | Varied Perceived Barriers | -.22 | .001 | -.12 | .025 | -.18 | .001 | -.34 | .001 | ns | | -- | | ns | |
| | Transportation Barriers | -- | | ns | | -.08 | .030 | -- | | -- | | -- | | -- | |
| | Model summary | $R^{2**}$ .38 | .001 | $R^2$ .17 | .001 | $R^2$ .56 | .001 | $R^2$ .31 | .001 | $R^2$ .43 | .001 | $R^2$ .20 | .001 | $R^2$ .10 | .001 |
| | | F 43.76 | | F 15.43 | | F 68.21 | | F 24.38 | | F 46.57 | | F 27.07 | | F 10.96 | |

[*]. Statistically non-significant
[**]. Adjusted $R^2$

## 3-4. Implications and conclusions

This study tested the hypothesis that physical attributes of the environment affect various dimensions of neighborhood satisfaction and use patterns, with a particular emphasis on the nearby natural elements in the urban context. One of the strengths of this study is that it considers both satisfaction and use patterns in several respects. The results provide considerable support for the premise that nearby nature substantially affects neighborhood satisfaction and use of urban outdoor spaces in multiple ways.

There are yet many unanswered questions due to limitations of this study that should be mentioned. We had a younger and fairly well-educated sample population compared to Chicago population with a majority of them having no children, which makes the study area relatively different than other neighborhoods in Chicago and limits the possibility of generalizability of the findings. Also, it should be acknowledged that this study did not include demographic information about the participants in the analyses. Such measures may further refine the findings of the models presented in this study. Although the study area consists of various amounts and types of green spaces, there is insufficient variability in terms of availability of green street corridors and small-scale garden spaces. Therefore, the study is limited in permitting generalization with respect to the significance of street tree canopies in terms of their impact on different dimensions of satisfaction and use. Also, the majority of the study participants perceive that they have *quite a bit* or *very much* of green features in their walking distance proximity. This prevents us from further comparative analysis, and limits the ability to discern the impact of less green residential settings on neighborhood satisfaction and use patterns. Further, it is not clear what attributes of active recreation spaces have negative impact on neighborhood comfort and walking frequency to non-nature destinations, and whether these findings are affected by different age and demographic issues.

While these limitations and needs for further research are worth considering, this study offers a variety of contributions and extensions to the current literature. One of the advantages of this study in addition to the multi-dimensional investigation of satisfaction and use is the examination of the correlations between the four aspects of neighborhood satisfaction and the three types of neighborhood use. Our results show that there are significant correlations between many aspects of these measures, which question the reliability of previous studies in which

neighborhood satisfaction has been considered as a function of use without addressing the reverse direction. This work advances our understanding in environment-behavior studies by acknowledging the multi-dimensional nature of both neighborhood satisfaction and use, their interrelations, and the mechanisms through which different aspects of the environment impact each of these dimensions. Acknowledging this interrelation also provides more flexibility in terms possible ways of influencing the causal relationships between environmental factors and satisfaction and use. For example, some aspects of the environment may have stronger effects on satisfaction than on use (e.g., walking distance proximity to green and social spaces as shown in this study), which would ultimately affect the frequency of use due to interconnection between these measures. So we can seek ways to improve that aspect of satisfaction while being aware of the ultimate influence on both satisfaction and use. In some cases this may be true in a reverse direction, meaning that by improving some environmental factors that have stronger impacts on certain use patterns than on satisfaction (e.g., nearby garden space as shown in this study), we would be confident in predicting that satisfaction with one's neighborhood would be ultimately improved as well.

Another significance of this study is that it examined the effects of both immediate nearby nature (nature window view) and walking-distance nature (nearby nature in a five-minute walk from home) on key aspects of neighborhood satisfaction and use patterns. By nature view from the window we meant all types of green elements ranging from lawns and flowerbeds to shrubs and tree canopies that could be viewed from inside the residents' home. Walking-distance nature settings included numerous types of green spaces that could be experienced by the residents such as green boulevards, picnic areas, gathering and socializing areas as well as garden spaces and parks with large trees.

Further, unlike many previous studies, perceived landscape structure has been explored in terms of its effects on neighborhood satisfaction and use patterns through a participant-based typology resulting in four distinct types of landscape structure. Instead of objectively defining landscape structure categories in words, this study has used an empirical basis for grouping similarity through providing the participants with a variety of scenes depicting various types of landscape structure. This approach gives a stronger sense and a more reliable result in terms of the type of landscape structure the participants perceive to have in their walking distance

proximity. Additional investigations, however, are needed on more detailed landscape structure components and their effects on each dimension of neighborhood satisfaction and use pattern.

Investigating the effects of proximity of nature to homes, the structure of the nearby nature and barriers to use it in this study, provides an opportunity to reflect on possible ways to positively affect the associations between these physical aspects of the environment and neighborhood satisfaction and use patterns. The results highlight the substantial impact of nearby nature on satisfaction with quality of public space, satisfaction with the amount of affordances in the neighborhood and frequency of use of green and social spaces. While the presence of nearby nature is very important in this respect, this study emphasizes that the structure of the landscape greatly matters to the residents as well. Also it shows that perceived accessibility to such spaces is a major factor affecting the level of satisfaction and likelihood of use of nearby nature. Examining all these detailed relationships between physical attributes of the environment and the effects of each on various aspects of satisfaction and forms of use as presented in this work, can shed light on how physical environments could be changed in order to meet the users' preferences and needs in urban neighborhoods.

### *Design implications*

Considering the significant role green outdoor spaces play in satisfaction with life and wellbeing of urban residents (Fernandez and Kulik 1981; Kweon et al. 2010; Miller et al. 1980; Sullivan et al. 2014; Vemuri et al. 2011) through neighborhood satisfaction and use, it is worth investigating ways to improve the physical aspects of the environment to increase the level of neighborhood satisfaction among the residents and encourage them to spend time outdoors more frequently. Understanding the effects of the physical aspects of the environment on neighborhood satisfaction and use patterns from a psychological point of view, however, is a necessary but insufficient step for enabling the actual use of these settings. Therefore, empirical research must go beyond finding out the effects of environmental factors on people's perceptions and behavior, to extending the findings to practical implications that could make a difference in the real world. This section thus explores some research-practice connections based on the results of this study as well as the existing literature discussed earlier.

According to the findings presented in this study, the most important aspects planners and designers need to focus on appear to be satisfaction with quality of public space, amount of

affordances (possible opportunities for activities such as socializing, picnicking, and playing), and frequency of use of green and social spaces. Therefore, improving the environmental conditions to support these three aspects would be the first priority. As the second priority the focus should be placed on improvement of neighborhood comfort (peacefulness and safety) and the likelihood of residents' walking to purpose-based local destinations in the neighborhood (See Table 3-14). The detailed investigation of various dimensions of satisfaction and use with respect to environmental attributes in this study allows us to offer some simple, yet far-reaching planning and design considerations which would help improve outdoor residential spaces according to people's needs and preferences (See Table 3-14). While there is an overlap of what needs to be done to improve different aspects of satisfaction or form of use, there are also distinctive actions to be taken to improve each aspect.

The planning and design implications extracted from the survey results in this study represent a sample that can be considered as a step towards an translational design approach in landscape architecture and urban planning. It should be acknowledged that the implications addressed here are context-specific and based on the perception of the participants residing in a limited study area and should not be considered as a prescriptive set of planning and design guidelines to be used in other contexts. The emphasis of this study is on the significance and usefulness of this approach in terms of understanding the users' *needs and preferences* through investigating their neighborhood satisfaction and use patterns in all urban planning and design projects in residential neighborhoods. Another area of further research would be a comparison between objective proximity versus perceived proximity (being investigated in this work) to green spaces. A comparison between what is available in terms of green spaces and what is perceived to be available would shed light on planning and design priorities based on users' preferences and needs.

Table 3-14 Planning and design implications through survey analysis

| Planning/design recommendation | Detailed specifications | Immediate impact | Broader impact |
|---|---|---|---|
| Provide walking distance green space | Gathering areas, Picnic areas, Sitting areas | Improve socializing, encourage walking in the neighborhood both for pleasure and to purpose-based destinations | Satisfaction with quality of public space |
| | | | Satisfaction with neighborhood affordances |
| | | | Improve frequency of use of green/social spaces |
| | | | Improve frequency of walking in the neighborhood |
| | Open lawns with large trees | Provides destination, encourages walking | Satisfaction with quality of public space |
| | | | Improve frequency of use of green/social spaces |
| | Spaces away from active recreation areas such as sports fields | Improve feelings of peacefulness and safety | Neighborhood comfort |
| | | | Improve frequency of walking to non-nature destinations |
| | Small-scale garden spaces with seats nearby | Improve socializing, encourage involvement with nature | Improve frequency of use of green/social spaces |
| | | | Active use of space (gardening) |
| | | | Improve frequency of walking both for pleasure and to purpose-based destinations |
| Improve the amount of green features | Plant trees and shrubs wherever possible | alleviate the negative effects of building-dominated spaces | Satisfaction with quality of public space |
| | | | Neighborhood comfort |
| | | | Satisfaction with the amount of green features |
| | | | Satisfaction with the amount of affordances |
| | | | Improve frequency of use of green/social spaces |
| | Plant trees and shrubs along street corridors | Encourage walking | Satisfaction with the amount of green features |
| | | | Neighborhood comfort |
| Provide nature window view | Provide nature elements including tree canopies, shrubs and flowerbeds visible from residences | Increase awareness of neighborhood facilities and resources | Satisfaction with quality of public space |
| | | | Satisfaction with the amount of green features |
| | | | Improve frequency of use of green/social spaces |
| | | | Neighborhood comfort |
| Reduce barriers to use / improve accessibility | provide opportunities for socializing in the neighborhood | Improve sense of community, improve sense of safety, encourage walking | Neighborhood comfort |
| | Improve sidewalk walkability | | Satisfaction with the amount of affordances |
| | | | Satisfaction with quality of public space |
| | improve appearance of outdoor spaces/provide more pleasant spaces by providing more nature elements | | Improve frequency of use of green/social spaces |
| | improve maintenance | | Improve frequency of walking both for pleasure and to purpose-based destinations |
| | Accommodate pedestrian needs to cross major streets | | |

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# CHAPTER IV
# Direct and indirect effects of the physical aspects of the environment on mental wellbeing

*Abstract*

Research in environmental psychology and public health has yielded valuable findings demonstrating that urban nature settings promote mental wellbeing and life satisfaction. However, the mere presence of nature seems to be insufficient. Learning more about people's perception of the physical aspects of the environment and their possible direct and indirect effects on mental wellbeing will help planning and design professionals to make a difference in this respect.

This study focuses on four physical aspects of the environment relevant to planning and design. These include the positive effects of perceived proximity of home to green/social spaces and the landscape structure defined by open lawn with trees, and the negative effects of building-dominated spaces and perceived barriers to use of nearby outdoor spaces. Even when green spaces are in close proximity to residents' home, they may not have the expected impact on mental wellbeing if residents do not use them, or have low satisfaction with their neighborhood. This study thus examines the relationships between a) physical aspects of the environment and mental wellbeing, b) physical aspects of the environment and both neighborhood satisfaction and use, and c) mental wellbeing and both neighborhood satisfaction and use, and then investigates the mediating role of neighborhood satisfaction and frequency of use of outdoor spaces in the effects of the physical environment on mental wellbeing.

This study was conducted in a residential area in Chicago covering portions of four community areas. A random sample of 434 residents participated in a survey, in which they were asked questions based on a five-point rating scale about perceived proximity to different types of green spaces, quality of nearby green spaces, general neighborhood satisfaction, frequency of use

of outdoor spaces, the type of activities done in such spaces, barriers to use of nearby outdoor spaces and sense of mental wellbeing. The results of linear regression modeling and mediation analyses support the hypothesis that satisfaction with quality of public space and frequency of use of green/social spaces have significant mediating role in the relationship between the physical aspects of the environment and mental wellbeing.

Exploring the effects of perceived proximity of nature to people's home, landscape structure and barriers to use of neighborhood outdoor spaces on neighborhood satisfaction, neighborhood use patterns and mental wellbeing provided insights into useful place-based planning and design recommendations. This approach can be considered as a step towards translational design of public spaces which is highly significant in landscape architecture and related fields in terms of creating spaces that better meet people's needs and preferences and improve their sense of mental wellbeing.

## 4-1. Introduction

Effective functioning and sense of peacefulness are significant indicators of mental wellbeing for urban residents who are dealing with so many distractions and sources of stress in their daily life. There is a sizeable body of research showing that natural environments are the most restorative environments among different outdoor settings (Berman, Jonides, and Kaplan 2008). There is also a large body of research on the significance of *nearby* nature in terms of its positive effects on wellbeing (Hartig et al. 2011; Kaplan and Kaplan 1989; Kaplan 1995; Ward Thompson 2011). These studies show that being exposed to nature settings and use of such spaces positively affect the sense of wellbeing. Further, it has been well documented that the physical attributes of the environment affect the level of satisfaction with the neighborhood and mental wellbeing (e.g., Hur and Nasar 2014; Hur, Nasar, and Chun 2010; Kaplan 2001; Kweon et al. 2010; Lee et al. 2008; Peschardt and Stigsdotter 2013; Scopelliti and Giuliani 2004). Despite the significant role of natural environments in restoring people's effective functioning and sense of peacefulness, the opportunity to have daily contact with natural environments in crowded and densely populated cities is generally rare. This highlights the importance of

considering all possible types and sizes of urban open space for their potential as restorative environments rather than focusing merely on urban parks.

Although a growing body of research over the past few decades confirms the significant effects of the physical design of urban landscapes on the well-being of residents and their behavior in outdoor settings (Matsuoka and Kaplan 2008), less attention in practice has been paid by planners and designers to the health problems arising from cityscapes that fail to support people's needs or restore their mental wellbeing. Part of this problem may be due to insufficient evidence-based planning/design guidelines to help the professionals implement this valuable body of knowledge. In fact, merely knowing that the physical aspects of the environment can influence mental wellbeing cannot be practically helpful because it does not provide specific planning/design solutions for decision-makers. In order to find pragmatic solutions to planning and design of public outdoor spaces, detailed investigation of these physical attributes and the mechanisms through which each of them affects mental wellbeing is required. This study aims to investigate the effects of planning/design-related aspects of the environment on mental wellbeing in order to find applicable planning and design solutions to improve urban residents' mental wellbeing. More specifically, this study focuses on four attributes of the environment and uncovers some associations between the perceived physical attributes of the environment and mental wellbeing that are more tangible from a planning/design viewpoint.

### 4-1-1. The effects of outdoor environment, neighborhood satisfaction and use

*Nearby nature:* Views of nature and use of green environments have been found to be related to stress reduction (Grahn and Stigsdotter 2003; Ulrich 1986; Ulrich et al. 1991), stronger feelings of peacefulness, less distraction and more neighborhood satisfaction (Berman, Jonides, and Kaplan 2008; de Jong et al. 2012; Hartig and Staats 2006; Kaplan 2001; Kaplan 1995; Lee et al. 2008), and increased likelihood of social interaction and physical activities (Maas et al. 2009; Sugiyama et al. 2008). Previous research has also revealed that the nature settings that enhance social interactions help nurture a sense of community that is critical to mental wellbeing (Matsuoka and Kaplan 2008; Sarason 1974). Availability of nearby trees, well-landscaped grounds and places for taking a walk significantly contribute to neighborhood satisfaction as well (Ellis, Lee, and Kweon 2006; Kaplan 2001). Further, the perception of proximity to green spaces has shown to be beneficial to neighborhood satisfaction (Crow, Brown, and De Young 2006;

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Kaplan and Austin 2004; Sugiyama, Thompson, and Alves 2009; Ward Thompson and Aspinall 2011). It also improves the frequency of use of outdoor spaces (Grahn and Stigsdotter 2003; Macintyre, Macdonald, and Ellaway 2008; Shackleton and Blair 2013; Wright Wendel, Zarger, and Mihelcic 2012) and the likelihood of walking by residents in the neighborhood (Ball et al. 2001; Humpel et al. 2004; Owen et al. 2004).

Despite the well-documented significance of nearby nature settings, it is still not clear how different kinds of outdoor green spaces and different types of landscape structure affect mental wellbeing. Further in-depth research on green and social spaces, perceived landscape structure and the mechanisms of the associations between these factors are needed in order to help planners and designers find practical solutions. This study examines the role of perceived proximity to green/social spaces, and the significance of nearby open lawn with trees as a specific type of perceived landscape structure, in terms of their effects on mental wellbeing.

As opposed to nature settings, the built elements of the urban environments (e.g., Berman, Jonides, and Kaplan 2008; Kaplan 1995; Peschardt and Stigsdotter 2013) and lack of perceived accessibility in the neighborhoods (e.g., Hur and Nasar 2014; Kaplan 1985; Ward Thompson and Aspinall 2011) have been shown to diminish the sense of mental wellbeing among urban residents. This study examines *building-dominated space* as a specific type of landscape structure common in many urban residential neighborhoods and investigates the mechanism of their impact on wellbeing.

*Buildings:* While tree canopies have been shown to be positive factors (Holtan, Dieterlen, and Sullivan 2014; Kaplan 2001), structure-dominated spaces have a negative influence on neighborhood satisfaction (Ellis, Lee, and Kweon 2006; Kaplan 2001; Kweon et al. 2010). The potential for restorativeness is also different depending on the amount of nearby built structures versus nature elements (Peschardt and Stigsdotter 2013; Scopelliti and Giuliani 2004). Current literature has revealed that more natural views result in better sense of effective functioning in daily life activities, as compared to built views (Kaplan 1995). Therefore, it is plausible to consider the dominance of the built structures as one of the important negative factors of the environment, and investigate the mechanisms through which it affects mental wellbeing. This study examines building-dominated spaces as a specific type of landscape structure common in many urban residential neighborhoods and investigates the mechanism of its impacts.

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*Barriers:* Research findings have demonstrated that better accessibility to safe public open spaces is associated with more frequent walking in the neighborhood and encourages the residents to spend more time outdoors (Giles-Corti et al. 2005; Humpel et al. 2004; Kaplan and Kaplan 2003). By contrast, as previously documented, unattractiveness/unpleasantness (e.g., Giles-Corti et al. 2005; Parkes, Kearns, and Atkinson 2002), long distances (e.g., Giles-Corti et al. 2005; Wright Wendel, Zarger, and Mihelcic 2012), low maintenance (Hur and Nasar 2014; Kaplan 1985) and safety issues (Cook 1988; Lee 1981; Ward Thompson and Aspinall 2011) contribute to lower level of neighborhood satisfaction and discourage the residents from use of outdoor spaces. Safety concerns specifically, are associated with less frequent use of outdoor spaces (Ward Thompson and Aspinall 2011). Further, it has been shown that poorly maintained nature settings may increase fear of crime (Nasar and Jones 1997) and thus decrease overall neighborhood satisfaction (Hur, Nasar, and Chun 2010). All of these negative factors that contribute to lack of perceived accessibility are considered as barriers to neighborhood use in this study. Research has revealed that lack of sense of community due to inaccessible green open spaces negatively influence mental wellbeing (Riger and Lavrakas 1981). Given the multi-dimensional nature of these barriers, further research is needed to learn more about the detailed mechanisms through which planners and designers can mitigate the negative effects of these barriers on neighborhood satisfaction, frequency of use and mental wellbeing.

*Neighborhood satisfaction and use:* In addition to the role played by the perceived physical aspects of the environment in affecting mental wellbeing, a growing body of research has revealed the associations between neighborhood satisfaction and use and mental wellbeing (e.g., Grahn and Stigsdotter 2003; Kaplan and Kaplan 1989; Ward Thompson and Aspinall 2011). The studies on human-environment relationships suggest that people's perception is central to their functioning in the environment (e.g., Kaplan and Kaplan 1982; Lee et al. 2008). According to their perception, people can rapidly assess whether an environment is likely to be supportive of their needs (Kaplan and Kaplan 1982; Kaplan and Kaplan 1989). Satisfaction with the environment thus is based on people's perception of the environment, their preference and the extent to which the environment affords to meet the variety of people's needs.

Identifying residents' perception of the physical attributes of the environment and their preferences and needs can significantly contribute to our understanding of how the physical

aspects of the environment affect mental wellbeing. Nordh et al. (2009) have also reported that preferences for small green spaces may serve well as indicators of restorative quality of such spaces. Therefore, in addition to the four perceived attributes of the environment, we investigate the role of neighborhood satisfaction and frequency of use of green/social spaces on wellbeing as well.

Given the significance of neighborhood satisfaction and its multidimensional nature (Hur, Nasar, and Chun 2010) it is plausible to investigate each dimension separately and in depth to find out how it is affected by the environment and how it influences wellbeing. This study focuses on *satisfaction with the quality of public space* as one of the important dimensions of neighborhood satisfaction.

### 4-1-2. Research constructs:

Previous research has considered: a) the effects of the environment on mental wellbeing, b) the effects of neighborhood satisfaction and use on mental wellbeing and c) the effects of the environment on neighborhood satisfaction and use. In light of these studies, it is plausible to hypothesize that the effects of the physical aspects of the environment on mental wellbeing are mediated by neighborhood satisfaction and use. This study thus aims to answer the following questions (See Figure 4-1):

- How are perceived physical attributes of the environment associated with the sense of mental wellbeing?

More specifically, we examine the association of perceived proximity to green/social spaces, open lawn with trees and building-dominated spaces as well as perceived barriers to neighborhood use and mental wellbeing.

- To what extent is the association between each of the physical attributes of the environment and mental wellbeing mediated by satisfaction with quality of public space and frequency of use of green/social spaces?

The choice of research constructs and measures is strongly guided by environmental concerns that are in the purview of planning and design professionals. The focus on satisfaction with the quality of public space and use of green/social spaces specifically targets dimensions of

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the physical environment. Insights about the possible mediating role of these neighborhood satisfactions and use patterns can open doors to more tangible ways of improving mental wellbeing through planning and design by understanding what people need and care about with respect to nearby outdoor spaces. The findings then can lead to evidence-based planning and design implications that can be considered in practice. This research thus contributes to both the literature and the planning/design-related professions as a step towards *translational design of public spaces*.
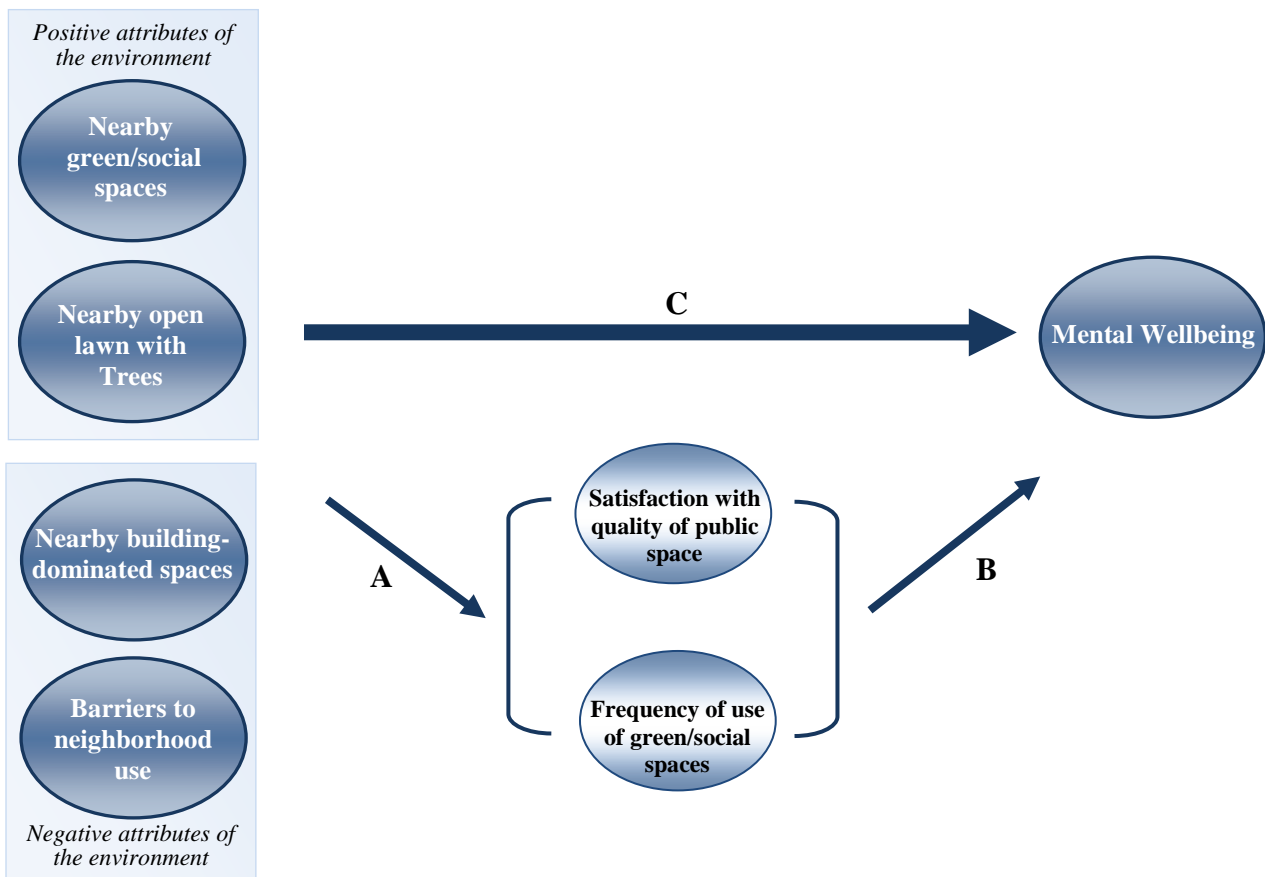
Fig.4-1 Research constructs

## 4-2.  Methods and data analysis

### 4-2-1.  Study area

The study area covers 3400 acres of a moderately dense residential area in Chicago, IL that includes portions of four community areas; Logan Square, Avondale, Humboldt Park and West Town (See Figure 4-2). Choice of this area was based initially on analysis of citywide GIS modeling considering criteria comprising median income[1], housing stock type[2], crime rate, and green spaces[3]. The precise study area boundary was then selected through ground-truthing. The study area is characterized by majority of multifamily houses, and residents with median incomes between $25000 and $75000. It includes a variety of public green spaces (large park, small parks, green boulevards, and very small community gardens), with the amount of these spaces ranging from very little green (in Avondale) to a substantial amount (in Logan Square), providing the opportunity for comparative investigations.
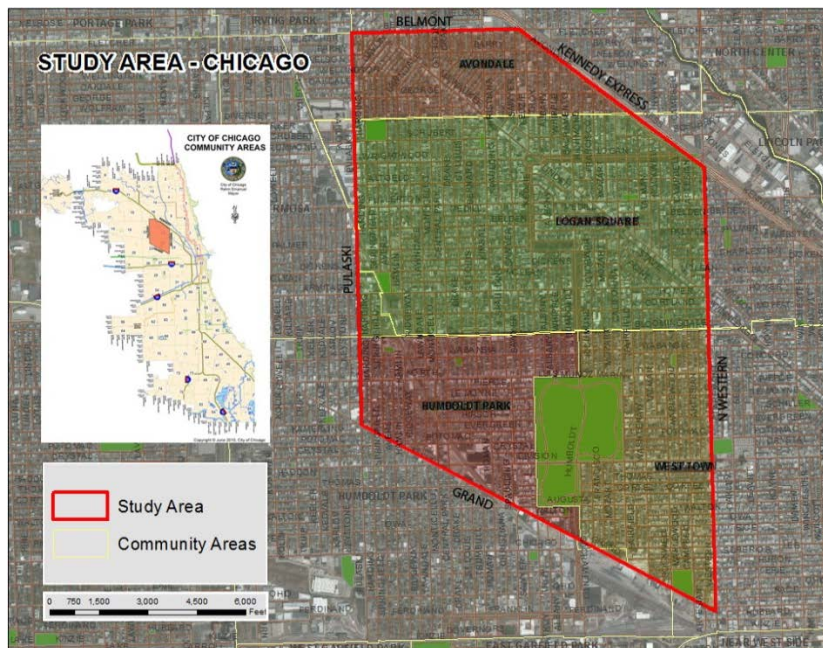


Fig. 4-2 Study site including community areas

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[1] Census data: http://www.socialexplorer.com/tables/ACS2009_5yr/R10591609; Census tract boundaries: http://www.census.gov/geo/www/tiger/

[2] Source: Landuse inventory 2005; http://www.cmap.illinois.gov/land-use-inventory

[3] https://data.cityofchicago.org/browse?tags=gis

### 4-2-2. Research instrument

A survey with a five-point rating scale was used for assessing a number of variables including perceived proximity to green, nearby landscape structure, barriers to use of outdoor spaces, neighborhood satisfaction, use pattern and sense of mental wellbeing. Demographic information was also collected. The six-page questionnaire was color printed in a letter-size booklet format which included two pages of landscape scenes taken in the study area. A web link to the survey was enclosed in the cover letter for those who preferred to participate online.

*Environment-related variables:* Perceived *proximity* was determined through questions about the likelihood of seeing different types of green/non-green features and spaces both in view from windows and within a 5-minute walk from home. Also 20 photographs representing a variety of available *landscape structures* were included in the survey, and the participants were asked about the similarity of the pictured content to what they see nearby. *Perceived accessibility* of public outdoor spaces was tapped through questions about what discourages the participants from pursuing activities in their neighborhood (Barriers to neighborhood use).

*People-related variables: Neighborhood satisfaction* was determined through questions about the participants' satisfaction with the quality of neighborhood outdoor spaces and the amount of green features and social spaces. Use pattern was examined through questions about the frequency of use of different types of outdoor spaces, and the possible types of outdoor activities. Mental wellbeing items in the survey mainly focused on peacefulness and effectiveness, including questions adapted from three different scales; the Attentional Functioning Index (AFI-13 items) (Cimprich, Visovatti, and Ronis 2011), Positive and Negative Affect Scale (PANAS- 15 items) (Watson, Clark, and Tellegen 1988), and Social Connectedness Scale (SCS- 3 items) (Lee and Robbins 1995).

### 4-2-3. Characteristics of the sample population

The first phase of data collection was conducted through a mail survey. A stratified random sample was drawn based on two categories of proximity of the multi-family houses to large green spaces: within one block and at least four blocks. To select the random sample of 1250 housing units from each category the target population (total of 5309 eligible households) was stratified by nine-digit zip codes. From a randomly selected starting point, addresses were

selected using the mathematically determined interval—the total eligible households (5309) divided by sample size (2500). An initial invitation postcard was sent by the end of July 2013 to the sample indicating that a survey would be coming, followed by the survey a week later. The response rate of the mail survey was very low, 4.9%, (111 mail returns plus 12 online responses).

The second phase of data collection was on-site. Between August 24 and September 30, 2013, the researcher approached individuals in the study area during various summer events such as farmers' market, music festivals, kids' activity tents, and community gatherings, as well as in outdoor spaces of a few coffee shops in the study area. When individuals showed interest in filling out the survey, they were asked to find their home on a simple sketched map to make sure that they were residents of the study area. Two neighborhood organizations, Avondale Neighborhood Association (ANA) and Logan Square Neighborhood Association (LSNA), also agreed to share the online survey link with their members via email. In this phase, the total number of participants who lived in the study area was 311 (264 on-site survey plus 47 online survey participants). The total number of participants was 468, but 34 could not be used due to either incompleteness or being outside of the study area. Therefore, the total sample size used in this study is 434.

Demographic information collected through the survey is shown in Table 4-1. In relevant cases demographic data from U.S. Census Bureau for Chicago city (2012) is also shown to allow comparison with the sample data. The study sample is younger and more educated than the Chicago population. Responses to survey items about the participants' daily commuting habits and familiarity with their neighborhood also indicate the sample does not reflect the general population in a number of respects. As shown in Table 4-1, more than half of the sample uses public transportation (bus or train) to get to work which is twice the percentage of people who do the same in Chicago, and about three times as many walk to work than is the case for the Chicago population. It is also worth noting that nearly 60 percent of the sample population has lived in the neighborhood for more than three years, meaning that the majority of the participants are quite familiar with the neighborhood.

Table 4-1 Sample characteristics

| | Study sample (%) | Chicago city in 2012(%)[*] |
|---|---|---|
| **Gender** | | |
| Female | 59.6 | 52.4 (Population 25 years old and |
| Male | 40.4 | over) |
| | | 47.6 |
| **Marital status** | | |
| Married or with partner | 52.5 | 34.3 |
| single | 46.3 | 65.6 |
| **Children** | | |
| No | 71.7 | |
| Yes | 27.2 | |
| **Education level** | | |
| Less than high school | .9 | 18.0 |
| High school | 2.1 | 25.0 |
| Technical degree | 1.6 | 5.2 |
| Some college | 13.1 | 18.2 |
| College degree | 45.6 | 20.3 |
| Post-graduate degree | 35.9 | 13.3 |
| **Work status** | | |
| Work full-time | 69.1 | |
| Work part-time | 15.0 | |
| Student | 10.8 | |
| Homemaker | 7.8 | |
| Retired | 3.9 | |
| Volunteer work | 4.4 | |
| **Total household income ($)** | | |
| <25,000 | 15.2 | 29.9 |
| 25,000-34,999 | 8.6 | 10.5 |
| 35,000-49,999 | 15.5 | 13.0 |
| 50,000-74,999 | 19.5 | 16.2 |
| 75,000-100,000 | 16.7 | 10.4 |
| 100,000+ | 24.5 | 19.9 |
| **Amount of time to get to work/school (Minutes)** | | |
| <15 | 10 | |
| 15-30 | 40 | |
| 30-45 | 20 | |
| 45+ | 15 | |
| N/A | 15 | |
| **How to get to work/school** | | |
| Walk | 15.4 | 6.6 |
| Car | 39.6 | 59.3 |
| Bus | 18.0 | 26.8 (Bus+Train) |
| Train | 36.2 | |
| Bike | 22.6 | 2.9 (Bike&other means) |
| N/A | 11.8 | |
| **Amount of time living in the neighborhood (Years)** | | |
| <1 | 13.6 | |
| 1-2 | 17.3 | |
| 3-5 | 27.0 | |
| 6-10 | 21.4 | |
| 10+ | 9.9 | |

[*] Source: http://factfinder2.census.gov/faces/nav/jsf/pages/download_center.xhtml

### 4-2-4. Data analysis: Defining variables

All statistical analyses in this study were conducted using SPSS version 22. First, Exploratory Factor Analysis (EFA) was used to determine the latent variables according to the participants' answers related to proximity, landscape structure, barriers to neighborhood use, neighborhood satisfaction and use patterns. Principal Components, with Varimax rotation and a maximum of 25 iterations for convergence, was followed for each of the constructs. Only the loadings with absolute values greater than 0.50, were included in the analysis. The larger double loader was selected if it was at least 0.05 greater than the alternative; otherwise the item was eliminated from the final solution. Factor means were then calculated and saved as latent variables. To test for reliability, Cronbach's Alpha was calculated for each factor and only factors with Alpha coefficients greater than .73 were retained. The reliability test was performed for the mental wellbeing construct as well. Table 4-2 shows all factors with Alpha coefficients, means and standard deviations.

Table 4-2 Environment/people-related measures

| Survey Constructs | | Latent Variable | Cronbach's Alpha | Mean[*] | Standard Deviation |
|---|---|---|---|---|---|
| Environment-related factors | Proximity to home | Nearby Green/Social Spaces | 0.91 | 3.87 | 1.20 |
| | | Amount of Nearby Green features | 0.80 | 4.05 | 0.85 |
| | | Nearby Active Recreation | 0.84 | 3.39 | 1.29 |
| | | Nature Window View | 0.78 | 3.64 | 1.06 |
| | Nearby landscape structure (Photo questionnaire) | Nearby Garden Space | 0.87 | 2.54 | 1.13 |
| | | Nearby Open Lawn with Trees | 0.87 | 3.59 | 1.17 |
| | | Nearby Green Corridor | 0.77 | 3.91 | 0.78 |
| | | Nearby Building-dominated Space | 0.74 | 12.2 | 0.98 |
| | Barriers to use | Varied Perceived Barriers | 0.85 | 2.09 | 0.86 |
| | | Transportation Barriers | 0.81 | 2.34 | 1.10 |
| People-related factors | Neighborhood satisfaction | Satisfaction with Amount of Affordances | 0.84 | 3.33 | 1.21 |
| | | Satisfaction with Amount of Green Features | 0.77 | 3.75 | 1.09 |
| | | Satisfaction with Quality of Public Space | 0.88 | 3.20 | 1.03 |
| | | Neighborhood Comfort | 0.76 | 3.51 | 0.86 |
| | Use patterns | Use of Green/Social Spaces | 0.91 | 3.08 | 0.98 |
| | | Active Use | 0.76 | 1.87 | 0.94 |
| | | Walk to Non-nature Destinations | 0.76 | 3.92 | 0.87 |
| | Mental wellbeing | - | 0.94 | 3.72 | 0.58 |

[*]. The 5-point scale ranged from '1=not at all/never' to '5=very much/very often'

The associations between all of these measures, except for Mental Wellbeing, have been explored in detail in the previous chapter. For this study a subset of latent variables was selected that is most relevant in terms of landscape planning and design implications (See Appendix A for detailed information about the selection of variables). With one exception a single latent variable was selected for each of the constructs (highlighted in Table 4-2): Proximity to Green/Social Spaces, Open Lawn with Trees, Varied Perceived Barriers to Neighborhood Use, Satisfaction with Quality of Public Space and Use of Green/Social Spaces. A second landscape structure measure, Building-dominated Space, was also added to the model in order to assess the extent to which its impact is significant in terms of planning/design implications. Thus the model for this study encompasses four independent variables, two mediating variables and one outcome variable as described below.

### *Independent Variables: Perceived physical aspects of the environment*

The four independent variables investigated in this chapter include Proximity to Green/social Spaces, Nearby Open Lawn with Trees, Nearby Building-dominated Spaces and Varied Perceived Barriers to Neighborhood Use. Table 4-3 shows the survey questions and items clustered through factor analysis to define each of these latent variables.

Table 4-3 Independent variables as hypothesized predictors of mental wellbeing[*]

| **Proximity to Green/Social Spaces** | |
| --- | --- |
| How likely are you to see each of the following within a 5-minute walk from your home? | Boulevard<br>Park-like square<br>Park with large trees<br>Outdoor gathering/picnic area |
| How much do you have each of these within a 5-minute walk from your home? | Sitting areas<br>Outdoor gathering areas |

**Open Lawn with Trees**

| How similar is each scene to what you see while walking near your home (no more than five minutes away)? |  |
| --- | --- |

**Building-dominated Spaces**

| How similar is each scene to what you see while walking near your home (no more than five minutes away)? |  |
| --- | --- |

**Barriers to neighborhood use**

| How much do each of these discourage you from pursuing activities in your neighborhood? | Safety concerns<br>Unpleasant open spaces<br>Low maintenance<br>Fences<br>Lack of information about availability<br>Lack of walkable sidewalks<br>Lack of sense of community |
| --- | --- |

[*]scale: 1= not at all, 2= a little, 3= somewhat, 4= quite a bit, 5= very much

## Outcome variable: Mental Wellbeing

To test for reliability of this variable Cronbach's Alpha was calculated for the 31 items addressing mental wellbeing (Alpha=.938). Table 4-4 shows the survey questions addressing this outcome variable.

Table 4-4 Survey questions addressing Mental Wellbeing

| How well have you been doing in the following areas over the last few weeks? | |
|---|---|
| Getting started on activities (tasks, jobs) you intend to do | 1 = not at all well |
| Following through on your plans | 2 = a little |
| Doing things that take time and effort | 3 = somewhat |
| Making your mind up about things | 4 = quite a bit |
| Keeping your mind on what you are doing | 5 = very well |
| Remembering to do all the things you started out to do | |
| Keeping your mind on what others are saying | |
| Keeping yourself from saying or doing things you did not want to say or do | |
| Being patient with others | |
| **During the last few weeks, how often have you:** | |
| Found it hard to concentrate on details | 1 = never or rarely |
| Felt isolated from others | 2 = a little |
| Made mistakes on what you were doing | 3 = occasionally |
| Felt in tune with the world | 4 = often |
| Gotten annoyed or irritated easily | 5 = very often |
| Felt connected to the people around you | |
| Forgot to do important things | |
| **Considering the last few weeks, how would you rate yourself on each of these:** | |
| Alert                Forgetful | |
| Hassled              Irritable | |
| Effective            Lonely | |
| Positive             Peaceful | |
| Calm                 Patient | |
| Attentive            Relaxed | |
| Disorganized         Competent | |
| Focused | |

## Mediating variables: Neighborhood Satisfaction and Use

Satisfaction with Quality of Public Space and frequency of Use of Green/Social Spaces are the two latent variables considered as mediators in this study. Table 4-5 shows the survey questions and items clustered through factor analysis to define these factors.

Table 4-5 Mediating variables: Neighborhood satisfaction and use

| **Satisfaction with Quality of Public Space** | |
| --- | --- |
| How satisfied are you with your nearby neighborhood in terms of these?<br><br>1 = not at all satisfied<br>2 = a little<br>3 = somewhat<br>4 = quite a bit<br>5 = very satisfied | Overall appearance<br>Amount of open space<br>Variety of the green spaces<br>Opportunities for outdoor community/ friends gathering |
| **Use of Green/Social Spaces** | |
| How often do you visit/use each of the following in your neighborhood? | Park-like square<br>Park with large trees<br>Outdoor gathering/picnic areas<br>Boulevard seating areas |
| How often do you walk within your neighborhood? | For pleasure<br>To visit a green space |
| How often do you do each of these in your neighborhood?<br><br>1 = never or rarely<br>2 = a little<br>3 = occasionally<br>4 = often<br>5 = very often | Outdoor sitting and watching<br>Outdoor community/friends gathering<br>Picnicking<br>Resting on the lawn |

## 4-2-5.  Data analysis: Steps for hypothesis testing

After defining distinct variables for this study, Pearson correlations were used to examine the associations between latent variables and the outcome variable. Then multiple steps were taken to test the hypothesis concerning the mediating role of neighborhood satisfaction and frequency of use in the relationship between the perceived physical attributes of the environment and sense of mental wellbeing. For each independent variable, the following steps were taken (See Figure 4-3):

a. Standard Linear Regression modeling to examine the significance of the relationships between

- *Step1.* each independent variable and the outcome variable (C Path, Total effect).
- *Step2.* independent and mediating variables (A Path)
- *Step3.* mediators and the outcome variable (B Path)

b. Mediation Analysis (*Step4*) to examine the role of mediators in terms of the indirect effect of each independent variable on the outcome variable (AB path and C' path). Mediation was

assessed using Preacher and Hayes (2008) Indirect Mediation macro for SPSS, which bootstraps the indirect effect of a predictor variable on an outcome variable through one or more mediating variables.
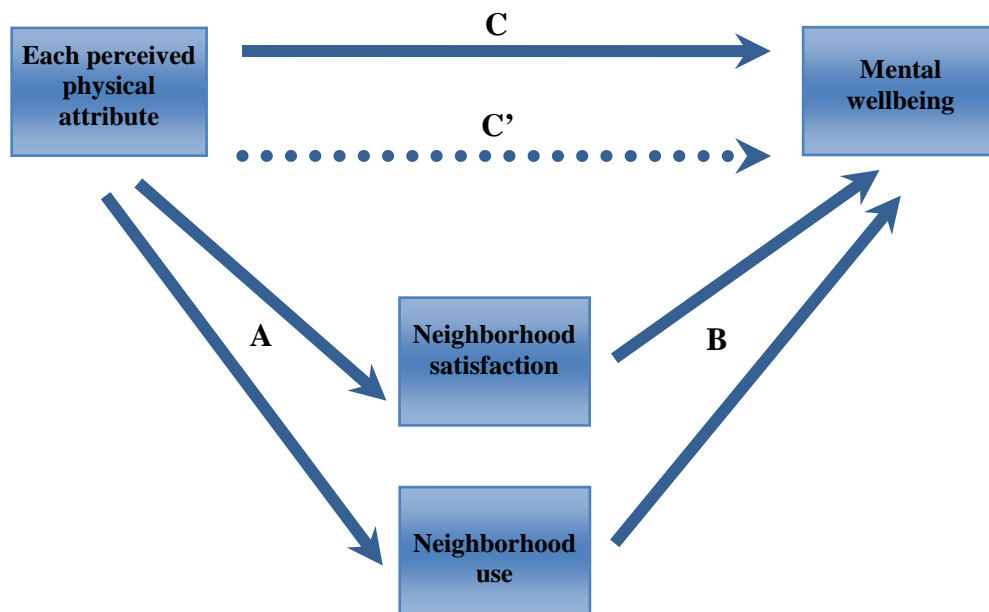


Fig. 4-3 Multiple analyses steps for each independent variable. C path-Total effect; C' path-Direct effect when controlling for mediators; AB path- Indirect effect of independent variable on the outcome variable through mediators

## 4-3.  Results

### 4-3-1.  Associations between environment-related and people-related variables

As shown in Table 4-6 all but one of the first-order correlations among the variables in the model are significant, including those between each of the four physical aspects of the environment and mental wellbeing. The correlations of the two mediating variables and wellbeing are also significant. As would be expected, the Barriers and Building-dominated variables are negatively correlated with the other variables and positively related to each other. The significant associations between Mental Wellbeing and the rest of factors (the four physical

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factors of the environment, neighborhood satisfaction and use) in addition to strong correlation between the four physical factors and mediators are basis for further analyses in this study.

Table 4-6 Correlation analysis

| | Proximity to Green/Social Spaces | Nearby Open Lawn with Trees | Building-dominated Spaces | Varied Perceived Barriers | Satisfaction w/ Quality of Public Space | Frequency of Use of Green/Social Spaces | Mental Wellbeing |
|---|---|---|---|---|---|---|---|
| Proximity to Green/Social Spaces | 1 | | | | | | |
| Nearby Open Lawn with Trees | .664** | 1 | | | | | |
| Building-dominated Spaces | -.124** | -- | 1 | | | | |
| Varied Perceived Barriers | -.331** | -.219** | .115* | 1 | | | |
| Satisfaction w/ Quality of Public Space | .642** | .544** | -.274** | -.429** | 1 | | |
| Frequency of Use of Green/Social Spaces | .580** | .551** | -.139** | -.246** | .633** | 1 | |
| Mental Wellbeing | .158** | .165** | -.110* | -.181** | .235** | .219** | 1 |

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

### 4-3-2. The effects of perceived physical attributes of the environment on neighborhood satisfaction and use measures

The satisfaction and use variables were separately regressed on the four perceived environment-related factors to examine the extent to which each of the physical aspects of the environment influences the participants' level of satisfaction with the quality of public space and frequency of use of green/social spaces (A path in Figure4-3). Variance Inflation Factor (VIF) was assessed for each regression model and assured that multicollinearity was not an issue. The model summary presented in Table 4-7 shows a substantial effect on the satisfaction measure

accounting for 53 percent of the variance (p<0.001). In terms of the effects of these physical factors on frequency of Use of Green/Social Spaces, the model summary shows a smaller yet significant effect accounting for 39 percent of the variance (p<0.001). In general, the perceived physical factors are stronger predictors of the neighborhood satisfaction measure rather than the use measure, except for the landscape structure measure, Nearby Open Lawn with Trees, which has a stronger effect on Frequency of Use of Green/Social Spaces.

Among the four perceived physical attributes, Proximity to Green/Social Spaces is by far the strongest predictor of Satisfaction with Quality of Public Space and Use of Green/Social Spaces with Beta coefficients of 0.40 and 0.35 respectively (p <0.001). The other three independent variables have relatively similar strength in terms of predicting the satisfaction measure (Beta coefficients ranging from 0.19 to 0.23 with two of them having negative effects). As opposed to the positive factors, the negative factors of the environment play a strong significant role only with respect to the satisfaction measure.

Table 4-7 Effects of the selected physical aspects of the environment on neighborhood satisfaction and use of outdoor spaces

| | Perceived physical factors | Satisfaction with Quality of Public Space | | Frequency of Use of Green/Social Spaces | |
|---|---|---|---|---|---|
| | | Beta | P-value | Beta | P-value |
| Positive Factors | Proximity to Green/Social Spaces | .40 | .000 | .35 | .000 |
| | Nearby Open lawn with Trees | .22 | .000 | .30 | .000 |
| Negative Factors | Building-dominated Spaces | -.19 | .000 | -.08 | .044 |
| | Barriers to Neighborhood Use | -.23 | .000 | ns[*] | |
| | **Model Summary** | $R^2$ .53   P .000   F 120.89 | | $R^2$ .39   P .000   F 69.10 | |

[*]. Statistically not significant

### 4-3-3.   The effects of neighborhood satisfaction and use of outdoor spaces on wellbeing

Mental Wellbeing was regressed on both Satisfaction with Quality of Public Space and Use of Green/Social Spaces as its potential predictors (B path in Figure 4-3). The standard linear

regression modeling results presented in Table 4-8 show that the neighborhood satisfaction measure has a relatively stronger effect (Beta= 0.16, P<0.01) on Mental Wellbeing as compared to the use measure with Beta coefficient of 0.12, which was marginally significant.

Table 4-8 Effects of the selected physical aspects of the environment on neighborhood satisfaction and use of outdoor spaces

| Outcome variable | Predictor variable | Beta | P-value |
|---|---|---|---|
| Mental Wellbeing | Satisfaction with Quality of Public Space | .16 | .008 |
| | Frequency of Use of Green/Social Spaces | .12 | .054 |
| Model Summary | $R^2$  .06        F  14.525 | | P  .000 |

### 4-3-4. The mediating role of satisfaction w/ quality of public space and use of green/social spaces

In this section the total, direct and indirect effects of each of the four perceived physical attributes of the environment on mental wellbeing are investigated to find out the possible mediating role of neighborhood satisfaction and use measures. Table 4-9 provides the model summary for each of the four environmental measures. In each instance the results are statistically significant although the explanatory power of the each environmental factor is small, accounting for between one and three per cent of the variance in well-being. The details of each of these models are presented separately in the next four sections. The model summaries for all of the four mediation analyses are also presented in Table 4-14 at the end if this section.

### *Effects of Proximity to Green/Social Spaces on Mental Wellbeing*

*Total effect (C path in Figure 4-3):* The regression analysis results presented in Table 4-9 demonstrate statistically significant effect of Proximity to Green/Social Spaces on Mental Wellbeing with Beta coefficient of 0.077 (P<0.005).

Table 4-9 Total effect of each perceived physical attribute measure on Mental Wellbeing

| | Predictor variable | Unstandardized Beta | P-value |
|---|---|---|---|
| | Proximity to Green/Social Spaces | .077 | .001 |
| Model Summary | $R^2$ .02 | F 11.09 | P .001 |
| | Nearby Open Lawn with Trees | .082 | .001 |
| Model Summary | $R^2$ .03 | F 11.98 | P .001 |
| | Nearby Building-dominated Space | -.066 | .022 |
| Model Summary | $R^2$ .01 | F 5.28 | P .022 |
| | Varied Perceived Barriers to Use | -.122 | .000 |
| Model Summary | $R^2$ .03 | F 14.59 | P .000 |

*Mediated effects (AB path and C' path in Figure 4-3):* The relationship between Proximity of Green/Social Spaces and Mental Wellbeing was mediated by Satisfaction with Quality of Public Space and Use of Green/Social Spaces which accounts for 6 percent of the variance (P<.0001) as shown in Table 4-14. The unstandardized regression coefficient between the proximity measure and the satisfaction measure is statistically significant, as is the unstandardized regression coefficient between the satisfaction measure and Mental Wellbeing as illustrated in Figure 4-4. This is also true in terms of the use measure (Figure 4-4). As shown in Table 4-10, the unstandardized indirect effect (A×B) is (.560) (.097) = .054 for the satisfaction measure and (.470) (.074) = .035 for the use measure. The significance of these indirect effects was tested using bootstrapping procedures. Unstandardized indirect effects and the 95% confidence interval were computed for each of 1,000 bootstrapped resamples through *Indirect* macro. The bootstrapped unstandardized indirect effect for the satisfaction measure was also .054, and the 95% confidence interval ranged from 0.018 to 0.095. In terms of Use of Green Social Spaces, the bootstrapped unstandardized indirect effect was rounded to .035 with a confidence interval ranging from 0.004 to 0.070. Thus, the indirect effect of the proximity measure through both the satisfaction and use measures were statistically significant. The results show that when including the mediators, the direct effect of the proximity measure on the wellbeing measure is no longer significant, which implies that the relationship between

Proximity to Green/Social Spaces and Mental Wellbeing is only through the mediators and not a direct relationship.
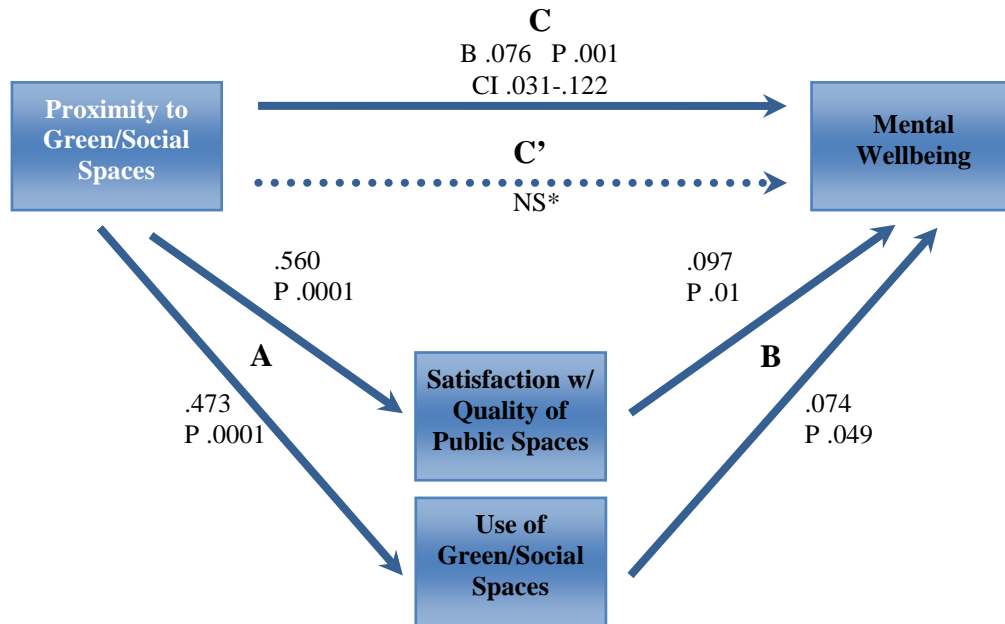


*. Statistically not significant

Fig. 4-4 Path coefficients presenting the effects of Proximity to Green/Social Spaces on Mental Wellbeing through neighborhood satisfaction and use measures

Table 4-10 Bootstrap results for indirect effect of Proximity to Green/Social Spaces on Mental Wellbeing

| Mediator | Indirect Effect (A×B) | Confidence Interval (95) | |
| --- | --- | --- | --- |
| | | Lower | Upper |
| Satisfaction w/ Quality of Public Space | .0541 | .0176 | .0953 |
| Use of Green/Social Spaces | .0349 | .0037 | .0736 |
| Total | .0890 | .0517 | .1362 |

***Effects of Nearby Open Lawn with Trees on Mental Wellbeing***

*Total effect (C path in Figure 4-3):* The regression analysis results presented in Table 4-9 demonstrate statistically significant effect of Nearby Open Lawn with Trees on Mental Wellbeing with unstandardized coefficient of 0.08 (P<0.005), which accounts for 3 percent of the variance. In the next step the role of mediators in this relationship is investigated.

*Mediated effects (AB path and C' path in Figure 4-3):* The mediation analysis of this type of landscape structure was investigated to find out the extent to which the total effect is explained through mediators. The model summary in Table 4-14 shows that the R square is 0.06 (P<.0001). As Figure 4-5 shows, the unstandardized regression coefficient between Nearby Open Lawn with Trees and the satisfaction measure is statistically significant (path A), as is the unstandardized regression coefficient between the satisfaction measure and Mental Wellbeing (path B). In terms of the use measure, however, we do not see a mediating role in the model because as Figure 4-5 illustrates, there is no statistically significant effect of the use measure on Mental Wellbeing. Table 4-11 shows the unstandardized indirect effect (A×B) for both the satisfaction and use measures. The bootstrapped unstandardized indirect effect for the satisfaction measure was .043, and the 95% confidence interval ranged from 0.010 to 0.078. In terms of Use of Green Social Spaces, the bootstrapped unstandardized indirect effect was .030 with a confidence interval ranging from -0.007 to 0.062, indicating the statistically significant indirect effect of Nearby Open Lawn with Trees through Satisfaction with Quality of Public Space but the non-significant effect of Use of Green/Social Spaces in this relationship. The results show that when including the mediators, the direct effect of this type of landscape structure on the wellbeing measure is no longer significant, which implies that the relationship between this environment-related measure and Mental Wellbeing is through the mediator (Satisfaction w/ quality of Public Space) and not a direct relationship.

Fig. 4-5 Path coefficients presenting the effects of Nearby Open Lawn with Trees on Mental Wellbeing through neighborhood satisfaction and use measures

Table 4-11 Bootstrap results for indirect effect of Nearby Open Lawn with Trees on Mental Wellbeing

| Mediator | Indirect Effect (A×B) | Confidence Interval (95) | |
| --- | --- | --- | --- |
| | | Lower | Upper |
| Satisfaction w/ Quality of Public Space | .0431 | .0100 | .0781 |
| Use of Green/Social Spaces | .0295 | -.0067 | .0616 |
| Total | .0726 | .0354 | .1078 |

### *Effects of Nearby Building-dominated Spaces on Mental Wellbeing*

*Total effect (C path in Figure 4-3):* The regression analysis results (Table 4-9) show statistically significant negative effect of Nearby Building-dominated Spaces on Mental Wellbeing with unstandardized coefficient of -0.066 (P<0.05). To find out how much of this total effect is explained through neighborhood satisfaction and use measures, the following mediation analysis was performed.

*Mediated effects (AB path and C' path in Figure 4-3):* The mediation analysis results (Table 4-14) show that the adjusted R square is 0.06 (P<.0001). As presented in Figure 4-6, both A (B=-.292, P<.0001) and B paths (B=.082, P<.05) related to the neighborhood satisfaction measure have statistically significant regression coefficients. Table 4-12 also indicates that the indirect

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effect (A×B=-.024) of Nearby Building-dominated Spaces on Mental Wellbeing through the satisfaction measure is significant. In terms of the mediating role of the use measure, we have a significant A-path coefficient and a marginally significant B-path coefficient (Figure 4-6). Given the bootstrapping results shown in Table 4-12, despite the very little indirect effect (A×B=-.0095), the mediating role of the use measure is still statistically significant. The model shows that when controlling for satisfaction and use measures, the direct effect of Nearby Building-dominated Spaces (C' path) is no longer significant, indicating that this relationship is fully mediated by Satisfaction with Quality of Public Spaces and Use of Green/Social Spaces.
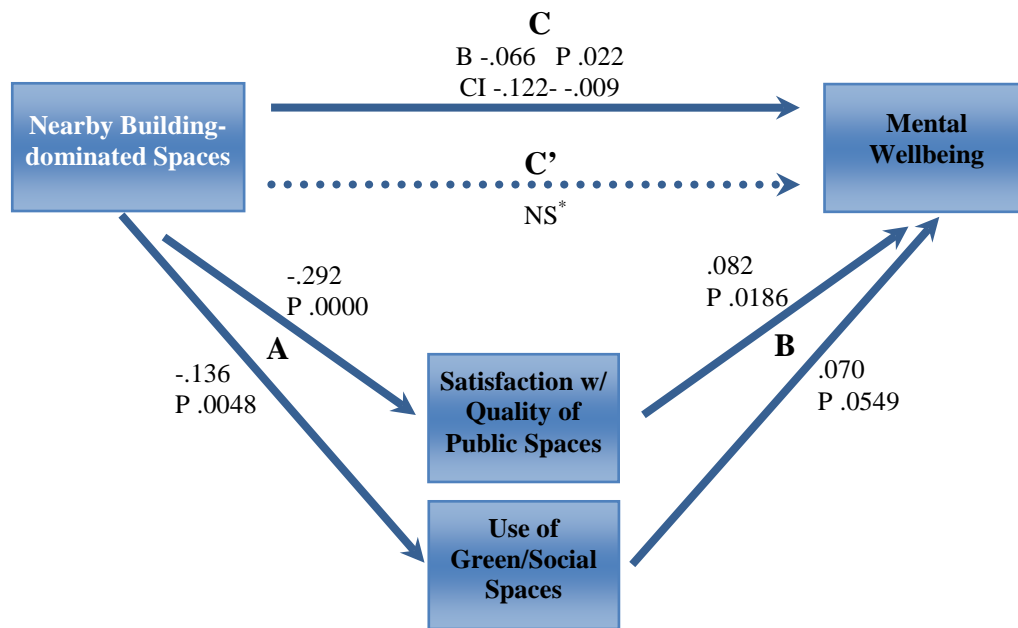


Fig. 4-6 Path coefficients presenting the effects of Nearby Building-dominated Spaces on Mental Wellbeing through neighborhood satisfaction and use measures

Table 4-12 Bootstrap results for indirect effect of Nearby Building-dominated Spaces on Mental Wellbeing

| Mediator | Indirect Effect (A×B) | Confidence Interval (95) | |
| --- | --- | --- | --- |
| | | Lower | Upper |
| Satisfaction w/ Quality of Public Space | -.0240 | -.0507 | -.0038 |
| Use of Green/Social Spaces | -.0095 | -.0277 | -.0001 |
| Total | -.0335 | -.0590 | -.0139 |

### Effects of Varied Perceived Barriers to Use on Mental Wellbeing

*Total effect (C path in Figure 4-3):* The total effect of Varied Perceived Barriers to Use on Mental Wellbeing is statistically significant with unstandardized regression coefficient of -.122 (P<.001) as shown in Table 4-9. The following mediation analysis examines the role of Satisfaction with Quality of Public Space and Use of Green/Social Spaces in this relationship.

*Mediated effects (AB path and C' path in Figure 4-3):* The model summary shown in Table 4-14 demonstrated that this mediation results for this predictor account for 7 percent of the variance (P<.0001). Unlike all the three previously investigated independent variables, Varied Perceived Barriers to Use has no significant indirect effect on Mental Wellbeing through the satisfaction measure (See Figure 4-7 and Table 4-13). Use of Green/Social Spaces, however, plays a statically significant mediating role between the barrier and wellbeing measures. As shown in Figure 4-7, the C' path is marginally significant. Further, the comparison between the total indirect effect of the predictor (A×B=-.0534) and the total effect (C path) implies that the mediators explain almost 45 percent of the total effect of the barrier measure on Mental Wellbeing. Therefore, there is a partial mediating effect of satisfaction and use measures in this relationship.
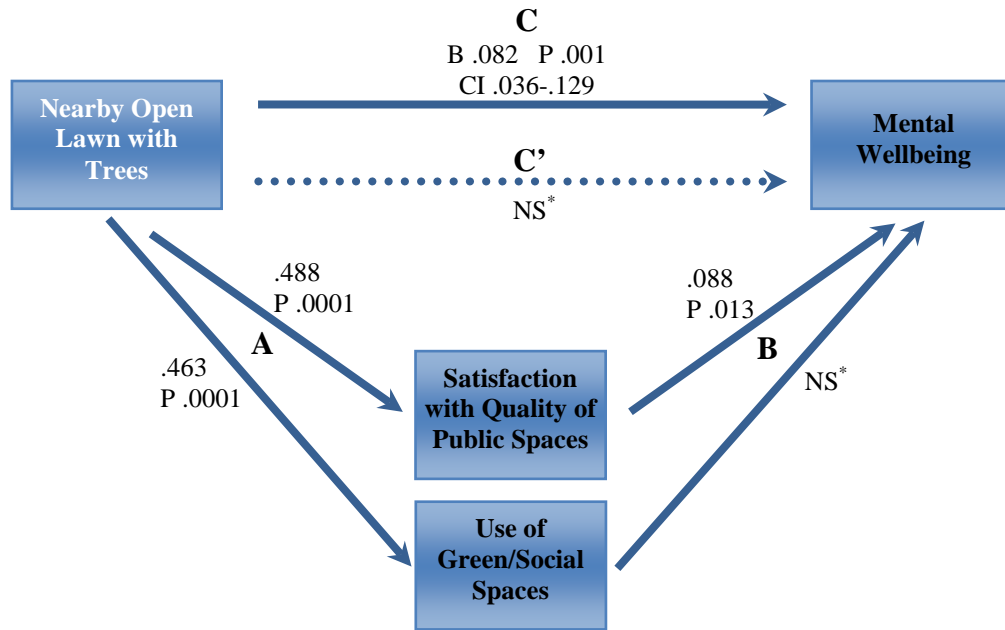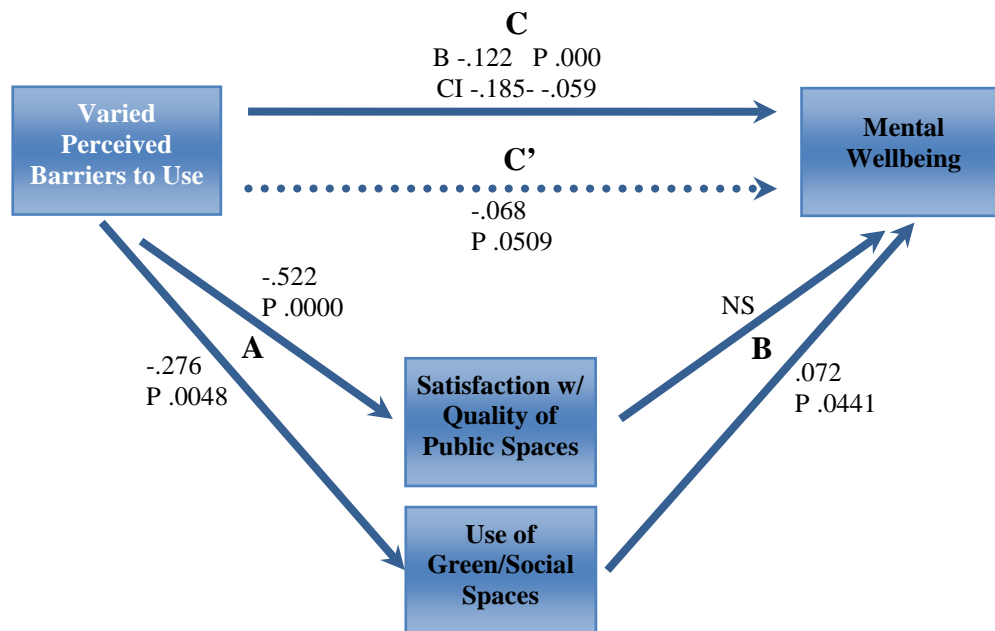


Fig. 4-7 Path coefficients presenting the effects of Nearby Building-dominated Spaces on Mental Wellbeing through neighborhood satisfaction and use measures

Table 4-13 Bootstrap results for indirect effect of Varied Perceived Barriers to Use on Mental Wellbeing

| Mediator | Indirect Effect (A×B) | Confidence Interval (95) | |
|---|---|---|---|
| | | Lower | Upper |
| Satisfaction w/ Quality of Public Space | -.0334 | -.0760 | .0020 |
| Use of Green/Social Spaces | -.0200 | -.0462 | -.0022 |
| Total | -.0534 | -.0877 | -.0223 |

Table 4-14 Model summaries for all four mediation analyses

| Predictors | Model summary | | |
|---|---|---|---|
| | Adjusted $R^2$ | F | P-value |
| Proximity to Green/Social Spaces | .06 | 9.720 | .0001 |
| Nearby Open Lawn w/ Trees | .06 | 9.678 | .0001 |
| Nearby Building-dominated Spaces | .06 | 10.063 | .0001 |
| Varied Perceived Barriers | .07 | 11.024 | .0001 |

## 4-4.  Discussion

Given the importance of people's mental wellbeing and the significant role of planners and designers in creating public outdoor spaces, it is worthwhile to know more about the detailed mechanisms that result in better sense of mental wellbeing through contact with outdoor public spaces. Since we previously found that environmental attributes strongly affect neighborhood satisfaction and use, and the research of others has shown the effects of neighborhood satisfaction and use on mental wellbeing, we hypothesized that local environmental attributes are likely to affect mental wellbeing indirectly through neighborhood satisfaction and frequency of use of the nearby environment. The study thus examined the relationships between a) the physical aspects of the environment and both neighborhood satisfaction and use, b) mental wellbeing and both neighborhood satisfaction and use, and c) the physical aspects of the environment and mental wellbeing.

Although neighborhood satisfaction has been previously studied both with respect to environmental factors (e.g., Ellis, Lee, and Kweon 2006; Kaplan 2001; Kweon et al. 2010) and as a factor in wellbeing (e.g., Kaplan and Kaplan 1989; Ward Thompson and Aspinall 2011), the mediation analyses presented here are additions to the current literature. While Leslie and Cerin (2008) mentioned neighborhood satisfaction as having a potential mediating role in the relationship between perceived neighborhood characteristics and mental health, their study did

not include mediation analysis. Furthermore, their measures for perceived neighborhood characteristics, neighborhood satisfaction, and mental wellbeing are totally different from those investigated in this study.

In addition to providing consistent support for the role played by the outdoor environment in sense of mental wellbeing, our results demonstrate that some specific aspects of the environment affect mental wellbeing through neighborhood satisfaction and frequency of use of outdoor spaces. This study demonstrates the *direct* and *indirect* (mediated) effects of four physical attributes of the environment (proximity to green/social spaces, proximity to open lawn with trees, nearby building-dominated spaces and barriers to neighborhood use) on mental wellbeing. Providing a functional understanding of the relationship between variables, mediation analysis is found to be a helpful method to investigate direct/indirect effects of various environmental attributes on mental wellbeing. It also helps us understand how people's satisfaction with and frequency of use of their nearby outdoor environment can be improved through specific planning and design considerations in order to ultimately improve the sense of mental wellbeing. In other words, by understanding that wellbeing is indirectly affected by the physical aspects of the environment through neighborhood satisfaction and use, designers and planners can be attuned to outcomes that improve physical attributes that are locally associated with neighborhood satisfaction and use.

Although the models investigating the effects on mental wellbeing in this study do not account for a high percentage of the variance, the findings have considerable significance with the potential to affect urban residents' mental health, considering the large sample size (n=434) relative to similar studies and that mental wellbeing may be influenced by many factors other than the physical aspects of the environment or neighborhood satisfaction. The summary of the findings is presented in Table 4-15.

### 4-4-1. Positive effects on mental wellbeing

#### *Satisfaction with quality of public space*

The results show that satisfaction with the quality of the public space positively affects mental wellbeing. In this study, satisfaction with quality of public spaces includes satisfaction with overall appearance of the neighborhood, amount of open space, variety of green spaces and

opportunities for outdoor gathering in the neighborhood. Most of these items have been separately investigated in previous studies. For instance, Parkes et al. (2002) reported the significant effect of neighborhood appearance on neighborhood satisfaction, and Hur et al. (2010) reported a strong association between perceived amount of open space and overall neighborhood satisfaction. It has been also shown that factors such as perception of neighborhood, and the social interactions that take place within public spaces affect health (e.g., Macintyre, Maciver, and Sooman 1993). In this study, these factors are clustered under *satisfaction with quality of public space.* Our results confirm the significant role of neighborhood satisfaction in life satisfaction and wellbeing of residents found by other studies (Fernandez and Kulik 1981; Kweon et al. 2010; Miller et al. 1980; Vemuri et al. 2011).

### *Frequency of use of green/social spaces*

Frequency of use of green/social spaces has a direct effect on mental wellbeing as the results of this study demonstrate. In this study use of green spaces and the social aspects of outdoor spaces have been integrated through factor analysis and evaluated as one entity, *frequency of use of green/social spaces*. In other words, use of green/social spaces in this study ranges from walking in the neighborhood for pleasure and visiting green spaces such as parks with large trees, to picnicking, using outdoor sitting and gathering areas and resting in the lawn. Previous studies have usually examined the social aspect and use of green spaces separately and in some cases have investigated the associations between them. For example, it has been shown that social interaction with the neighborhood and community ties positively affect mental wellbeing (e.g., Riger and Lavrakas 1981). In another study, Mass et al. (2009) have shown that the positive effect of green spaces on mental wellbeing is mediated by social interaction and physical activity. There is also evidence on the direct effect of interaction with green environment on stress reduction and recovery from mental fatigue (Grahn and Stigsdotter 2003; Hartig and Staats 2006; Kaplan 1995; Ulrich et al. 1991). Research has also shown that use of the urban settings that offer an experience of nature promote both neighborhood satisfaction and sense of wellbeing among urban dwellers (Ellis, Lee, and Kweon 2006; Kaplan and Kaplan 1989; Ward Thompson and Aspinall 2011). Our results on the effects of frequency of use of green/social spaces on mental wellbeing are in line with the current findings.

*Nearby nature*

While supporting the growing consensus that nearby nature positively affects mental wellbeing (Barton and Pretty 2010; Ellis, Lee, and Kweon 2006; Kaplan 1984; Kaplan and Kaplan 1989), our findings offer further insight by examining details about the characteristics of nearby nature settings that are indirectly beneficial for mental wellbeing.

***Proximity to green/social spaces*:** The mediation analysis shows that nearby green and social spaces (such as green boulevards, park-like squares, parks with large trees and outdoor sitting areas as well as nearby picnic and gathering areas) affect mental wellbeing through both satisfaction with quality of public space and frequency of use of such spaces. In other words, perceived proximity to such spaces affect neighborhood satisfaction and frequency of use, and these two positively affect mental wellbeing as discussed above.

Previous research has revealed that having nature settings in walking distance has a positive effect on neighborhood satisfaction (Crow, Brown, and De Young 2006; Kaplan 1985; Kaplan and Austin 2004; Sugiyama, Thompson, and Alves 2009; Ward Thompson and Aspinall 2011) and our findings in the previous chapter also support this. It has been also shown that perceived proximity to green spaces can influence the frequency of use of outdoor spaces (Macintyre, Macdonald, and Ellaway 2008; Shackleton and Blair 2013; Sugiyama, Thompson, and Alves 2009; Ward Thompson and Aspinall 2011; Wright Wendel, Zarger, and Mihelcic 2012). However, the mediating effects of neighborhood satisfaction and use on the relationship between nearby green/social spaces and mental wellbeing have not been reported in earlier literature. Our results suggest that walking-distance green spaces that meet people's needs by providing opportunities for walking for pleasure and social activities makes them feel good about the quality of their nearby public space. It also encourages them to use outdoor spaces more frequently for those purposes, which consequently influences residents' mental wellbeing.

***Proximity to open lawn with trees:*** The mediation results demonstrate that nearby green spaces that include open lawn with trees *indirectly* affects residents' mental wellbeing through their satisfaction with quality of public space. One important contribution of this measure with respect to proximity to nature settings is that it is based on images (See Table 4-3). Earlier studies show that photographs can be used with confidence in perceptual studies as surrogates for

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actual landscapes (Coeterier 1983; Kaplan 1985; Shuttleworth 1980). Visualizing the different types of nature settings may make it easier for the participants to envision the kinds of spaces they have nearby, and have a better sense of how much they use the specific types of landscape settings they see in the photos. Therefore, even though the two proximity measures (proximity to green/social spaces and proximity to open lawn with trees) are highly correlated, they provide different ways to help participants consider something they may not be consciously aware of in terms of what they actually have in a walking distance environment.

There is a sizeable body of research on preference for trees in urban settings and associations between tree canopies and neighborhood satisfaction (Frumkin 2003; Hur, Nasar, and Chun 2010; Kaplan and Kaplan 1989; Nordh et al. 2009; Zhang and Lin 2011). Openness has been shown to be one of the important factors in relation to overall preference and neighborhood satisfaction (Hur, Nasar, and Chun 2010; Zhang and Lin 2011). Various types of landscape structure may have different levels of effect on neighborhood satisfaction as presented in the previous chapter. The work by Kweon et al. (2010) has also confirmed that landscape components such as open spaces, trees and structures have significant effects on neighborhood satisfaction.

Open lawn with trees is a specific type of landscape structure that offers sense of openness while providing enough tree canopies and softening the solidness of built structures. Perhaps the combination of these qualities creates a spatial characteristic that positively influences people's satisfaction with quality of public space. This is in line with the previous findings (Zhang and Lin 2011) indicating that the salience of trees and openness on green space simultaneously improve positive feelings towards the environment.

The lack of the frequency of use in the relationship between this type of landscape structure and mental wellbeing highlights the validity of Kaplan's (1984) view point about the significant forms of involvement with natural settings that are different from physical use, including 'observing' and 'conceptual' involvement. It has been shown that both being able to see green settings nearby (without physically using them) and even being aware of their existence nearby (conceptual involvement) are closely associated with neighborhood satisfaction and wellbeing (Kaplan 1984; Kaplan and Kaplan 1989; Russell et al. 2013). Therefore, the *actual use* of a nature setting such as open lawn with trees is not essential to the residents' expression of

satisfaction or sense of mental wellbeing. Apparently, this type of landscape structure affects the sense of mental wellbeing only through offering the residents a good feeling about the quality of their neighborhood and the fact that they have the opportunity to, for instance, rest in the lawn under the tree canopies if they would like to, even though they may never do that.

### 4-4-2. Negative effects on mental wellbeing

*Proximity to building-dominated spaces*

This measure also emerged through a photo questionnaire (See Table 4-3), providing the participants an easier way to tell what they have in their walking distance environment rather than the verbal items which may be more stereotypic. Instead of verbally asking the participants if their neighborhood is building-dominated with little green, the images of such spaces were presented to them. The consistency of the factor analysis results with respect to the photo questionnaire in this study shows the use of visual questions to be a very helpful way to investigate people's perception of landscape structure and rely on the answers.

Our results show that being surrounded by built structures with little green, as shown in the images, negatively affects sense of mental wellbeing of the residents. This is not surprising given that there is now a growing consensus that built, mixed-built and natural environments differ regarding their restorative potential (Peschardt and Stigsdotter 2013; Scopelliti and Giuliani 2004) and even building-dominated views from home have undesirable influences (S Kaplan 1995; R Kaplan 2001) on effective functioning. What is striking about our findings in this respect is that building-dominated spaces do not have direct effect on mental wellbeing and as demonstrated in the mediation analyses, this aspect of the environment *indirectly* decreases the sense of mental wellbeing through its negative effects on both satisfaction with quality of public space and frequency of use. The negative effect of building-dominated spaces on neighborhood satisfaction is consistent with the current literature (e.g., Ellis, Lee, and Kweon 2006; Kaplan 2001; Kweon et al. 2010). According to previous findings, proximity to nature settings increases the likelihood of more frequent use of outdoor spaces (e.g., Macintyre, Macdonald, and Ellaway 2008; Shackleton and Blair 2013). Thus, it makes sense that the residents who have building-dominated spaces in their walking distance are less likely to use their outdoor spaces. This study suggests that people's perception of living in a building-dominated neighborhood is associated

with less satisfaction with the quality of public space and lower frequency of use of green/social spaces, which ultimately affect residents' mental wellbeing. Perhaps planting more trees and shrubs in such spaces would alleviate the negative influence of buildings on people's perception.

### *Barriers to neighborhood use*

In this study, barriers to neighborhood use include safety concerns, unpleasant open spaces, low maintenance, and lack of walkability, accessibility and sense of community – all factors that have been examined by others with respect to their effects on mental wellbeing. For instance, Barton (2009) showed that access to green open spaces and local social networks are factors in mental wellbeing. Sense of community has been also shown as critical to sense of mental wellbeing (e.g., Riger and Lavrakas 1981). Thus it seems reasonable to conclude that lack of spaces that support social activities in the neighborhood can deteriorate the sense of belonging and community. As reviewed by Ellis et al. (2006), sense of safety (Cook 1988), pleasant appearance of the neighborhood (Parkes, Kearns, and Atkinson 2002) and maintenance (Hur and Nasar 2014; Kaplan 1985) are important contributors to neighborhood satisfaction. Although our results are consistent with these findings in terms of the negative effects of barriers on satisfaction, we found that neighborhood satisfaction is not a mediating factor in the negative relationship between barriers to neighborhood use and mental wellbeing.

Barriers to neighborhood use have both direct *and* indirect effects on mental wellbeing. This stands in contrast to all other physical attributes of environment investigated in this study wherein only indirect effects on mental wellbeing were detected. The partial indirect effect of barriers on mental wellbeing is through frequency of use of green/social spaces. These findings highlight the substantial role played by barriers to neighborhood use in sense of mental wellbeing and the possibility of alleviating the negative effects through improvement of accessibility in the neighborhood. However, further detailed investigation is required to find out which of these barriers affect mental wellbeing specifically through the frequency of use. By better maintenance of public outdoor spaces, improving public safety, creating more social spaces and refining walkability we can improve mental wellbeing both directly and through encouraging people to use the outdoor spaces more frequently.

In sum, while highlighting the significant role played by four attributes of the environment on sense of wellbeing the findings of this study demonstrate the direct and indirect effects of each of the four factors through neighborhood satisfaction, use or both. Being aware of the mechanisms through which environmental aspects of the environment affect sense of mental wellbeing can be helpful for planners and designers who create outdoor spaces for the public.

Table 4-15 Positive/negative effects of the physical attributes of the environment on neighborhood satisfaction, use and mental wellbeing

| Physical attributes of the environment | | Satisfaction with quality of public space | Frequency of use of green/social spaces | Mental wellbeing | | |
|---|---|---|---|---|---|---|
| | | | | Direct effect | Indirect effect | |
| | | | | | through Satisfaction | through Use |
| Positive effect | Proximity to green/social spaces | ✓ | ✓ | - | ✓ | ✓ |
| | Proximity to open lawn with trees | ✓ | ✓ | - | ✓ | - |
| Negative effect | Proximity to building-dominated spaces | ✓ | ✓ | - | ✓ | ✓ |
| | Barriers to neighborhood use | ✓ | ✓ | ✓ | - | ✓ |

## 4-5. Implications and conclusions

The results of this study provide substantial support for the premise that both the environment-related and the people-related factors (neighborhood satisfaction and use patterns) matter in terms of their effects on mental wellbeing. While awareness of the associations between the physical aspects of the environment and mental wellbeing is important, it is insufficient to enable planners/designers to make a difference in this respect. A strength of this work is that an examination of the mechanisms through which the physical attributes of the environment *indirectly* influence sense of mental wellbeing, can provide insights into ways that planning and design practices can address mental wellbeing. It should be acknowledged that this study did not include personal attributes and demographic information about the participants in the analyses. Such measures may further refine the findings of the model. Also, despite the

acceptable sample size of this study, we had to exclude a large Hispanic population in the study area due to language barrier.

In spite of the limitations and the need for further research, the findings of this study have contributed to the literature in various ways. In practice, the experts usually examine the outdoor environments from an objective point of view, which might be due to many reasons including financial and time constraints of the projects or lack of pragmatic evidence-based knowledge. This study highlights the significance of the users' perception of the environment in creating spaces that support their own wellbeing. While the professionals generally focus on the physical attributes of the environment, this study highlights the significance of people-related factors including neighborhood satisfaction and use patterns as well.

### 4-5-1.  The physical attributes of the environment matter

While we speak of physical attributes of the environment, the study focuses on these in terms of the participants' perceptions, because of the fundamental role of perception in people's functioning in the environment. This study demonstrates the significance of what people perceive to have in their nearby outdoor spaces and their perception of barriers to using such spaces. When it comes to people's sense of mental wellbeing, it matters whether they live near green/social spaces or building-dominated spaces with little green. The residents who perceive that they have more green and social spaces, as opposed to hardscapes, nearby have a better sense of mental wellbeing. Even the type of the nearby green spaces matters. If proximal green/social spaces are comprised of lawn-covered open spaces with large trees in them, they are likely to have significant effects on sense of mental wellbeing. Also, the perception of accessibility to nearby outdoor spaces matters. The more the residents are discouraged from pursuing activities in their nearby outdoor spaces due to barriers to neighborhood use, the poorer the sense of mental wellbeing. Apparently, these barriers are required to be examined through users rather than merely relying on the experts' knowledge. Although these are interesting findings in support of the current literature, delving into the details of these associations is the key to understanding how the physical aspects of the environment can be manipulated to positively affect mental wellbeing.

### 4-5-2. Needs and preferences matter

The results of the study are particularly important in highlighting the substantial mediating role of both satisfaction with the quality of public spaces and frequency of use of green and social outdoor spaces between the physical factors of the environment and mental wellbeing. People's use of their outdoor environments depends on their needs and preferences. The better their needs and preferences are met in the outdoor environments the more satisfied they may be with their nearby outdoor settings and the more likely they are to use those spaces, which ultimately influence mental wellbeing. This study suggests that if we intend to have residential neighborhoods with capability of improving the sense of metal wellbeing, we need to design spaces that improve the level of neighborhood satisfaction and the frequency of use of green and social spaces. In other words, we need to create outdoor spaces that are in line with people's needs and preferences.

### 4-5-3. Planning and design decisions matter

The need for creating outdoor spaces that meet people's needs and preferences as a requirement for improving sense of mental wellbeing highlights the critical role of planners and designers as the experts who make decisions about public outdoor spaces. This study indicates that evaluation of the usefulness of an outdoor green space should not be only based on the physical use of the space, as some spaces may influence the residents' satisfaction and mental wellbeing through other forms of involving them with nature. By focusing on planning/design-related aspects of the environment and investigating their direct and indirect effects on neighborhood satisfaction, use and mental wellbeing, this study offers an evidence-based approach to planning and design of outdoor spaces. Based on this approach, a set of planning/design recommendations can be extracted from the findings as summarized in Table 4-16. While some of these recommendations are specific to the neighborhoods under study, the evidence-based approach presented in this study is applicable in other planning/design projects.

Table 4-16 Planning/design recommendations to improve neighborhood satisfaction and use, mediating factors shown to positively affect mental wellbeing

| Physical attributes | Improve mental wellbeing through: | |
| --- | --- | --- |
| | Increased satisfaction with quality of public space | Increased frequency of use of green/social spaces |
| **What to provide?** | | |
| Green boulevards | ✓ | ✓ |
| Park-like squares | ✓ | ✓ |
| Park with large trees | ✓ | ✓ |
| Outdoor gathering areas | ✓ | ✓ |
| Sitting areas | ✓ | ✓ |
| Picnic areas | ✓ | ✓ |
| Open lawn with trees | ✓ | - |
| **What to improve?** | | |
| Safety | | ✓ |
| Pleasantness of open spaces | | ✓ |
| Maintenance | | ✓ |
| Physical access | | ✓ |
| Walkability | | ✓ |
| Sense of community | | ✓ |
| Amount of open spaces | ✓ | |
| Variety of green spaces | ✓ | |
| **What to soften?** | | |
| Building-dominated spaces | ✓ | ✓ |

## 4-5-4. The usefulness of the methods

*Engaging people with planning/design solutions:* The survey permitted local residents to engage in issues that entail their own surroundings, desires, and wellbeing. Putting users in the center of focus asking how they perceived and responded to nearby nature and relying on their perception of outdoor environments as a source of information about what is locally present has offered an evidence-based approach to planning and design of outdoor spaces. Engaging users in the process of decision-making for planning and design of outdoor spaces provides a more

reliable set of guidelines, the application of which may result in more successful outcomes as compared to expert-oriented design solutions.

*Combining verbal questions with visual questions:* Including both verbal questions and images in the survey provides more reliable responses in terms of perceived attributes of the nearby landscape. The results show strong consistencies for the verbal and visual approaches as well as important nuances in participants' perceptions of the use of these settings. This study thus suggests including both verbal and visual questions in planning/design-related studies to increase the level of confidence about the validity of the participants' responses.

*Mediation analysis:* By exploring the mediating role of people-related factors in the associations between environmental attributes and mental wellbeing, this study makes linkages between two areas of research that have been previously investigated separately: a) the association between the physical attributes of the environment and neighborhood satisfaction and use, and b) the associations between neighborhood satisfaction and use and mental wellbeing. Making this mediating link contributes to the literature on the effects of outdoor environments on mental wellbeing, and sheds light on pragmatic ways for planners and designers to positively influence mental wellbeing in urban development and rehabilitation projects. Examining these mediating roles for both satisfaction with quality of public space and frequency of use of green/social spaces is a further contribution that highlights the role of each of them separately. These findings provide planners and designers with a more tangible tool to improve mental wellbeing that reveals people's needs and preferences. In other words, by engaging people in the decision-making process of planning and design of neighborhood outdoor spaces, people can provide useful information about their needs and preferences, which helps the professionals to create health-promoting spaces.

While providing helpful new understanding of the relationships between environmental attributes and mental wellbeing, the findings of this study also raise interesting questions for further research. We still do not know which of the perceived barriers to neighborhood use affect mental wellbeing directly and which of them indirectly affect it through frequency of use. It is also worth investigating the effects of other types of landscape structure on mental wellbeing. It should be acknowledged that only four environmental attributes have been examined in this study. Indeed, including more planning/design-related attributes of the environment with more

details would bring further insights into how the physical attributes of the environment affect mental wellbeing, and how planners and designers could have positive influence on these associations.

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# CHAPTER V
# Conclusion


## 5-1.  Overview of the study

Through three studies conducted in Chicago, IL, this dissertation explored urban residents' preferences for outdoor green spaces from a design perspective, and the mechanisms through which planning/design-related aspects of the environment may affect mental wellbeing. A qualitative approach was used in the first study with a focus on the preferred qualities of nearby nature in terms of environmental affordances and design characteristics in urban neighborhoods. In a multi-step interview context using photos depicting common landscape design elements of outdoor scenes, 53 individuals were asked to identify their preferences. The findings illuminate interconnections between environmental affordances and design attributes that address participants' needs and preferences. This study offers evidence of the preference for small green spaces that provide opportunities for both socializing and growing plants. Further, it reveals the most preferred design characteristics of such green spaces leading to a set of place-based design considerations.

The other two studies (Study II and Study III) presented in this dissertation draw on a survey with a random sample of 434 residents. Using both photographs and verbal items and a five-point rating scale, the participants were asked about perceived proximity to different types of green spaces, quality of such spaces, neighborhood satisfaction and use, barriers to neighborhood use, and sense of mental wellbeing. Study II explored the associations between physical aspects of the environment (including proximity of nature to home, nearby landscape structure and barriers to neighborhood use) and participants' neighborhood satisfaction and use patterns. The results of multiple linear regression modeling demonstrate that satisfaction with quality of public spaces, amount of affordances provided by them, and neighborhood comfort are strongly influenced by the physical structure and content of the environment. The findings also show that

perceived landscape structure and walking-distance proximity to green and social spaces are strong predictors of satisfaction with the quality of public spaces and frequency of use of green and social spaces. Given the relatively detailed design-related aspects of the neighborhood encompassed by the photo-survey, these findings led to a set of planning/design related recommendations.

Drawing on the strongest relationships found in Study II, Study III focused on the direct and indirect relationships between the physical environment and mental wellbeing, with satisfaction and use pattern as the mediating factors. The mediation analyses conducted in Study III support the hypothesis that satisfaction with quality of public space and frequency of use of green/social spaces have significant mediating role in the relationship between the physical aspects of the environment and mental wellbeing. In particular, the presence of specific types of green and social spaces in walking-distance proximity of people's home positively affect mental wellbeing through improving satisfaction with quality of public spaces and frequency of use of such spaces. On the other hand, building-dominated spaces and some barriers such as safety issues in the neighborhood were found to negatively affect mental wellbeing through decreasing neighborhood satisfaction and frequency of use of green/social spaces.

## 5-2.   Research contributions

This dissertation offers contributions and extensions to the current literature in various ways. The contributions include a practical tool for broadening the scope of preference studies by using *participant-generated photo grouping* and addressing *environmental affordances* as practical tools for understanding people's perception of the environment and their preferences for nearby outdoor green spaces from a planning/design perspective (Study I). Also, instead of considering neighborhood satisfaction and use as single entities, this work has investigated various dimensions of each as well as the correlations between these multiple dimensions of neighborhood satisfaction and use (Study II). Examinations of the effects of both immediate nearby nature (view from window) and walking-distance nature on key aspect of neighborhood satisfaction and use patterns is another significance of the present work (Study II). In addition, instead of objectively defining landscape structure, this study has used a participant-based typology through photo survey resulting in four distinct types of perceived landscape structure,

and has explored their effects on neighborhood satisfaction, use and mental wellbeing (Study II and Study III).

Furthermore, Study III in particular contributes to the conceptual understanding of human-landscape interactions by examining both *direct* and *indirect* relationships between environmental factors and sense of mental wellbeing through neighborhood satisfaction and use. By exploring the mediating role of people-related factors in the associations between environmental attributes and mental wellbeing, this study makes linkages between two areas of research that have been previously investigated separately: the association between the physical attributes of the environment and neighborhood satisfaction and use; and the associations between neighborhood satisfaction and use and mental wellbeing. Considering these mediating roles for both satisfaction with quality of public space and frequency of use of green/social spaces is a further contribution that highlights the role of each of them separately.

The inclusion of both visual stimuli and verbal items to gain an understanding of what people have or want to have in their neighborhood, provides a more reliable approach than either alone. These studies thus suggest including both verbal and visual questions in planning/design-related studies to increase the level of confidence about the validity of the participants' responses. As an example of interdisciplinary work each of the three studies makes meaningful linkages among environmental psychology, urban planning, landscape architecture and related fields. By looking at the principles and theories from cognitive psychology and environment-behavior studies through the lens of landscape architecture, this dissertation offers practical approaches to link research findings in environmental psychology with planning and design goals.

## 5-3.    Translational design of public outdoor spaces

Going beyond finding the effects of environmental factors on people's perceptions and behavior, this dissertation has extended the findings to practical implications that have the potential to make a difference in the real world. An examination of the mechanisms through which the physical attributes of the environment *indirectly* influence sense of mental wellbeing, provides insights into possible ways that planning and design practices can address mental wellbeing. Jointly examining preferences for nearby green spaces and, the detailed relationships

between physical attributes of the environment and multiple aspects of satisfaction and forms of use provided a deeper understanding of how outdoor spaces could be rehabilitated in order to meet users' preferences and needs in urban neighborhoods, and ultimately improve mental wellbeing.

Pragmatic planning and design implications extracted from both the participant-generated photo grouping and the survey results in this dissertation represent steps towards a translational design approach linking research findings with realistic planning and design solutions. In line with the growing body of research on evidence-based design (e.g., Brown and Corry 2011; Sullivan et al. 2014), and inspired by the phrase "translational medicine" applied in health-related fields (e.g., Sonntag 2005), *translational design* of public outdoor spaces offers an integrative model built upon a multi-dimensional understanding of research and design for mental wellbeing. We suggest creating an environment that allows for cooperation of researchers and practitioners to address different aspects of evidence-based design to create environments that better support mental wellbeing drawing on synergies of *academia and consulting firm* expertise. Theoretical and applied concepts can be crafted to guide planners and designers to create more restorative neighborhoods in urban areas. Such efforts of linking theory and practice can be vital at the small-scale and local level while contributing to larger networks of professional decision-making institutions in the long run.

## 5-4.    Recommendations for practitioners

The first take-away message from this study for practitioners is that in order to create public spaces with the potential to improve mental wellbeing, concern about the users' needs and preferences has higher priority than their own taste for decision-making. In urban rehabilitation/redevelopment projects it is necessary to learn about the residents' preferences and different aspects of satisfaction with the existing conditions of the neighborhood as well as how they currently use the outdoor spaces. This can be a reliable source of information and provides planners and designers with a more tangible tool to influence mental wellbeing in the neighborhood. In other words, by putting users in the center of focus and engaging them in the process of decision-making, a more reliable set of planning/design guidelines can be achieved. The application of such user-oriented findings may result in more successful outcomes as compared to expert-oriented solutions.

In answer to the question of how to gain the users' input, this study has provided specific qualitative and quantitative approaches that lead to simple, yet far-reaching planning and design recommendations that could be applied in practice. Such context-based planning/design recommendations reveal instructive concepts that are worth considering by planning/design professionals. The following tips concluded from this study are presented to exemplify how the application of such approaches may result in practical solutions:

**Specific qualities of restorative neighborhood outdoor spaces**

Our findings indicate that outdoor spaces need to be *green*, *social* and *close* (i.e. five-minute walk from home) to homes in order to meet the basic requirements for restorativeness. These nearby green and social spaces also need to have specific qualities and design characteristics to be considered as restorative environments. The type and size of green and social spaces may vary throughout the neighborhood. It can be as small as a picnic bench under a shade tree or a garden created in a vacant lot and as large as green boulevards or parks with large trees. Two of the most important types of green/social spaces are community gardens and open lawn areas with trees.

*Design characteristics and their benefits*

*Opportunities for outdoor socializing:* Opportunities for socializing within walking-distance encourage walking and increase sense of community. Gathering areas, picnic areas and sitting areas should be provided wherever possible in nearby green spaces to meet these needs. In terms of design characteristics for seating areas the material, form and layout of amenities matter. Our findings encourage provision of seating areas that are surrounded by trees with seats preferably made of wood rather than metal or concrete, designed and arranged to encourage socializing. As a significant feature of small gathering spaces, gazebos with naturalistic design style and surrounded by green can also meet this need.

*Community gardens:* As one of the most preferred green spaces, community gardens are encouraged to be developed in residential neighborhoods at any size possible. Getting people involved in creating such spaces and community gardening can improve sense of community, place attachment and safety in the neighborhood which all contribute to wellbeing. Our findings suggest including both ornamental plants and vegetables to meet wider range of preferences and providing sitting areas to invite people to enjoy observing the communal space. Fencing

community gardens is helpful so they are limited to those who work in them. However, the garden fences should not block the view from outside so that the other residents can visually benefit from the presence of the gardens.

*Lawn-covered open spaces with trees:* Among different types of landscape structure, open lawn areas with trees are one of the most preferred neighborhood green spaces. They encourage walking in the neighborhood and provide a destination for residents to take a rest, sit and watch, or have a picnic.

*Sense of accessibility:* Providing more walkable sidewalks in the neighborhood improves the residents' satisfaction with the quality of public spaces and feeling of comfort in the neighborhood and encourages more frequent use of outdoor green spaces. Also accommodating pedestrian needs to cross major streets improves sense of accessibility and safety in the neighborhood which result in higher level of neighborhood satisfaction and walking frequency.

*Appearance:* Pleasant neighborhood appearance can be achieved through improving the maintenance and planting more trees and other green features. Well-maintained plantings soften the dominance of the buildings thereby increasing satisfaction with the quality of public spaces and sense of safety and encouraging more frequent walking in the neighborhood.

*Plantings:* Single shade trees or small groups of large trees are preferred if they offer the opportunity for resting near or under their canopy; either a bench next to them or their placement in the lawn can provide a place to rest in the shade and make it more desirable. Our findings show that trees and shrubs with natural forms and seasonal color are preferred over trimmed plants and non-shade trees with regular forms. Different green features including flowerbeds, shrubs and trees are recommended to be planted wherever possible at the door steps and along the streets in order to provide nature views for the residents. This improves awareness of neighborhood resources and positive feelings about the quality of public spaces and encourages people to use outdoor spaces more frequently.

*Sense of Peacefulness and safety:* Improving the sense of peacefulness and safety can be achieved through considering some of the other tips presented here. For example, creating community gardens nearby, providing window views of nature, increasing the amount of green features and improving maintenance throughout the neighborhood may all contribute to the sense

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of peacefulness and safety. Also, our findings show that active recreation areas such as sports fields and playgrounds have negative impacts on sense of peacefulness and safety when they are located in walking distance from the residents' home.

*Sense of community:* Providing more opportunities for socializing by creating more gathering and sitting areas and also opportunities for meaningful activities such as community gardening may improve sense of community among the residents.

## 5-5.  Visions for future work

While providing helpful new understanding of both the environmental affordances as a basis for preference studies and the relationships between environmental attributes and mental wellbeing, the findings of this dissertation also raise interesting questions for further research. In terms of the participant-generated photo grouping approach, further investigations using greater demographic diversity, different study contexts and larger sample size are needed to improve confidence about the reliability of the methods and findings.

Although our study area consisted of various amounts and types of green spaces, there was insufficient variability in terms of availability of green street corridors and the majority of the participants perceived to have a lot of them nearby. Therefore, this study is limited in permitting generalization with respect to the significance of street tree canopies in terms of their impact on different dimensions of satisfaction and use and ultimately, mental wellbeing. In addition, while our qualitative study highlighted the significance of community gardens, lack of variability in our quantitative data in terms of availability of garden spaces also limited further analyses regarding the relationships between community gardens and sense of mental wellbeing. Given that both green street corridors and garden spaces are two significant categories of perceived landscape structure, further research is required to learn more about their possible direct/indirect effects on neighborhood satisfaction, use patterns and mental wellbeing.

The majority of the study participants perceive that they have *quite a bit* or *very much* of green features in their walking distance proximity, which limits the ability to discern the impact of less green residential settings on neighborhood satisfaction, use patterns and mental wellbeing. Therefore, it is worthwhile to conduct similar studies in urban residential areas with more variability in amounts and types of green spaces to allow for comparative investigations. Our

findings with respect to the negative impact of nearby active recreation areas such as sports fields and playgrounds also call for further research. Are such relationships with respect to neighborhood comfort and frequency of purpose-based walking affected by different age groups and demographic issues?

Barriers to neighborhood use such as safety concerns, low maintenance, poor appearance and lack of walkability played a substantial direct *and* indirect role in reducing the sense of mental wellbeing. While these findings point to the possibility of alleviating the negative effects of barriers through improvement of accessibility in the neighborhood, further research is needed to identify which of the perceived barriers affect mental wellbeing directly and which of them indirectly affect it through frequency of use. Given the multi-dimensional nature of these barriers, further research is needed to learn more about the detailed mechanisms through which planners and designers can mitigate the negative effects of these barriers on neighborhood satisfaction, frequency of use and mental wellbeing.

Moreover, only four specific environmental attributes have been examined in this dissertation. In order to bring further insights into how planning/design-related aspects of the environment affect mental wellbeing, future investigations should include additional variables. The distinct dimensions of each environmental attribute such as landscape structure emerged from the perception of residents of a specific urban dense area. It is also worth investigating the effects of other types of perceived landscape structure in different urban contexts (e.g., arid and semi-arid urban landscapes) on mental wellbeing. In addition, the three presented studies did not include personal attributes and demographic information about the participants in the analyses. Such measures may further refine the findings for future application.

Another area of further research would be a comparison between objective proximity versus perceived proximity (being investigated in this work) to green spaces. It is worth investigating the extent to which people's perception of the quality of outdoor environment and green spaces and their perceived distance from homes are consistent with the actual quality of the neighborhood and physical distances from their homes measured by the experts. If there are discrepancies between perceived and actual attributes of the environment and green space availability, decision-makers would be enabled to prioritize the improvement plans in residential neighborhoods based on people's perception of the neighborhood rather than the actual attributes

measured objectively by professionals. The three studies presented here, have provided context-specific planning and design implications that can be applied in practice. From a practical point of view, it is worthwhile to test the findings and apply the recommendations in real world and evaluate the outcomes.

## 5-6. The bigger picture

This research has focused on a small neighborhood scale, yet we believe that application of such findings in practice can have a broader impact at an urban scale. While the importance of social/green spaces is recognized, the findings provide an understanding of specific design attributes that meet people's preferences and needs in walking-distance proximity to residents' home and that these have the potential for improving mental wellbeing. Furthermore, these can be created in small areas close to residents' homes. By accepting this evidence-based idea and beginning to make place-based adjustments in each neighborhood in the city, it is conceivable to have the image of the entire city transformed ultimately through expansion of a network of both small and large restorative environments (depending on the context) that would be connected together through green street corridors. This network of restorative environments can contribute to the ecological network of green patches and corridors in the city and more importantly, add a social value to it by improving the perceived quality of public spaces through meeting the urban dwellers' needs and preferences and expanding the capacity to improve mental wellbeing.

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# Appendix A

**Correlations between all latent variables**

One measure out of each main category (Proximity, Landscape structure, Barriers, Satisfaction and Use) of variables was picked based on the strength of correlations with the variables outside of their own category. The highlighted latent variables and the highlighted correlations are shown in the above table. Building-dominated space has significant negative correlations with all of the selected variables. Given the focus of the study, the role of planning/design aspects of the environment on the sense of mental wellbeing, and the fact that, the effect of the building-dominated spaces could be soften through planning/design of outdoor spaces, this measure was also added to the list of environment-related factors in this study

| | Proximity of nature to home | | | | Landscape structure | | | | Barriers to use | | Neighborhood satisfaction | | | | Use patterns | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Nearby green/social spaces | Amount of nearby green features | Nearby active recreation | Nature window view | Nearby garden space | Nearby open lawn w/ trees | Nearby green street corridor | Nearby building-dominated space | Varied perceived barriers to use | Transportation barriers | Satisfaction w/ amount of affordances | Satisfaction w/ amount of green features | Satisfaction w/ quality of public space | Neighborhood comfort | Use of green/social spaces | Active use | Walk to non-nature destinations |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 |
| 1 | 1 | | | | | | | | | | | | | | | | |
| 2 | .463** | 1 | | | | | | | | | | | | | | | |
| 3 | .541** | .403** | 1 | | | | | | | | | | | | | | |
| 4 | .216** | .502** | .244** | 1 | | | | | | | | | | | | | |
| 5 | .484** | .346** | .315** | .215** | 1 | | | | | | | | | | | | |
| 6 | .664** | .301** | .324** | .167** | .606** | 1 | | | | | | | | | | | |
| 7 | .240** | .215** | .096* | .246** | .424** | .438** | 1 | | | | | | | | | | |
| 8 | -.124** | -.124* | ns | ns | .114* | ns | .344** | 1 | | | | | | | | | |
| 9 | -.331** | -.204** | -.170** | -.170** | -.154** | -.219** | -.131** | .115* | 1 | | | | | | | | |
| 10 | -.298** | -.180** | -.204** | -.164** | -.152** | -.211** | ns | ns | .503** | 1 | | | | | | | |
| 11 | .563** | .308** | .352** | .210** | .310** | .399** | .172** | -.175** | -.391** | -.262** | 1 | | | | | | |
| 12 | .165** | .327** | .114* | .311** | .116** | .144** | .183** | -.126** | -.229** | -.198** | .537** | 1 | | | | | |
| 13 | .642** | .450** | .365** | .307** | .411** | .544** | .215** | -.274** | -.429** | -.367** | .565** | .278** | 1 | | | | |
| 14 | .366** | .295** | .121* | .244** | .184** | .284** | .154** | -.222 | -.448** | -.238** | .292** | .196** | .618** | 1 | | | |
| 15 | .580** | .387** | .374** | .244** | .490** | .551** | .241** | -.139** | -.246** | -.186** | .365** | .141** | .633** | .386** | 1 | | |
| 16 | .190** | .216** | .349** | .207** | .336** | .208** | ns | ns | ns | ns | ns | ns | .263** | ns | .480** | 1 | |
| 17 | .271** | .209** | ns | .094* | .238** | .222** | .122* | ns | -.137** | -.110* | .178** | .096* | .355** | .344** | .429** | .132** | 1 |